Public Environment Report

Technical Appendix D: Commonwealth land

North East Link Project

Public Environment Report

Technical Appendix D – Commonwealth land technical report

Prepared for North East Link

September 2019

Executive summary

This technical report is an appendix to the North East Link Public Environment Report (PER). It has been used to inform preparation of the PER and address the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) assessments required for North East Link.

Overview

North East Link (‘the action’) is a proposed new freeway-standard road connection that would complete the missing link in Melbourne’s ring road, giving the city a fully completed orbital connection for the first time. North East Link would connect the M80 Ring Road (otherwise known as the Metropolitan Ring Road) to the Eastern Freeway, and include works along the Eastern Freeway from near Hoddle Street to Springvale Road.

The proponent for North East Link is the State of Victoria through the Major Transport Infrastructure Authority (MTIA), an administrative office within the Victorian Department of Transport with responsibility for overseeing major transport projects.

North East Link Project (NELP) is the division within MTIA that is responsible for developing and delivering North East Link on behalf of the Victorian Government. NELP is responsible for developing the reference project, engaging and informing stakeholders and the wider community, obtaining key planning and environmental approvals and coordinating procurement for construction and operation.

On 13 April 2018, a delegate of the Australian Government Minister for the Environment and Energy determined that North East Link is a controlled action due to likely significant impacts on the following matters protected under Part 3 of the EPBC Act:

- Listed threatened species and communities (Sections 18 and 18A)
- Listed migratory species (Sections 20 and 20A)
- The environment on Commonwealth land (Sections 26 and 27A).

The delegate of the Minister also determined that North East Link requires assessment by a PER. The PER allows stakeholders to understand the likely impacts of the action on Matters of National Environmental Significance (MNES) and on the environment on Commonwealth land and how they are proposed to be managed.

The PER was developed in parallel with the reference project development and the preparation of the North East Link Environment Effects Statement (EES). The reference project has been assessed in the PER.

GHD was commissioned to undertake the Commonwealth land assessment to inform the PER. This executive summary must be read in conjunction with the complete Commonwealth land technical report and the assumptions and limitations contained within.

Assessment approach

This report assesses impacts on the environment of Commonwealth land. Commonwealth land that is potentially affected by North East Link includes:

- Simpson Barracks – the Department of Defence's (DoD) reserve in Melbourne occupying approximately 112 hectares of land and comprising a mix of developed land and significant natural areas. The assessment includes a smaller section of Commonwealth land located immediately south of Simpson Barracks near Borlase Reserve. This area is publicly accessible and used for informal outdoor recreation
- War Services easement – land located approximately one kilometre north of Simpson Barracks on Frensham Road in Watsonia which is an easement for electricity transmission lines.

Requirements for the assessment of the potential impacts North East Link on Commonwealth land are set out in Section 2.5.3 of the PER Guidelines.

To assess the whole of the environment within Commonwealth land, 18 technical studies were conducted and assessed in accordance with the criteria from the EPBC Act Significant Impact Guidelines 1.2: *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies*. (DSEWPAC, 2013b). The following table identifies the technical studies completed for this report for each criteria.

EPBC Significant Impact Guidelines 1.2 criteria	Technical studies	
Flora and fauna	• Flora and fauna	• Arboriculture
People and communities	• Land use • Social and community • Surface noise and vibration • Air quality	• Business • Transport • Tunnel vibration • Human health
Culture and heritage values	• Aboriginal heritage	• Historic heritage
Landscape and soils	• Landscape and visual impact	• Ground movement
Water resources	• Surface water	• Groundwater
Pollutants, chemicals, and toxic substances	• Contaminated land • Greenhouse gases • Includes consideration of water and air related impacts discussed under the Water resources criteria and People and communities criteria	

The assessment for each technical study includes a description of the environment, assessment of relevant impacts, proposed measures to avoid and mitigate impacts, identification of residual impacts and, where necessary and appropriate, considers offsetting. The methodologies for assessment are specific to each technical discipline and are described in the relevant sections.

After the draft PER was published, additional work was undertaken in respect of the Matted Flax Lily and Studley Park Gum and further numerical groundwater modelling was carried out. The findings and results of this further work is incorporated in this report.

Description of the environment

Simpson Barracks

Simpson Barracks is in the suburb of Yallambie and is surrounded on all sides by residential communities with Greensborough Road to the west and Yallambie Road to the north. There is a mix of residential accommodation facilities, schools, administrative buildings, a workshop, playing fields, service areas and training buildings, sitting within a large portion of natural areas including remnant woodland. The base is host to a range of defence operations, with a particular focus on training. The area south near Borlase Reserve is open to the public for informal outdoor recreation uses.

War Services easement

The War Services easement is owned by the Secretary of the Department of Veterans' Affairs (Commonwealth), as the successor in title for the Director of War Service Homes. The War Services easement is located to the rear of residential properties on Elder Street and is a small part of a larger electricity easement reserve for high voltage electricity lines that pass through Watsonia. The reserve is used for informal outdoor recreation, is zoned for Public Parks and Recreation use under the Banyule Planning Scheme and is administered by Banyule City Council as part of the Frensham SEC Reserve.

Key findings

The technical studies conducted for the PER have assessed the potential risks of North East Link and the likelihood of adverse impacts occurring during construction and operation, and has identified measures to avoid, minimise or manage these impacts, and then assessed the likely residual impacts.

The significance of relevant impacts was assessed against the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b) for the environment on Commonwealth land. The following table summarises the conclusions from these assessments.

Criteria	Key findings
Plants and animals	Impacts on flora and fauna were assessed through a flora and fauna study and an arboriculture study. The flora and fauna study found that North East Link would likely have a significant impact on plants based on two criteria • Involve medium or large-scale native vegetation clearance • Involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species. Significant residual impacts on animals are not expected. **Medium or large-scale native vegetation clearance** North East Link would require removal of 10.976 hectares of Plains Grassy Woodland (21 per cent of the 52.5 hectares of remnant native vegetation at Simpson Barracks) representing a medium-scale native vegetation clearance. This represents a significant residual impact for which an offset is recommended. A number of large trees on Commonwealth land are likely to rely on groundwater (between 10< and 20-metre depth to groundwater depth zone) under drought conditions and may be negatively affected by groundwater drawdown.

Criteria	Key findings
	At the end of construction, in the absence of any mitigation measures, a total of 45 large trees at Simpson Barracks would have a moderate to high chance of being negatively affected, and one further large tree would have a low chance of being impacted. Eight trees would have a moderate to high likelihood of being negatively affected by 2075, and potentially declining in health and/or dying prematurely. Where vegetation has a moderate to high likelihood of being impacted by groundwater drawdown in the long term, it would be considered lost. Most trees predicted to be impacted are River Red Gums, apart from nine Studley Park Gum (five high and four moderate risk) by the end of construction and three Studley Park Gum (three moderate risk) by 2075. Watering during construction may reduce the number of trees impacted. Any large trees predicted to be affected over the long-term would be considered lost and would be offset in accordance with the requirements of the DELWP (2017a) *Guidelines for the removal destruction and lopping of native vegetation*. An NVR report has been completed that identifies general offset units and species offset units required for the vegetation removal. Enquiries have been made with offset brokers and NELP has received assurance that sites are currently available on the market to offset the removal of 10.98 ha of Plains Grassy Woodland. **Clearance of any vegetation containing a listed threatened species** Clearance of vegetation from Simpson Barracks would involve direct permanent removal of three listed threatened plant species: • Matted Flax-lily (*Dianella amoena*), Endangered under EPBC Act, Listed under FFG Act, endangered on DELWP Advisory List. Approximately 31 per cent (83 out of 271 plants/patches) of the Simpson Barracks population would likely be impacted. With successful implementation of a salvage and translocation program, significant impacts on Matted Flax-lily are expected to be unlikely for seven or eight of the nine significant impact criteria, while significant impacts are possible for one criterion: 'Adversely affect habitat critical to the survival of a species', and possibly a second criterion, 'Reduce the area of occupancy of the species'. However, the residual post-translocation impact of North East Link on Matted Flax-lily is expected to be non-significant for the following reasons: a) evidence points to strong prospects of long-term survivorship of translocated individuals, b) translocation risk is proposed to be spread across a number of potential receptor sites in the local area, minimising the risk of failure, and c) multiple ramets would be harvested (and grown on) from each plant/patch to be salvaged; therefore, it is likely the overall population size in the local area would increase following implementation of the translocation program. • Arching Flax-lily (*Dianella longifolia var. grandis*), vulnerable on the DELWP Advisory List. Two individuals were observed during field assessments at Simpson Barracks. Removal of these individuals is unlikely to result in a long-term decline in a population and would not be a significant impact. These would be translocated as part of the Matted Flax Lily Salvage and Translocation Plan noted above. • The direct clearance of 44 mature individuals of Studley Park Gum within the project boundary at Simpson Barracks, and the additional indirect impact on three large Studley Park Gums outside the project boundary by groundwater drawdown over the long-term (2075 operational scenario based on further groundwater modelling) is likely to result in a long-term decline in a population, or threaten the viability, or reduce the occupancy of Studley Park Gum. Consequently, the unavoidable loss of at least 47 Studley Park Gum individuals is regarded as a significant impact. In accordance with the EPBC Act Environmental Offsets Policy, this would trigger a requirement for offsets for impacts to Studley Park Gum on Commonwealth land. NELP proposes to contribute to the conservation of Studley Park Gum by establishing new habitat through the implementation of the Studley Park Gum Management Framework (the Framework) (PER Technical Appendix A – Flora and fauna, Appendix G).

Criteria	Key findings
	This approach is expected to result in a viable outcome noting that the creation of new habitat for a protected matter is a type of direct offset under the EPBC Act Environmental Offsets Policy. In addition to the above, at the State level native vegetation offsets would be provided based on the Victorian Guidelines (DELWP 2017a) to offset for the removal of native vegetation (which Studley Park Gum trees form part of) directly impacted by the project, and three Studley Park Gum trees expected to experience premature mortality due to long term groundwater drawdown. Implementing the Studley Park Gum Management Framework and State offsets is in line with the *EPBC Act Environmental Offsets Policy* and commensurate with the conservation status of the species. Based on the information at hand, the clearance of native vegetation from Commonwealth land is likely to be considered a significant impact on plants on Commonwealth land.
People and communities	Significant residual impacts on people and communities are not expected based on the land use, business, social and community, transport, surface noise and vibration, tunnel vibration, air quality and human health assessments
Culture and heritage values	Significant residual impacts on culture and heritage values are not expected based on the Aboriginal and historic cultural heritage studies.
Landscape and soils	Significant impacts on landscape and soils are not expected based on the landscape and visual amenity and ground movement assessments.
Water resources	Significant residual impacts on water resources are not expected based on the surface water and groundwater assessments.
Pollutants, chemicals, and toxic substances	Significant residual impacts from pollutants, chemicals and toxic substances are not expected based on the contaminated land and greenhouse gas assessments.

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Abbreviations

Abbreviation	Term in full
ACHRIS	Aboriginal Cultural Heritage Register and Information System
ACM	Asbestos containing material
AEP	Annual exceedance probability
AQF	Australian Qualification Framework
ASR	Acid sulfate rock
ASSMP	Acid Sulfate Soil Management Plan
ATC	Automatic traffic counts
BoM	Bureau of Meteorology
BP	Before present
CALD	Culturally and linguistically diverse groups
CBD	Central business district
CEMP	Construction Environmental Management Plan
CHL	Commonwealth Heritage List
CHMP	Cultural Heritage Management Plan
CIRIA	Construction Industry Research and Information Association
CMP	Conservation Management Plan
CNVMP	Construction Noise and Vibration Management Plan
CO_2	Carbon dioxide
CO_{2-e}	Carbon dioxide equivalent
CORTN	Calculation of road traffic noise
DAQMMP	Dust and Air Quality Management and Monitoring Plan
DBH	Diameter at breast height
DELWP	Department of Environment, Land, Water and Planning
DHHS	Department of Health and Human Services
DISCON	Defence Secure Communications Network
DoD	Department of Defence
DoEE	Department of the Environment and Energy
EAM	Economic assessment model
EES	Environment Effects Statement
EHNV	Epizooti Haematopoietic Necrosis Virus
EMF	Environmental Management Framework

Abbreviation	Term in full
EPA NSW	Environment Protection Authority NSW
EPA Victoria	Environment Protection Authority Victoria
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cmwlth)*
EPR	Environmental Performance Requirements
ESD	Ecologically sustainable development
ESO	Environmental Significance Overlay
EV	Electric vehicle
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988* (Vic)
GDE	Groundwater dependant ecosystem
GHG	Greenhouse gas
GHS	Greensborough Historic Society
GIS	Geographic information system
GLC	Ground level concentration
GMP	Ground Movement Plan
GNSS	Global navigation satellite system
HCV	Heavy commercial vehicles
HHS	Heidelberg Historic Society
HMP	Heritage Management Plan
HO	Heritage Overlay
IS	Infrastructure sustainability
ISCA	Infrastructure Sustainability Council of Australian
IWRG	Industrial Waste Resource Guidelines
LAC Act	*Land Acquisition and Compensation Act 1986* (Vic)
LCV	Light commercial vehicles
LGA	Local Government Authority
LVIA	Landscape and Visual Impact Assessment
M80	Metropolitan Ring Road
MNES	Matters of National Environmental Significance
MVEI	Motor vehicle emissions inventory
NELP	North East Link Project
NEPM	National Environmental Protection Measure
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cmwlth)
NHL	National Heritage List

Abbreviation	Term in full
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
NSW RMS	New South Wales Roads and Maritime Services
NVR	Native vegetation removal
OEMP	Operation Environmental Management Plan
OHS	Occupational Health and Safety
OMP	Odour Management Plan
OVGA	Office of the Victorian Government Architect
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soil
PC	Passenger cars
PER	Public Environment Report
PM_{10}	Particulate matter with a diameter of 10 micrometres or less
$PM_{2.5}$	Particulate matter with a diameter 2.5 micrometres or less
PPE	Personal protective equipment
RAP	Registered Aboriginal Party
SEPP	State Environment Protection Policy
SIA	Social Impact Assessment
SMP	Spoil Management Plan
T SRZ	Structural Root Zone
SUP	Shared use path
TBM	Tunnel boring machine
TCRP	Tree Canopy Replacement Program
TMP	Transport Management Plan
TPP	Tree Protection Plan
TPZ	Tree Protection Zone
TRG	Technical Review Group
UDLP	Urban Design and Landscape Plan
UDS	Urban Design Strategy
ULE	Useful life expectancy
UNFCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VAHR	Victorian Aboriginal Heritage Register
VGF	Victorian Geomorphological Framework

Abbreviation	Term in full
VHI	Victorian Heritage Inventory
VHR	Victorian Heritage Register
VIF	Victoria in Future
VKT	Vehicle kilometres travelled
VOC	Volatile organic compounds
VROT	Victorian rare or threatened (species)
VWHI	Victorian War Heritage Inventory
WEMP	Worksite Environmental Management Plan
WHO	World Health Organisation
WMIS	Water measurement information system
WSUD	Water sensitive urban design
ZTV	Zone of theoretic visibility

Glossary

Term	Description
Acid sulfate soil and rock	Natural soils and rock that contain iron sulphides which when exposed to oxygen can release acid that may damage or otherwise adversely impact built structures and ecosystems.
Activity Centre	Areas that provide a focus for services, housing, transport, and social interaction. They range in size and intensity of use from smaller neighbourhood centres to major suburban centres and larger metropolitan centres.
Acute or short-term exposure	Contact with a substance that occurs only once or for a short period of time, typically an hour or less, but may be up to 14 days.
Alluvial	Pertaining to, or composed of, alluvium or other deposits from streams and rivers.
Annual Exceedance Probability (AEP)	Defines the likelihood of a flood occurring in any given year. The most commonly used definition is the '1 in 100 year flood'. This refers to a flood level that has a one in a hundred, or 1 per cent chance of being equalled or exceeded in any given year (1%AEP = 100 year average reoccurrence interval). F
Asbestos containing material (ACM)	A group of manufactured material that contains asbestos minerals. They can be friable (loose and easily crumbled) or non-friable (bonded) asbestos.
Aquifer	A geological formation, group of formations or part of a formation, which contains sufficient saturated permeable material to transmit and yield significant quantities of water.
B-Double	A heavy vehicle consisting of a prime mover towing two semi-trailers. The first trailer is attached to the prime mover and the second is mounted on the rear of the first semi-trailer by a fifth wheel coupling.
Basalt	A dark coloured, fine grained, mafic volcanic rock.
Bedrock	A general term for rock, usually solid that underlies soil or other unconsolidated material.
Biodiversity	The variety of all life forms, the different plants, animals and microorganisms, the genes they contain, and he ecosystems of which they form a part.
Bioregion	A landscape based approach to classifying the land surface using a range of environmental attributes such as climate, geomorphology, lithology and vegetation.
Business	Commercial activity in which the aim is to make a profit.
Canopy tree	A mature tree (that is, it is able to flower) that is greater than three metres in height and is normally found in the upper layer of the relevant vegetation type.
Carcinogen	A substance that causes cancer.
Chronic or long-term exposure	Contact with a substance that occurs repeatedly over a long time, with the USEPA indicating defining this as exposures that occur for more than approximately 10 per cent of a lifetime. Exposures that occur for less than 10 per cent of a lifespan are considered sub-chronic.
Collector-distributor	A collector-distributor is a component of a freeway, usually an outer carriageway, which facilitates entry and exit movements for on and off-ramps.

Term	Description
Community facilities	Refers to recreational, social or educational spaces (for example schools, sports ovals or local halls) available for use by the local community.
Community values	Community values, or a sense of community, are generally accepted to be the social ties established within a community, in part based around the features and qualities of the built environment that encourage these social ties and contribute to quality of life and wellbeing (Maller, 2014; Paranagamage, 2010).
Contaminant	A substance, element or compound that has an adverse effect on the quality of soil and water.
Continuous vibration	A vibration source that is continuous in nature during an assessment period (may be constant or variable). ISO10137 defines continuous vibration as having a duration of more than 30 minutes per 24-hour period.
Culturally significant landscapes	For the purpose of this report, culturally significant landscapes are those that have cultural or historical characteristics such as Bolin Bolin Billabong, Yarra Flats and the Heide Museum of Modern Art.
Cut and cover tunnels	Cut and cover construction involves using excavation equipment to dig a large trench or rectangular hole in the ground which is then covered by a concrete deck. Cut and cover construction can be conducted through a top-down or bottom-up configuration.
Decibel (dB)	A logarithmic scale is used to describe the level of sound, referenced to a standard level. It is widely accepted that a 3dB change in traffic noise levels (of the same character) is barely, if at all detectable; whereas a change of 5 dB is clearly noticeable. A 10 dB increase is typically considered to sound twice as loud (noting a change of -10 dB would typically sound half as loud).
Dewatering	The lowering of static groundwater levels through extraction, usually by means of pumping from one or several groundwater bores.
Discharge	Any process by which water is removed from an aquifer. Includes water that flows to a surface feature, such as a spring, river or wetland, as well as water which flows to an adjacent aquifer.
Dissolved oxygen	The amount of oxygen dissolved in water, such as groundwater or surface water. Usually measured in parts per million.
Dive structure	Section of roadway where the tunnel portal gradually rises in elevation to meet the existing road network.
Drawdown	The change in groundwater head level that can be attributed to the operation of a pumping bore.
Ecological Vegetation Class (EVC)	A type of indigenous vegetation classification that is described through a combination of floristics, lifeforms and ecological characteristics through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities that occurs across a biogeographic range, and although differing in species, have similar habitat and ecological processes operating.
Ecosystem	A system that is made up of a community of animals, plants, and bacteria and its interrelated physical and chemical environment.
Environment Effects Statement	Provides a comprehensive framework for assessing the impacts of major projects in Victoria. The guidelines state the objective of the assessment process is to provide for the transparent, integrated and timely assessment of projects capable of having a significant effect on the environment.

Term	Description
Erosion	The process or group of processes whereby solids in the natural environment are relocated by moving water, glacial ice or wind.
Exotic vegetation	Any vegetation that is not native to Australia or its states and territories.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term (acute exposure), of intermediate duration, or long-term (chronic exposure).
Fill material	A designation of waste material defined by EPA Victoria. Often referred to as 'clean fill'.
Frequency	The rate per second of a vibration constituting a wave, either in the rock mass material (as in vibration) or in the air (as in sound waves), The number of cycles per unit of time, commonly per second, is called the frequency. The measurement is reported in Hertz (Hz).
Greater Melbourne	The Greater Melbourne area is defined by the Australian Bureau of Statistics' Greater Capital City Statistical Area for Greater Melbourne.
Ground-borne vibration	Vibration transmitted from a source to a receptor via the ground.
Groundwater	Water occurring naturally below ground level or water pumped, diverted and released into a bore for storage underground.
Groundwater Dependant Ecosystem (GDE)	An ecosystem that is partially or wholly reliant on groundwater for its survival. This can include terrestrial, subsurface and marine ecosystems.
Groundwater drawdown	Groundwater drawdown is the lowering of the water table from the existing groundwater level.
Groundwater monitoring bore	A bore installed with the purpose to; determine the nature and properties of subsurface ground conditions; provide access to groundwater for measuring level, physical and chemical properties; and permit the collection of groundwater samples and conduct of aquifer testing.
Heritage place	In an historical heritage context, the term 'place' is wide ranging. An industry standard which is most frequently referenced as a guide to best practice management of cultural heritage places in Australia is the Australia ICOMOS Burra Charter, 2013 (the Burra Charter). Consistent with the Burra Charter, a 'place' is a geographically defined area. It may include elements, objects, spaces and views. Places may have tangible and intangible dimensions (Australia ICOMOS, 2013) (Article 1). Heritage places can encompass a range of place types, including buildings, gardens, trees, shipwrecks, archaeological sites, precincts, sites and associated land. Monuments and memorials can also be considered, whether as heritage places (or as part of a heritage place) or as objects.
Historical archaeological site	As defined in Victoria's *Heritage Act 2017*, historical archaeological sites are those heritage places that contain archaeological artefacts, deposits or features which are more than 75 years old, and that provide information of past activity in the State and require archaeological methods to reveal information about the settlement, development or use of the place, and are not associated only with Aboriginal occupation of the place. Sites which contain artefacts, deposits or features less than 75 years in age can be approved by the Heritage Council as approved sites of archaeological value.

Term	Description
Historic heritage	The term ‘historical cultural heritage’ or ‘historical heritage’ (the two are used interchangeably) is understood in this report to mean places and objects that are of aesthetic, archaeological, architectural, cultural, scientific or social significance. It does not include places or objects that are of significance only on the grounds of their association with Aboriginal tradition. Accepting this, the term ‘historical heritage’ does not exclude Aboriginal cultural heritage values and there are many historical heritage places which have Aboriginal cultural heritage values in addition to non-Aboriginal cultural values (ie shared values). This is consistent with the definitions and exclusions in Victoria’s *Heritage Act 2017*.
Hydraulic hammer	A rock breaker/hydraulic hammer is a percussion hammer fitted to an excavator for excavating rock material. It is powered by an auxiliary hydraulic system from the excavator.
Indigenous vegetation	Indigenous vegetation includes vegetation that is native to Australia as well as being native to a specific geographic region. In the case of North East Link, this includes vegetation that is native to the Port Phillip and Westernport Catchment Management Region.
Inert waste	Waste which is neither chemically nor biologically reactive and will not decompose, such as concrete, building rubble.
Landscape character area	The characteristics that assist in defining the landscape character areas include geology, vegetation, topography and drainage patterns, as well as the extent of modifications and urban development.
Landscape feature	A component, part or feature of the landscape that is prominent or eye-catching, such as hills, buildings, vegetation.
Landscape sensitivity	The extent to which landscape can accept a change of a particular type and scale without unacceptable adverse impacts on its character.
Landscape value	The relative value that is attached to different landscapes by society. Landscape characteristics the community considers are significant for reasons such as their aesthetic (predominantly visual), social, environmental and heritage values. (IEMA, 2013).
Mainline	A mainline is a component of a freeway, usually the central carriageway, which facilitates the primary traffic demand along the freeway corridor. It is distinct from a collector-distributor which facilitates entry and exit movements.
Major Activity Centre	Suburban centres that provide access to a wide range of goods and services. They have different attributes and provide different functions, with some serving larger subregional catchments. Plan Melbourne identifies 121 major activity centres.
Mortality	Death, which may occur as a result of a range of reasons or diseases.
Native trees	Native trees include all trees that are native to Australia, and its states and territories.
Noise Management Level	A noise level (from the construction works) which triggers a particular action which is intended to manage the construction noise impacts.

Term	Description
North East Link Project (NELP)	North East Link Project (NELP) is the division within MTIA that is responsible for developing and delivering North East Link on the behalf of the Victorian Government. NELP was formerly known as the North East Link Authority prior to 1 January 2019. NELP is responsible for developing the reference project and coordinating development of the technical reports, engaging and informing stakeholders and the wider community, obtaining key planning and environmental approvals and coordinating procurement for construction and operation.
Open space	Land that provides outdoor recreation, leisure and/or environmental benefits and/or visual amenity.
Patch	A patch of native vegetation is either: An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native, or Any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or Any mapped wetland included in the current wetlands map, available in DELWP systems and tools (DELWP, 2017a).
Peak Particle Velocity (Resultant PPV)	The maximum instantaneous velocity of a particle at a point during a given time interval. The Resultant PPV is the vector sum of the three orthogonal component particle velocities (component PV).
Permeability	The property or capacity of a porous rock, soil or sediment for transmitting a fluid; it is a measurement of the relative ease of fluid flow within a material.
Place specific requirements (urban design)	Requirements within the Urban Design Strategy that respond to the local context and illustrate how the urban design principles must be addressed at a place-specific level.
Pollution	The introduction of contaminants into the natural environment that cause adverse change.
pH	A measure of the acidity or alkalinity of a solution. Neutral solutions have a value of seven, this value increases for alkaline solutions and decreases for acidic solutions.
Project boundary	The project boundary encompasses all areas that would be used for permanent structures, temporary construction areas and areas for potential minor road and rail works. It defines the area within which North East Link would be developed, and is the area that has been used as the basis for the specialist assessments. It is different to the study area adopted in the specialist assessments which is typically a much broader area allowing for a more comprehensive assessment of the impacts of North East Link.
Pumping test	A test that is conducted to determine aquifer or well characteristics.
Qualitative	Relating to or concerned with quality or qualities, rather than quantity or measured value.
Quantitative	An assessment based on quantifiable, measured data.
Receptor	A place, location or point at which exposure to particular impacts (such as noise, vibration, visual or airborne pollutants) is measured. ‘Sensitive receptors’ are those that are identified as likely to be more susceptible to adverse impacts, such as schools, hospitals, day care facilities and residences.

Term	Description
Recharge	The process of adding water, or the amount of water added, to the volume of water stored in an aquifer.
Reserve	Land reserved for community or public purposes.
Salinity	A measure of the dissolved salt content of water or soil.
Scattered tree	A scattered tree is a native canopy tree that does not form part of a patch.
Sedimentary rock	Rocks resulting from the consolidation of loose sediments that has accumulated in layers.
Shared use path	A shared use path is a path that may be used by walkers and cyclists. For North East Link, shared use paths have been designed to be not less than three metres wide.
Siltstone	Indurated sedimentary rock composed predominantly of silt-sized material.
Significant landscape	For the purposes of this assessment, a significant landscape is defined as an area considered significant for a combination of historic, aesthetic, scientific, social and cultural reasons.
Spoil	Waste material brought up during the course of an excavation, tunnelling or a dredging or mining operation.
Spoil Management Plan	A plan that provide details on the spoil management measures to be implemented.
Stakeholder	Person or group affected by or concerned with an issue.
Structural Root Zone	The area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The Structural Root Zone (SRZ) is nominally circular with the trunk at its centre and is expressed by its radius in metres. This zone considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which will usually be a much larger area. The SRZ is determined following the formula provided in AS 4970-2009 (Council of Australian Standards, 2009) where: SRZ radius = (D x 50)0.42 X 0.64, where D = trunk diameter, in m, measured above the root buttress.
Surface water	Any water that collects as a surface features, including rivers, streams, lakes, wetlands and the ocean.
Threatened species	For the purposes of this report, threatened species refers to species considered threatened in Victoria or Australia. This includes species that are rare, vulnerable or endangered in Victoria (Victorian Rare or Threatened or 'VROT') as defined by (DEPI, 2014) listed under Victoria's *Flora and Fauna Guarantee (FFG) Act 1988* or listed as vulnerable, endangered or critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*. VROT near-threatened, poorly known or data deficient species are not considered threatened.
Through traffic	Traffic with an origin and destination outside a given local area.
Tree Protection Plan	A plan prepared in accordance with AS4970-2009 *Protection of Trees on Development Sites* for the management of trees to be retained within and adjacent to construction and other works.

Term	Description
Tree Protection Zone	A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development. TPZ = DBH × 12. A Tree Protection Zone (TPZ) should not be less than two metres nor greater than 15 metres (except where crown protection is required) (AS4970-2009).
Truck	Light and heavy commercial vehicles are referred to as 'trucks'. This is based on the AustRoads vehicle classification system, where a truck is AustRoads classification 3 to 12.
Vibration	Vibration of the ground or structures and buildings, that is, the oscillatory displacement of the ground or structures or buildings.
Visual amenity	The value of a particular area or view in terms of what is seen.
Visual impact	Changes in the appearance of the landscape or in the composition of available views as a result of development, to people's responses to these changes, and to the overall impacts in regard to visual amenity. This can be positive (beneficial or an improvement) or negative (adverse or a detraction).
Vulnerable group	Group of people unable to withstand or adapt to change due to its characteristics. This report considers the following groups: socio-economically disadvantaged persons as identified by the Index of Relative Socio-Economic Advantage and Disadvantage (ISRAD), the elderly and very young, culturally and linguistically diverse (CALD) people, people who need assistance with core activities such as self-care, movement and communication due to a severe or profound disability.
Waste hierarchy	A hierarchical system of preferred waste handling approaches defined by EPA Victoria in Victoria's *Environment Protection Act 1970*. The approaches from most preferred to least preferred include avoidance, re-use, recycling and energy recovery, treatment, containment and disposal.
Water table	The surface between the vadose zone and the saturated zone of unconfined groundwater. This can also be defined as the surface at which groundwater pressure is equal to atmospheric pressure.
Water quality	The physical, chemical and biological characteristics of water, frequently used by reference to a set of standards against which compliance can be assessed.
Wetland	An area of land whose soil is saturated with moisture either permanently or seasonally. Such areas may also be covered partially or completely by shallow pools of water. Wetlands include swamps, marshes, and bogs, among others.
Yield	The rate at which water can be extracted from a pumping well, typically measured in L/sec or ML/day.
Zone of visual influence (ZVI)	The ZVI defines the differing zones of visual impact based upon the distance of the viewer to the largest visual component of North East Link within the study area.
Zone of theoretical visibility (ZTV)	A ZTV is the area around a designated point in the landscape from which that point is theoretically visible. It is calculated using elevation data within a Digital Terrain Model.

Part A Introduction

1. Introduction

1.1 Background

North East Link ('the action') is a proposed new freeway-standard road connection that would complete the missing link in Melbourne's ring road, giving the city a fully completed orbital connection for the first time. North East Link would connect the M80 Ring Road (otherwise known as the Metropolitan Ring Road) to the Eastern Freeway, and include works along the Eastern Freeway from near Hoddle Street to Springvale Road.

The proponent for North East Link is the State of Victoria through the Major Transport Infrastructure Authority (MTIA), an administrative office within the Victorian Department of Transport with responsibility for overseeing major transport projects.

North East Link Project (NELP) is the division within MTIA that is responsible for developing and delivering North East Link on behalf of the Victorian Government. NELP is responsible for developing the reference project, engaging and informing stakeholders and the wider community, obtaining key planning and environmental approvals and coordinating procurement for construction and operation.

North East Link was referred to the Australian Government Department of the Environment and Energy (DoEE) on 17 January 2018. On 13 April 2018 the action was declared a 'controlled action', requiring assessment and approval under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The decision notice requires North East Link to be assessed through a Public Environment Report (PER).

North East Link also requires assessment under Victoria's *Environment Effects Act 1978*. An Environment Effects Statement (EES) has been prepared under the Environment Effects Act.

In addition to impacts on Matters of National Environmental Significance (MNES), the requirement for a PER relates to three areas of Commonwealth land that lie within the referred 'EPBC boundary' (see Section 3.1) and would be affected by the action (see Section 3).

1.2 Purpose

This report describes the technical assessments undertaken to assess the impacts on Commonwealth land which have informed the PER.

1.3 PER Guidelines

1.3.1 Controlling provisions

The DoEE provided the North East Link Authority (NELA) (now known as North East Link Project or 'NELP) with '*Guidelines for the content of a draft Public Environment Report'* (PER Guidelines) on 10 July 2018. A full copy of the guidelines is provided as PER Attachment I – PER Guidelines.

The controlling provisions are the matters protected under Part 3 of the EPBC Act which the proposed action may have a significant impact on. These are the focus of the PER assessment:

- Listed threatened species and communities (Sections 18 and 18A of the EPBC Act)
- Listed migratory species (Sections 20 and 20A of the EPBC Act)
- The environment on Commonwealth land (Sections 26 and 27A of the EPBC Act).

1.3.2 Assessment of impacts related to Commonwealth land

The requirements for assessing the impacts of the action on Commonwealth land are set out in Section 2.5.3 of the PER Guidelines.

These require an assessment of 'any potential disturbance or impacts that the action may or will have on the whole of the environment on Commonwealth land' ' and refer to the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b).

The assessment must examine impacts relating to Commonwealth land on the 'whole of the environment' within the Commonwealth land boundary. The 'whole of the environment' includes:

- Flora and fauna
- People and communities (including the Defence estate as a distinct community)
- Cultural and heritage values
- Landscapes and soils
- Water resources
- Pollutants, chemicals, and toxic substances.

Impact are assessed using a range of discipline specific, technical methodologies, based on the assessment framework presented in Chapter 6 of the main PER document.

1.3.3 Consideration of the environmental context of Simpson Barracks at a landscape scale.

The PER Guidelines require assessment of the environmental services provided by Simpson Barracks to the greater Melbourne area. The Part B (Flora and fauna) and Part E (Landscape and soils) describe the features on Commonwealth land in the context of the surrounding landscape. Further details of the ecological context of the site's flora and fauna are presented in PER Technical Appendix A – Flora and fauna technical report.

1.3.4 Resources used to identify the potential impacts.

The PER Guidelines request details of the resources used to identify the potential impacts. NELP and GHD commissioned 18 technical assessments from a range of contributors. The contributors each provided the technical content for this section, set out in parts B to G of this report. The report contributors are listed in Table 1-1.

Table 1-1 Resources used to assess impacts on Commonwealth land

Technical assessment	Study resource
Aboriginal cultural heritage	Andrew Long and Associates
Air quality	Golder Associates
Arboriculture	Landscape Dept
Business	Matters More
Contamination and soil	GHD
Flora and fauna	GHD
Greenhouse gas	GHD
Ground movement	GHD

Technical assessment	Study resource
Groundwater	GHD
Historic heritage	Lovell Chen
Human health	ENRISK
Land use	GHD
Landscape and visual impacts	GHD and XURBAN
Social and community	GHD
Surface noise and vibration	SLR Consulting
Surface water	GHD
Traffic and transport	Smedley Technical & Strategic
Tunnel vibration	John Heilig and partners

1.4 Report structure

The structure of this report matches the criteria for assessing impacts on Commonwealth land presented in the EPBC Act Significant Impact Guidelines 1.2, and comprises seven sections:

- Part A Introduction
- Part B Flora and fauna
- Part C People and communities
- Part D Culture and heritage values
- Part E Landscape and soils
- Part F Water resources
- Part G Pollutants, chemicals, and toxic substances.

Parts B to G contain the technical assessments that are most applicable to that group of criteria in the PER Guidelines. Some technical assessments apply to more than one criterion heading (such as air quality, which is primarily interested in the impacts on people and is therefore described in Part C, but also involves describing emission of pollutants and so is referred to in Part G).

While presenting sufficient information to describe the impacts on Commonwealth land, the flora and fauna, groundwater and surface water sections of this report refer to more detailed assessments in separate technical reports (PER Technical Appendices A to C). These assess the impacts in relation to these disciplines for the action as a whole, where they apply to MNES as well as the impacts on Commonwealth land.

Since the numerical groundwater modelling was undertaken for the preparation of the draft PER that was published under Section 98 of the EPBC Act, additional numerical groundwater modelling has been undertaken. The purpose of the further modelling was to incorporate additional groundwater data collected over a period of approximately 12 months to enable transient calibration to seasonal variations in groundwater levels and to assess whether or not the additional calibration efforts result in changes to the assessment of project-induced groundwater impacts. The results of the further modelling has been incorporated as part of the finalisation of the PER.

1.5 PER exhibition and public submissions

As required by Section 98(1)(c) of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), the draft PER was published in mid-2019 together with an invitation for anyone to give NELP comments in writing relating to the draft PER. The period for comments to be made on the draft PER was for more than 30 business days between 16 April and 31 May 2019,.

For further detail relating to PER submissions received during the PER exhibition period and associated responses, refer to PER Attachment VIII – Submissions report.

2. Description of the environment

2.1 Location of Commonwealth land

Commonwealth land that is potentially affected by the action includes:

- Simpson Barracks
- An adjoining publicly accessible area immediately south-west of the Simpson Barracks fence line (see Figure 2-1). This area is used for informal outdoor recreation purposes. Throughout this PER, all of this land is referred to as 'Simpson Barracks'. Impacts on Simpson Barracks are assessed in Parts B to G of this report
- A strip of land located about one kilometre north of Simpson Barracks, to the rear of residential properties on Elder Street (see Figure 2-1). This strip of land is an easement for electricity transmission lines, and is referred to in this report as the 'War Services easement'.

2.2 Environment on Commonwealth land

2.2.1 Simpson Barracks

Environmental context

Simpson Barracks is located within an urban area approximately 18 kilometres north-east of the Melbourne central business district (CBD) in the suburb of Yallambie.

Surrounding land use is well-established residential development on all sides. Simpson Barracks is bordered by Greensborough Road to the west and Yallambie Road to the north. The main entry gate is located on Blamey Road, which is accessed from Greensborough Road, with secondary entry points on Yallambie Road and via Crew Street off Lower Plenty Road. Simpson Barracks is the Department of Defence's (DoD) largest reserve in Melbourne occupying approximately 112 hectares of land and comprising a mix of developed land and significant natural areas.

The developed part of Simpson Barracks comprises approximately 55 hectares and includes residential accommodation facilities, schools, administrative buildings, a workshop, playing fields, service areas and training buildings. Further information on land use at Simpson Barracks is provided in the following subsection.

A further portion of Commonwealth land exists immediately south of the Simpson Barracks fence line, near Borlase Reserve, and is accessible to the public for informal recreation.

Simpson Barracks contains a relatively large area of remnant woodland in an otherwise urbanised landscape, it is likely to attract and support a range of fauna. The western margin of Simpson Barracks largely consists of Eucalypt species (mainly River Red-gum, *Eucalyptus camaldulensis*) as well as several state and Commonwealth-listed plant species including Matted Flax-lily *Dianella amoena* (state and Commonwealth listed), and Arching Flax-lily *Dianella longifolia* var*. grandis* and the hybrid taxon, Studley Park Gum *Eucalyptus X studleyensis* (both state listed).

Banyule Creek within Simpson Barracks also has the potential to support aquatic species.

The landscape within the EPBC boundary on Simpson Barracks is a naturalised vegetated area comprised largely of Plains Grassy Woodland (Ecological Vegetation Class (EVC) 55). Banyule Creek originates in this area before flowing south through a residential area, Banyule Flats and to the Yarra River. This minor waterway is ephemeral and not expected to represent a significant groundwater recharge feature. Regional water mapping suggests groundwater levels of greater than five metres below the surface.

Information from the DoD has confirmed there are several historic landfills on Simpson Barracks, containing waste from DoD operations and potentially asbestos-containing materials (ACM) and bulk storage of fuel and waste oil. There is potential for acid sulfate rock (ASR) to underlie part of the barracks.

There are no historical heritage places which have been recognised through statutory listing and controls. However, there are some unlisted places of heritage significance or potential heritage significance within Simpson Barracks, including the historic residence Aldermaston, and the Watsonia Simpson Barracks Memorial Assembly Place and Lone Pine Commemorative Plantings, 138 Signal Flag Station and Memorial.

Two registered Aboriginal heritage places (two trees) are on the land. Discussions regarding these trees are ongoing with the Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation.

Further details of the environmental context of Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks are provided in Sections 5 to 30.

Land use

The land use activities at Simpson Barracks are generally associated with signalling and training activities. Key land uses are shown in Figure 8-1.

The property comprises military barracks, schools, administrative buildings, workshop and service areas and training buildings. The base is also host to the Army Communications training centre. It can be occupied by approximately 1,500 personnel at any one time, with housing for approximately 500 personnel.

Land uses comprise a mix of:

- Offices
- Training facilities
- Mess facilities
- Accommodation
- Outdoor and indoor sports facilities.

Accommodation is in the form of barracks. According to information provided by DoD, a large number of barracks inhabitants stay temporarily for two weeks to two years. Inhabitants are generally from outside the broader area (not from the City of Banyule) and stay on base most of the time while participating in training.

The interior part of the site is developed to accommodate core activities, and the remainder presents as open space and vegetation. There is limited public access. The following organisations have been identified as being on the site:

- Defence Force Schools of Signals (a Tri-Service educational facility)
- Royal Australian Corps of Signals Museum
- 402 Squadron – Australian Air Force Cadets
- Australian Military Bank
- Defence Bank

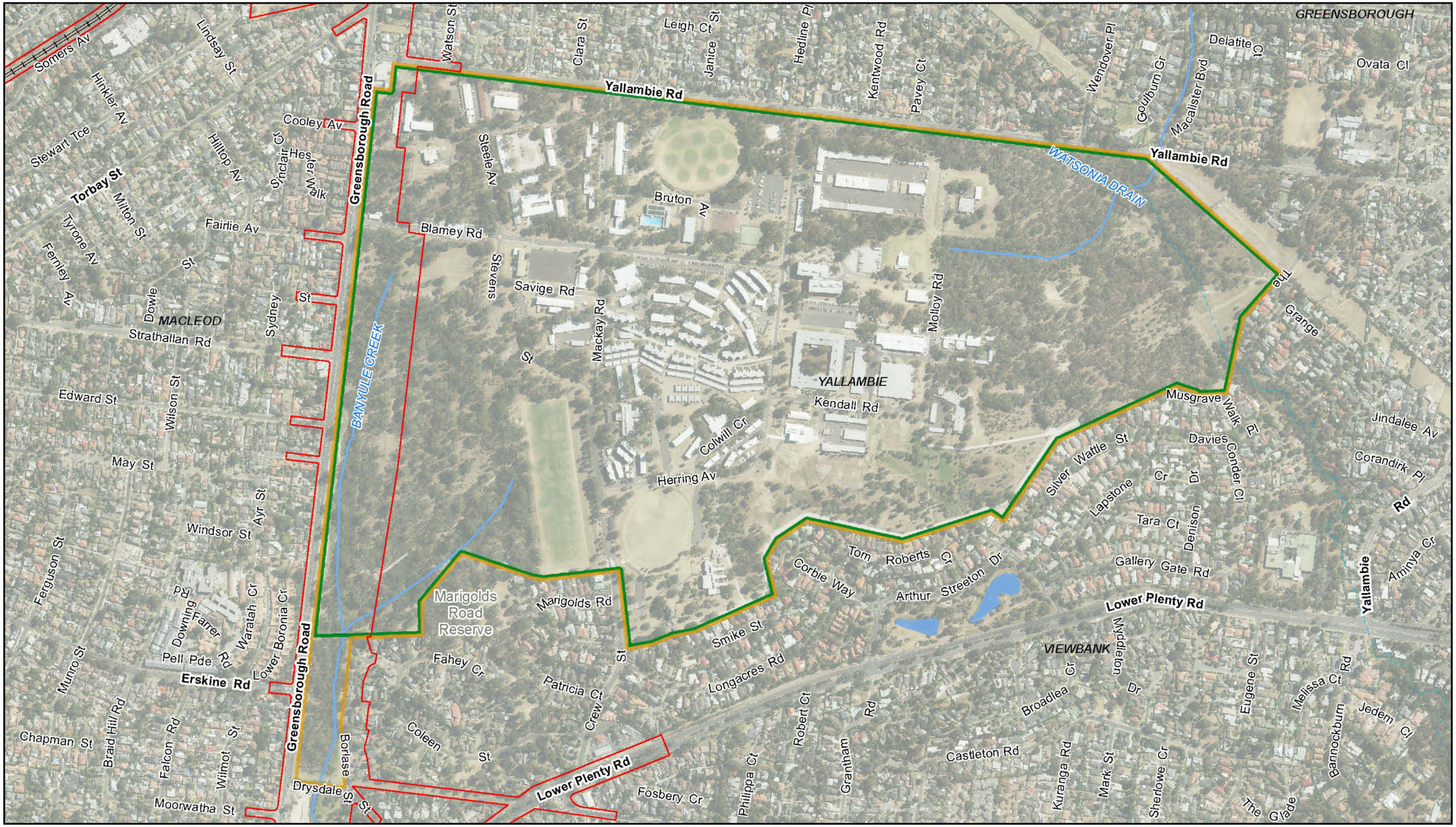
- Hairdressers
- Café
- Clothes shop.

A component of Simpson Barracks' population are permanent staff. Many of these live in nearby suburbs, and a large number of Defence housing association homes are located to the south of Simpson Barracks. Other staff commute from locally elsewhere (potentially from within the City of Banyule).

2.2.2 War Services easement

The War Services easement is a strip of land, part of a larger grassed area at 69–71 Frensham Road, Watsonia. The easement is owned by the Secretary of the Department of Veterans' Affairs (Commonwealth), as the successor in title for the Director of War Service Homes. The full area of the War Services easement is required for the construction of the action.

The War Services easement is located to the rear of residential properties on Elder Street and is a small part of a larger electricity easement reserve for high voltage electricity lines that pass through Watsonia. The reserve is used for informal outdoor recreation, is zoned for Public Parks and Recreation use under the Banyule Planning Scheme and is administered by Banyule City Council as part of the Frensham SEC Reserve. The War Services easement is 11 metres wide with a total area of about 0.28 hectares. The easement is mostly grassed with a shared use path and timber wall intersecting the western edge of the site. The area has no other identifying features other than four isolated trees on the boundary with the residential properties and some minor amenity planting near the timber wall.



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0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

Project boundary

- Project boundary - surface
- Barracks fenceline
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

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Commonwealth land - Simpson Barracks
unfenced land south of the barracks

Figure 2-1

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

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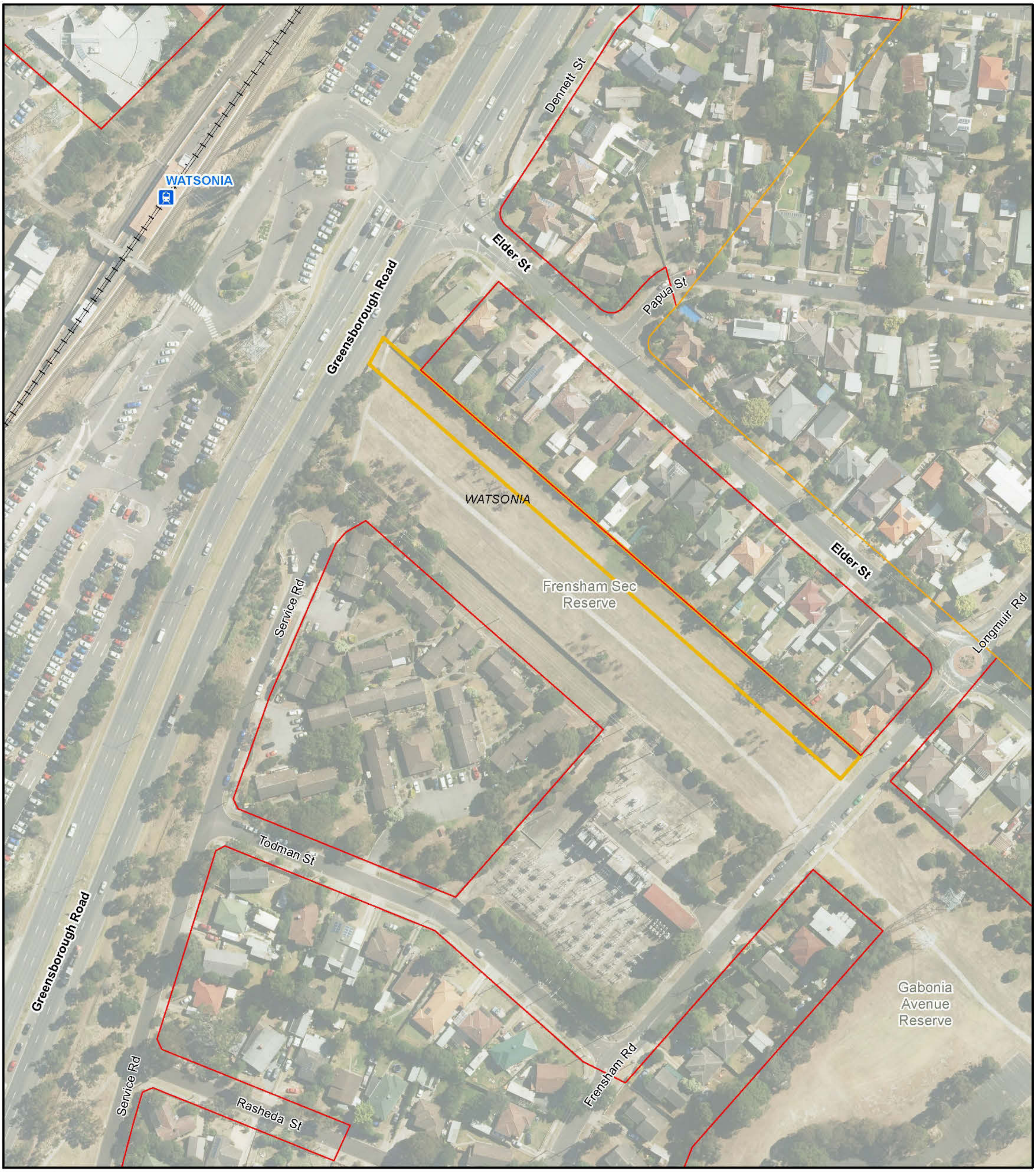

Legend

War Services easement

EPBC project area

Above ground

Project boundary

Project boundary - surface

Commonwealth land

Railway

Train station

Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

North East Link Project
Public Environment Report

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Revision C
Date 26/02/2019

Commonwealth land
War Services easement

Figure 2-2

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3. Description of the action

3.1 Introduction

This section provides a description of the action on Commonwealth land and its construction and operational components.

The action described in this section is based on a 'reference project', which has been developed by NELP. This represents one feasible means by which the action could be developed within the 'EPBC boundary' (as defined below) to achieve the North East Link objectives and environmental outcomes set by the environmental performance requirements (EPRs). This design would undergo further refinement and development by the contractor appointed to construct the action. However any modifications to the reference project would need to be consistent with the North East Link objectives, meet the EPRs as finalised by the Victorian Minister for Planning, and fall within the EPBC boundary for the action.

Throughout this report, specific terminology is used to describe the location of the works that form the action:

- **The EPBC boundary** – the area within which the action would take place, based on conservative assumptions made at the time of the referral variation (see 'Request to accept a Variation of a proposal (EPBC 2018/8142) pursuant to Section 156A of the EPBC Act' dated 30 May 2018 (NELA, 2018)
- **The project boundary** – contained within the EPBC boundary, the project boundary defines the maximum extent of the construction impacts of the reference project
- **The action on Commonwealth land** – this part of the action is defined to assess the impacts relating to Commonwealth land (under Sections 26 and 27A of the EPBC Act). The affected Commonwealth land is at Simpson Barracks in Yallambie (including the publicly accessible Commonwealth land south of Simpson Barracks) and a small strip of land to the rear of properties on Elder Street at Watsonia. Further information is provided in Section 4.

3.2 Overview of North East Link

The North East Link alignment and its key elements assessed in the PER include:

- **M80 Ring Road to the northern portal** – from the M80 Ring Road at Plenty Road, and the Greensborough Bypass at Plenty River Drive, North East Link would extend to the northern portal at Blamey Road using a mixture of above, below and at surface road sections. This would include new road interchanges at the M80 Ring Road and Grimshaw Street.
- **Northern portal to southern portal** – from the northern portal the road would transition into twin tunnels that would connect to Lower Plenty Road via a new interchange, before travelling under residential areas, Banyule Flats and the Yarra River to a new interchange at Manningham Road. The tunnels would then continue to the southern portal located south of the Veneto Club.
- **Eastern Freeway** – from around Hoddle Street in the west through to Springvale Road in the east, modifications to the Eastern Freeway would include widening to accommodate future traffic volumes and new dedicated bus lanes for the Doncaster Busway. There would also be a new interchange at Bulleen Road to connect North East Link to the Eastern Freeway.

An overview of North East Link is provided in Figure 3-1.

North East Link would also improve existing bus services from Doncaster Road to Hoddle Street with the Doncaster Busway and pedestrian connections and the bicycle network with connected cycling and walking paths from the M80 Ring Road to the Eastern Freeway.

For a detailed description of the action, refer to PER Chapter 3 – Project description.

3.3 Activities on Commonwealth land

Simpson Barracks

Within Simpson Barracks, North East Link would be constructed largely in a trench through the western portion of the barracks, adjacent to Greensborough Road. Bridges across the trench would retain existing levels of accessibility to and from Simpson Barracks. The northern portal ventilation structure would be located just north of Blamey Road. A number of water management features would also be constructed.

In addition to permanent infrastructure, the western part of Simpson Barracks that would be transferred to the Victorian Government would be used for construction activities.

War Services easement

The western-most part of the War Services easement would be used for the construction of surface road components of North East Link, including a local road connection (Greensborough Road), an upgraded shared use path and new noise wall. A small area of the western end of the easement may be used for a stormwater drainage bioretention water treatment pond. Some excavation may be required for buried utility infrastructure.

It is planned that all of Frensham SEC Reserve, including the War Services easement, would be used for the duration of construction for activities such as temporary car parking and equipment laydown. Once construction was complete, the War Services easement would be fully reinstated for informal recreation purposes. Very little land would be required for permanent infrastructure and it is expected that after construction about 96 per cent of Frensham SEC Reserve would be restored for passive recreation use.

3.3.1 Overview of construction works

Works occurring on Commonwealth land would include:

- Demolition
- Vegetation removal
- Construction of North East Link carriageways in a:
  - Trench (open cut excavation)
  - Tunnel (cut and cover)
- Road ramp construction
- Surface road works, including pedestrian and cycle paths and land bridges
- Power substation construction
- Northern portal ventilation structure construction
- Diversion of Banyule Creek
- Installation of flood protection
- Installation of water sensitive urban design (WSUD) features to manage surface water
- Laydown areas and construction compounds (potentially including the northern portal tunnel boring machine [TBM] launch site).

3.3.2 Construction methods

The construction methods that would be used to construct the action are outlined in Table 3-1.

Table 3-1 Construction methods for the Commonwealth land area

Type	Construction method
Earthworks	The majority of earthworks would involve excavation, including for the trench structure, with minor embankment fills. The trench would start at Watsonia railway station and end at the northern portal.
Cut and cover tunnels	Cut and cover construction involves using excavation equipment to dig a large trench or rectangular hole in the ground which is then covered by a concrete deck. Cut and cover construction can be conducted through a top-down or bottom-up configuration. Bottom-up is the method assumed for the reference project. This method would be used to dig sections of the action between Blamey Road and Lower Plenty Road. This section of work includes modification of Lower Plenty Road to allow connections to Greensborough Road and to the North East Link inner north and southbound carriageways. The new ramps located at Strathallan Road would be located on Commonwealth land.
Surface works	Roadworks, ramps and shared use path construction would occur along Greensborough Road and at the Lower Plenty Road interchange. The interchange consists of surface works, the realignment of roads, and building of new ramps between Strathallan Road and Lower Plenty Road. Shared use path surface works would also occur parallel to the road works from Elder Street through to Lower Plenty Road.

3.3.3 Area of impact

The maximum area impacted by the action is defined by the project boundary. All construction for the action would be contained within this footprint. A map showing the Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, as well as the project boundary, and the road type is shown in Figure 3-2.

The area that would be directly impacted by the action at Simpson Barracks contains mainly natural environment features. Bushland dominates, with some grassland and the origin and upper reach of Banyule Creek located on the barracks. This area also contains the entry gate to Simpson Barracks and the start of Blamey Road. Three training/office buildings would be directly impacted by the action. Two of these buildings are in the area between Yallambie Road and Blamey Road; the northern-most building (vehicle shed) would likely be retained, while the former guard house on Blamey Road would be demolished. One small building (shelter) is to the south of Blamey Road, at the eastern boundary of impact. This shelter would likely be impacted, but the extent of impact is not currently known.

3.3.4 Water management during construction

Table 3-2 outlines the water management methods for Commonwealth land.

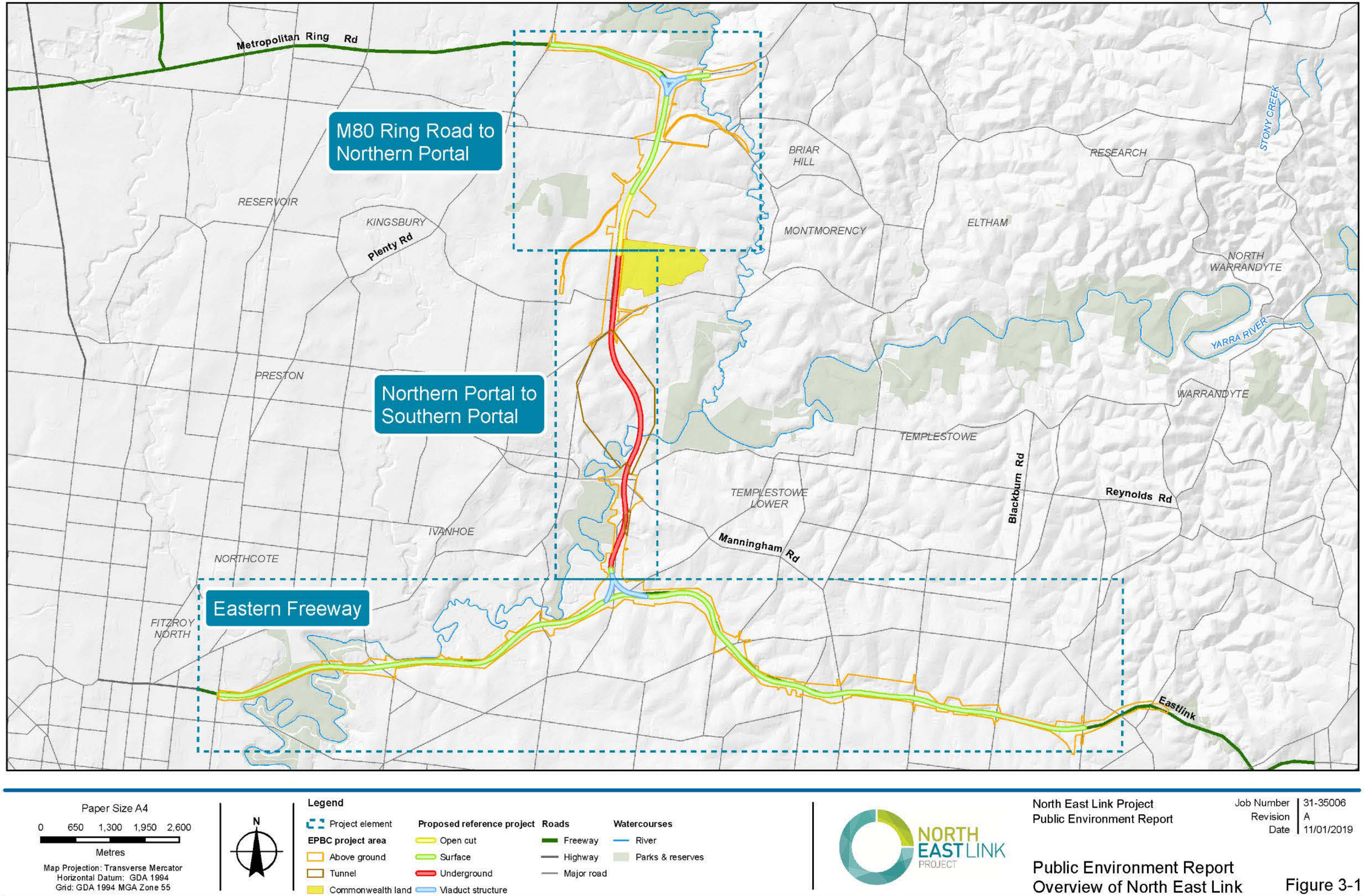
Table 3-2 Commonwealth land water management methods

Management	Description
Surface water management	Banyule Creek would be replaced by two pipes, one on either side of the North East Link alignment. Aside from the flood walls proposed around the trenches in the vicinity of the northern portal (up to approximately 1.5 metres in height from the existing ground level), other surface water management would be determined by the contractor in accordance with all relevant management plans.
Groundwater management	The groundwater management on Commonwealth land and the surrounding area would differ depending on the type of construction: • From Yallambie Road to Blamey Road, the trench would be drained during construction and operation. As the trench would be above the groundwater table, there would be no seepage into the structure. • From Blamey Road to midway between Oban Way and Erskine Road, the tunnels would be drained during construction and operation. As this section of the tunnels would be above the groundwater table, there would be no seepage into the structure. • From between Oban Way and Erskine Road to Lower Plenty Road, the cut and cover tunnels would be partially drained during construction, and tanked during operation. This means that during construction there may be some groundwater seepage and management, but during operation the tanked structure would be waterproof, with no seepage.

3.3.5 Operation activities

Following construction of North East Link, the key operation activities would include:

- Operation and maintenance of new road infrastructure
- Operation and maintenance of Freeway Management System
- Operation of North East Link motorway control centre
- Operation and maintenance of the tunnel ventilation system
- Operation and maintenance of water treatment facilities
- Operation and maintenance of the motorways power supply (substations)
- Maintenance of landscaping and water sensitive urban design (WSUD) features.



North East Link Project
Public Environment Report

Job Number 31-35006
Revision A
Date 11/01/2019

Public Environment Report
Overview of North East Link

Figure 3-1

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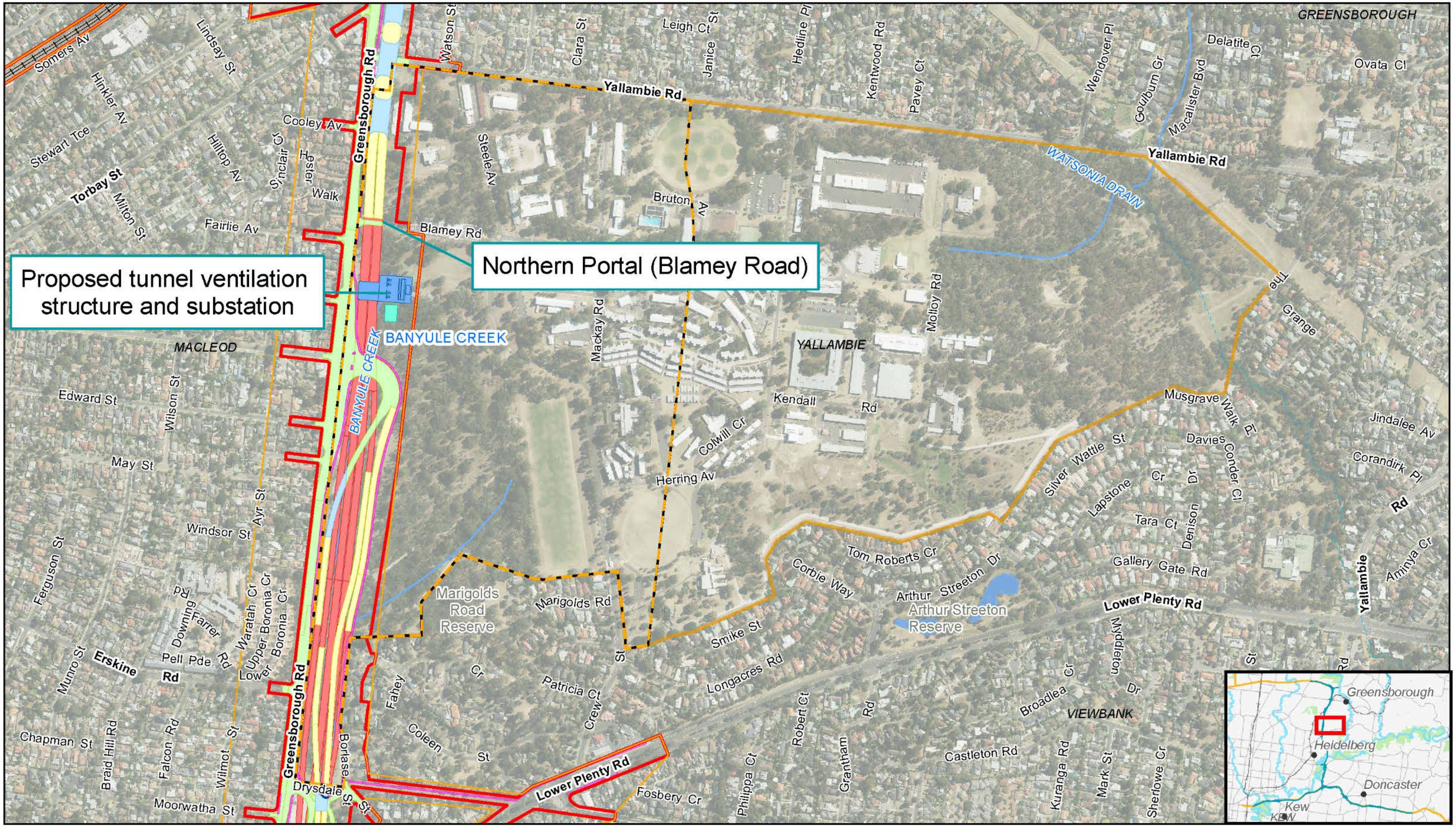
Data source: CIP Imagery - DELWP - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: trighetti



Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Reference Project boundary
- **EPBC project area**
  - Above ground
  - PER 500m buffer
  - Commonwealth land
- **Proposed reference project**
  - Ventilation system
  - Proposed area for substation
  - Shared use path overpass
  - Shared use path
  - Surface road
  - Elevated road, ramp or structure
  - Road in trench
  - Underground tunnel
  - Railway
  - Stream
  - Drain/channel/other
  - Lake

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

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Date	27/03/2019

Overview of action on Commonwealth land

Figure 3-2

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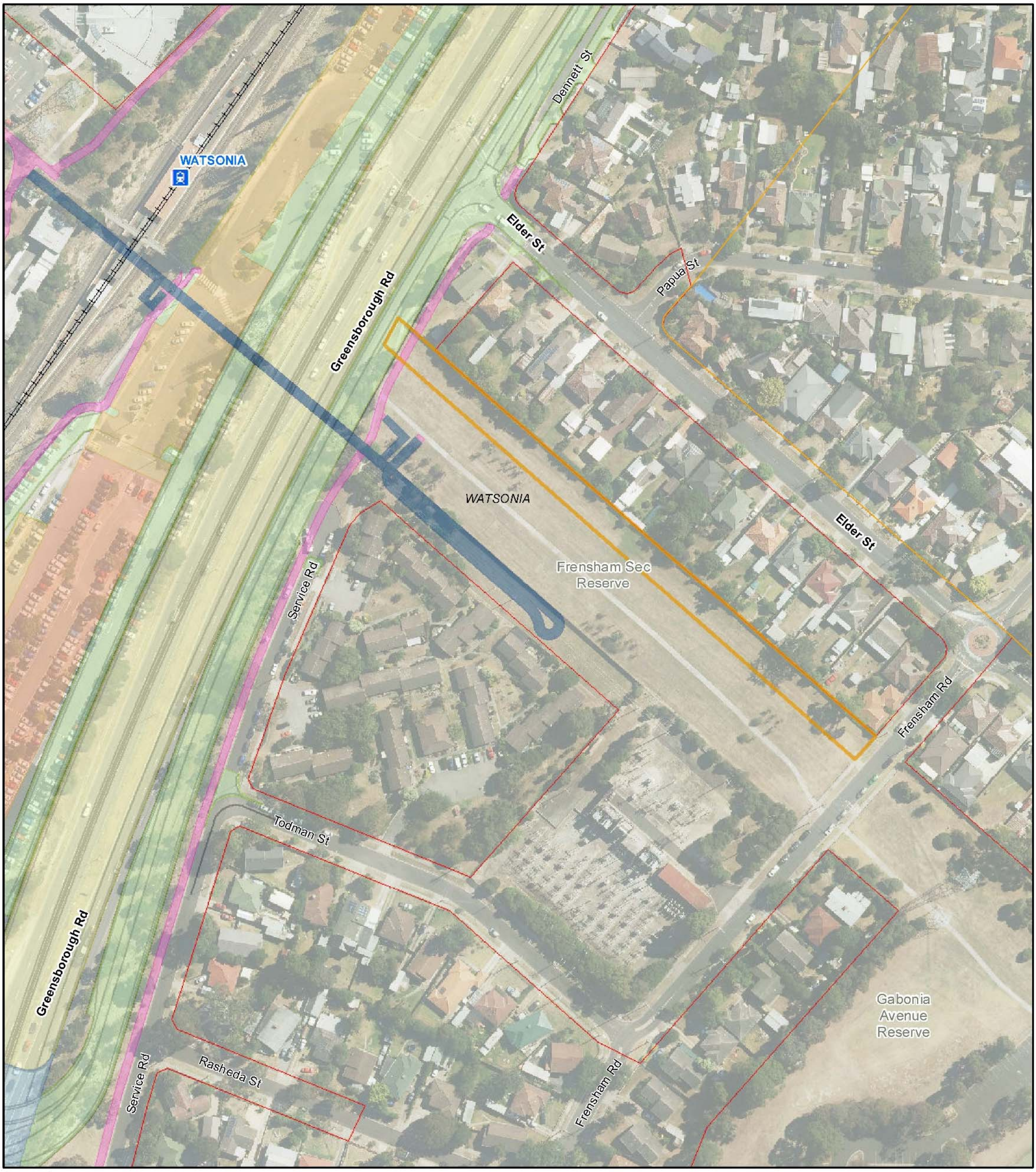
Data source: CIP Imagery - DELWP - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: bkaemmerling



Legend

Railway	**EPBC project area**	**Project boundary**	**Proposed reference project**	Surface road	Elevated road, ramp or structure
Train station	Above ground	Reference Project boundary - surface	Shared use path overpass	Multi-deck car park	Road in trench
		Commonwealth land	Shared use path	Public transport infrastructure upgrade	

Paper Size A4

0 12.5 25 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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North East Link Project
Public Environment Report

Job Number 31-35006
Revision E
Date 18 Sep 2019

Overview of action
on Commonwealth land
War Services easement

Figure 3-3

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4. Assessment method

4.1 Overview

Four technical reports were prepared to inform the PER and assessment of impacts. These reports are provided in Appendices A to D. Impacts and their significance were assessed taking into account relevant EPBC Act Significant Impact Guidelines. Figure 4-1 provides an overview of this process.

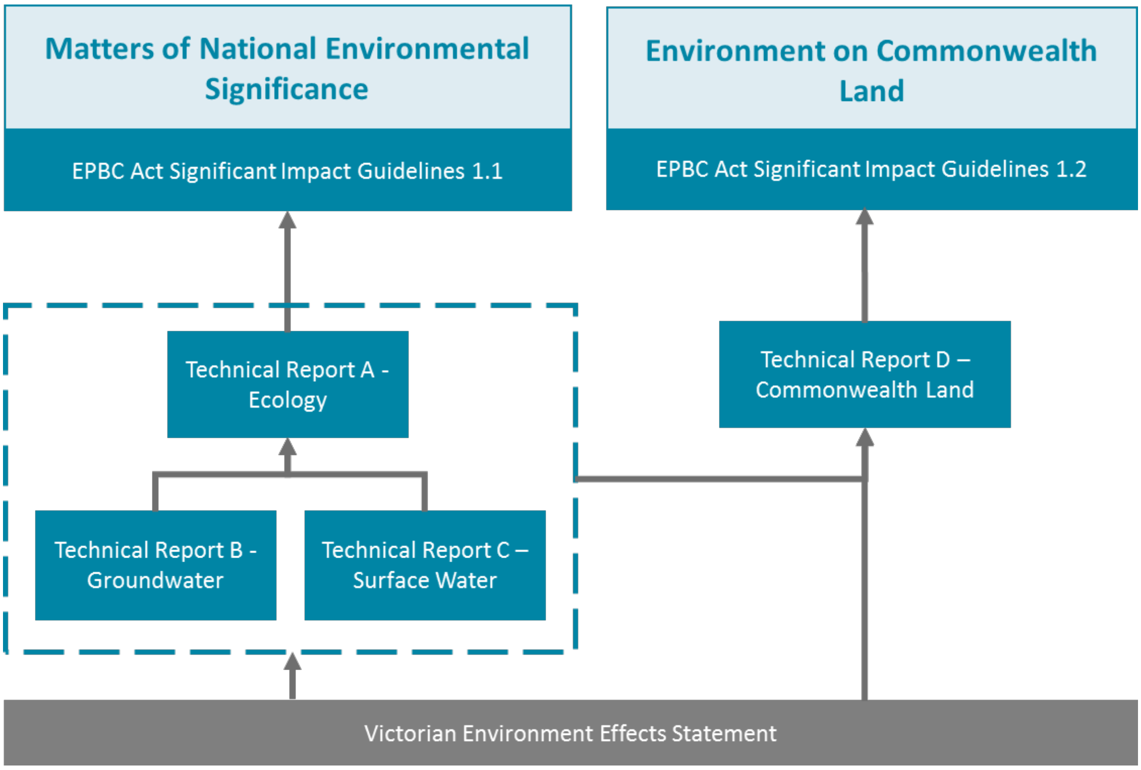

Figure 4-1 Assessment approach

PER Technical Appendix A – Flora and fauna technical report provides a detailed assessment of the potential presence and relevant impacts on ecological MNES; specifically threatened species and communities and migratory species that are listed. Potential impacts on MNES were assessed using the EPBC Act Significant Impact Guidelines 1.1 *Matters of National Environmental Significance*.

PER Technical Appendix B – Groundwater technical report and PER Technical Appendix C – Surface water technical report describe the water resources that may support MNES and provide an assessment of potential water-related impacts. These technical reports describe the groundwater modelling and surface water quality assessment carried out and have provided supporting information to inform PER Technical Appendix A – Flora and fauna technical report.

PER Technical Appendix D – Commonwealth land technical report (this report) contains an assessment of potential impacts on the whole of environment matters on Commonwealth land. Potential impacts were assessed using the EPBC Act Significant Impact Guidelines 1.2 *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies*. This report was informed by the findings of the flora and fauna, groundwater and surface water assessments where relevant to Commonwealth land.

4.2 Impact assessment process

4.2.1 Overview

The technical specialists identified and assessed relevant impacts through the technical sections. Technical specialists first described the existing environment with respect to Commonwealth land, and then identified how the construction and operation of North East Link may affect Commonwealth land – directly or indirectly. Measures to avoid, mitigate and where required to offset impacts were considered iteratively for the impact assessment.

The impact assessment process has informed and been informed by community and stakeholder engagement (refer PER Chapter 14 – Consultation) and development of the reference project (refer PER Chapter 3 – Description of the action). Figure 4-2 shows this process.

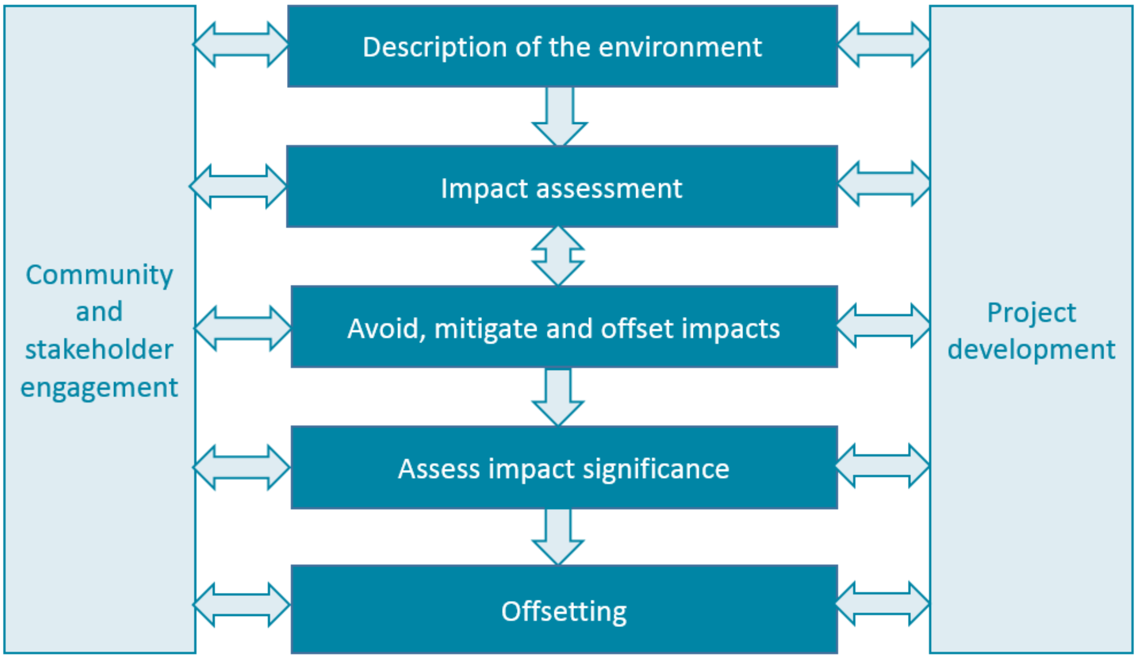

Figure 4-2 Impact assessment process

4.2.2 Study area

This technical report describes impacts on the various receptors that make up the 'whole of environment' on Commonwealth land. The Commonwealth land assessed is:

- Simpson Barracks including the publicly accessible Commonwealth land south of Simpson Barracks (see Section 2.2.1)
- The War Services easement (see Section 2.2.2).

While direct impacts would be experienced within the project boundary (see Section 3.1), beyond this, direct and indirect impacts may be experienced. Section 2.5.3 (c) of the PER Guidelines requests *'details of the distance of proposed works to any EPBC listed matters and on whole of the environment matters within 500 metres of the disturbance footprint'*.

The area of 500 metres from the project boundary (within Commonwealth land) was used as a guide for the extent of impacts to be considered. However, the nature of some types of impact mean they would be either experienced at a greater distance, or affect receptors that extend beyond 500 metres from the project boundary. Any potential impacts beyond 500 metres that were identified were assessed.

Each study discipline section provides a specific definition of study area.

4.2.3 Description of the environment

Each technical specialist identified and characterised the environmental assets, values and uses that may be affected by North East Link. These assessments focused on the environment on Commonwealth land.

Each assessment has considered:

- History, current use and condition of environmental assets and values
- Significance of environmental assets, values and uses
- Sensitivity or vulnerability to impacts.

The study area for the assessment of impacts on Commonwealth land is shown in Figure 3-2.

In some cases, the geographic area for each assessment differed for each technical study to reflect differences in the extent of risks and impacts for each discipline. In some cases, this area extends beyond the project boundary described in Section 3.1. For example, the flora and fauna assessment considered the presence of threatened flora, fauna and communities for a wider area than the Commonwealth land boundary.

The description of the environment is summarised in Section 2 and detailed in Parts B to G of this report and in PER Technical Appendices A to C.

4.2.4 Impact assessment

The change that would result from the implementation of North East Link is called an impact. Impacts can be positive or negative. Impacts can be a direct result of an action, or can occur indirectly, such as impacts on habitat for MNES resulting from a change in groundwater conditions. The nature and extent of any impact is measured against the current environmental conditions, considering the differences between the 'with project' and 'no project' scenarios.

The following factors were considered when assessing potential impacts:

- Severity including the intensity, duration, timing and frequency, and scale or geographic extent of impacts
- The relationship between different impacts on the environment
- The likely effectiveness of measures to avoid and mitigate adverse impacts
- The likelihood that any given environmental impact would occur
- Whether any impacts are likely to be unknown, unpredictable or irreversible
- Benchmarks and requirements set by statutory requirements, policies and guidelines
- Community expectations
- The principles of ecologically sustainable development and objects and requirements of the EPBC Act.

In some cases, specific methods for impact assessment were developed by technical specialists and, where relevant, these are documented along with the assessment of relevant impacts in Parts B to G of this report and in PER Technical Appendices A to C.

4.2.5 Avoid, mitigate and offset impacts

Measures to avoid and mitigate impacts were developed in response to the impact assessment to reduce impacts on the environment on Commonwealth land.

These have included refinements to the reference project and specification of measures to avoid and mitigate environmental impacts during the construction and operation of North East Link.

The final reference project is described in PER Chapter 3 – Description of the action. A consolidated list of avoidance and mitigation measures and the framework for implementing these is provided in PER Chapter 10 – Proposed avoidance and mitigation measures.

Where impacts could not be reduced through avoidance and mitigation measures, environmental offsets have been proposed in accordance with the EPBC Act Environmental Offsets Policy (DSEWPAC, 2012) and Victoria's Department of Environment, Land, Water and Planning (DELWP, 2017a) *Guidelines for the removal, destruction or lopping of natural vegetation*. These are described in PER Chapter 11 – Offsets.

4.2.6 Assess impact significance

The significance of relevant impacts was assessed against the EPBC Act Significant Impact Guidelines for the environment on Commonwealth land. The assessment also addressed the requirements of Section 2.5.3 of the PER Guidelines and the Significant Impact Guidelines 1.2. This assessment took into account the current environmental context and the likely effectiveness of measures to avoid, mitigate and offset potential impacts.

The potential significance of impacts is documented in the summary tables in Parts B to G of this report and in PER Technical Appendices A to C.

Part B Flora and fauna

5. Flora and fauna

5.1 Introduction

GHD undertook an assessment of the impacts of the action on Commonwealth land in relation to flora and fauna. This section summarises the assessment's findings.

As well as impacts on Commonwealth land, the PER must assess the potential impacts of the action on MNES. A more detailed assessment of impacts on Commonwealth land and a broader assessment of MNES within the overall EPBC boundary is provided in PER Technical Appendix A – Flora and fauna technical report.

5.2 Assessment method

5.2.1 Assessment scope

Study area

This study provides a detailed assessment of the potential presence and relevant impacts on flora and fauna on Commonwealth land.

Although direct impacts would occur within the project boundary (see Section 3.1), indirect impacts on flora and fauna may occur beyond this. Ecological features and communities affected may extend across the whole of the Commonwealth land. Therefore the assessment considered impacts on the ecological resources of the Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks.

Impacts on the flora and fauna of the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 7-2.

Scope of impacts considered

The potential impacts considered as part of the assessment are listed in Table 5-1.
Full description of these impacts is provided in Section 9 of PER Technical Appendix A – Flora and fauna technical report.

Section 5.5 and Section 5.6 below explain how these potential flora and fauna impacts affect the performance of the action against the criteria in the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b) for plants, terrestrial and aquatic animals respectively.

Table 5-1 Potential direct and indirect flora and fauna impacts considered

Phase	Potential impact
Construction	Removal of vegetation and habitat
	Degradation of vegetation and terrestrial habitat through erosion, sedimentation, dust, or contamination
	Degradation of vegetation and terrestrial habitat through soil compaction
	Degradation of aquatic habitat through sedimentation or contamination
	Degradation of aquatic habitat through waterway modification or construction activities in and around waterways
	Death or injury of fauna during construction
	Disturbance of fauna through noise, vibration or lighting

Phase	Potential impact
	Fragmentation of terrestrial wildlife corridors creating barriers to terrestrial fauna movement
	Fragmentation of aquatic wildlife corridors creating barriers to aquatic fauna movement
	Introduction or spread of weeds, pest species or pathogens leading to the reduction of flora and fauna values
	Detrimental changes to soil, surface water or groundwater conditions as a result of tunnel construction
	Drawdown of groundwater resulting in degradation of terrestrial or aquatic ecosystems
Operation	Loss or degradation of terrestrial or aquatic habitat through overshadowing
	Degradation of aquatic habitat through waterway modification
	Degradation of aquatic habitat through modification of stormwater catchment
	Degradation of aquatic habitat through contaminated runoff
	Death or injury of fauna during road operation
	Disturbance of fauna through noise, vibration or lighting
	Groundwater changes during operation resulting in degradation of terrestrial or aquatic ecosystems

5.2.2 Assessment method

A comprehensive flora and fauna assessment was undertaken to understand existing conditions of the study area to inform the environmental impact assessment for the works.
This assessment incorporated:

- A desktop assessment and synthesis of Commonwealth and State government-curated biodiversity datasets
- Review of existing literature and consultation with specialists
- Flora, fauna and aquatic ecosystem field assessments
- Vegetation quality assessment (Habitat Hectare Assessment) of recorded native vegetation
- Targeted survey for threatened species, where deemed necessary
- Determination of the likelihood of threatened species and threatened species' habitat presence.

Since the groundwater assessment was completed for the draft PER, additional data from the North East Link groundwater bore monitoring network has become available and further groundwater modelling has been undertaken. Using the further groundwater data, impacts to Groundwater Dependent Ecosystems have been reassessed, and the updated findings discussed is this report.

Full details of the assessment methodology is provided in PER Technical Appendix A – Flora and fauna technical report.

5.3 Description of environment

The flora and fauna of Commonwealth land are described in PER Technical Appendix A – Flora and fauna technical report. Figure 5-1 summarises the flora and fauna values on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks. The flora and fauna of the War Services easement are discussed in Section 2.2.2 and in PER Technical Appendix A – Flora and fauna technical report.

5.3.1 Plants

Flora communities

Simpson Barracks contains a range of significant environmental values including Commonwealth and Victorian-listed flora and several Ecological Vegetation Classes (EVCs). A summary of several ecological assessments conducted across the entire Simpson Barracks site includes:

- 52.5 hectares of remnant vegetation mapped
- 192 flora species have been recorded, including 92 indigenous and 100 exotic species.

Within the area that North East Link would impact at Simpson Barracks, the current study mapped three patches of native vegetation (10.976 hectares; 6.29 habitat hectares), 34 large trees in patches and 17 scattered trees (five large, 12 small). The area of Simpson Barracks within the project boundary comprises Plains Grassy Woodland (EVC 55).

Flora species

Of particular importance within Simpson Barracks are:

- A significant population of Matted Flax-lily *Dianella amoena* (Commonwealth and Victorian listed). Matted Flax-lily was identified on the eastern and western sides of the base, with an estimated total of 271 plants/patches at Simpson Barracks.
- A population of Arching Flax-lily *Dianella longifolia var. grandis* (DELWP, vulnerable). It is a perennial graminoid, to 1.3-metres tall, growing in solitary tufts or loose patches. Following urban expansion, many of the remaining populations of this species are very small and fragmented in Victoria, where it is mainly concentrated in the Volcanic Plains and Riverina. Two individuals were observed in moderate to good quality Plains Grassy Woodland on the western side of the site during field assessments at Simpson Barracks.
- A significant population of the hybrid taxon, Studley Park Gum *Eucalyptus X studleyensis* (DELWP, endangered). This is a hybrid of River Red Gum *Eucalyptus camaldulensis* and Swamp Gum *E. ovata* with a distribution covering areas of Melbourne. A total of 44 Studley Park Gum were identified within the project boundary at Simpson Barracks and additional Studley Park Gum of varying sizes were identified outside the project boundary at Simpson Barracks.

Ecological values mapped within Simpson Barracks are presented in Figure 5-1.

Groundwater dependant ecosystems

Parts of the Plains Grassy Woodland mapped within Simpson Barracks are mapped as a Groundwater Dependant Ecosystem (GDE). The dominant tree species are River Red Gum in the lower western section closest to the project boundary, in association with Yellow Box and Studley Park Gum.

5.3.2 Animals

Terrestrial fauna

Simpson Barracks contains relatively large areas of remnant woodland in an urbanised landscape and is therefore likely to attract and support a range of terrestrial fauna. However, because it is surrounded by urbanisation and has been considerably disturbed historically, it is generally degraded and consequently unlikely to support the full range of threatened and nonthreatened fauna that would have occurred there historically.

Habitats within Simpson Barracks have moderate value for fauna. Patches of woodland (remnant, regrowth or planted) of this size within the Melbourne area tend to be characterised by bold, common and adaptable fauna (such as the Red Wattlebird, Rainbow Lorikeet, Noisy Miner, Common Ringtail Possum (*Pseudocheirus peregrinus)*, Common Brushtail Possum (*Trichosurus vulpecula)*), which can be aggressive and outcompete other native fauna.

Other non-threatened species that are reasonably common but more notable in the Melbourne area are also likely to visit Simpson Barracks (such as the Common Bronzewing (*Phaps chalcoptera)*, Gang-gang Cockatoo (*Callocephalon fimbriatum)*, Horsfield's Bronze-Cuckoo (*Chrysococcyx basalis)*, and Olive-backed Oriole (*Oriolus sagittatus)*). Occasionally or rarely, habitats within Simpson Barracks may attract threatened fauna such as Powerful Owl (*N. strenua)*, Swift Parrot (*Lathamus discolor)* and Grey-headed Flying-fox (*Pteropus poliocephalus)*; although this is likely to be for foraging only, and these species are not expected to breed or roost there frequently or regularly.

Previous assessment of Simpson Barracks identified potential habitat for three threatened fauna: Swift Parrot (*Lathamus discolor)*, Grey-headed Flying-fox (*Pteropus poliocephalus)* and Brown Toadlet (*Pseudophryne bibroni)* (Jacobs, 2016). (HLA-Envirosciences PTY Ltd, 2007) assessed flora and fauna at the site in September 2006, including Elliot and pitfall trapping for fauna. During that assessment, no Swift Parrots, Grey-headed Flying-foxes, or Brown Toadlets were seen or heard, no small mammals were captured, and no threatened reptiles were detected. While Jacobs (2016) undertook baseline surveys for threatened communities and threatened species of fauna, the survey involved daytime observations of habitat only; no threatened fauna species were observed opportunistically, and no targeted surveys were conducted.

Paper Size A4

0 50 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

Project Boundary
- surface impact
- Simpson Barracks Boundary

Vegetation Assessed
- Creekline Grassy Woodland (68)
- Plains Grassy Woodland (55)
- Amenity planting

- Large trees in patches
- Large scattered trees
- Small scattered trees
- Matted Flax-lily (Defence 2006)
- Matted Flax-lily (HLA 2007)
- Matted Flax-lily (Jacobs 2016)
- Studley Park Gum (HLA 1998)
- Studley Park Gum (HLA 2007)
- Studley Park Gum (Jacobs 2016)
- Matted Flax-Lily Patch (AECOM/GHD 2017)
- Matted Flax-lily (AECOM/GHD 2019)
- Arching Flax-lily (AECOM/GHD 2017)
- Stream
- Drain/channel/ot...
- Lake
- Studley Park Gum tree (GHD 2019)

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	B
Date	16 Aug 2019

Summary of ecological values at Simpsons Barracks

Figure 5-1

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018, Roads, Watercourse - VicMap - 2018 | Threatened Flora - HLA, Defence, Jacobs - 1998-2016 | Trees, Matted Flax-lily, Arching Flax-lily, Project boundary - AECOM, GHD, 2018.

Species that are unusual/rare in the Melbourne area may visit Simpson Barracks occasionally, such as Grey Goshawk (*Accipiter novaehollandiae)*, Black Falcon (*Falco subniger)*, Barking Owl (*Ninox connivens)*, White-throated Needletail (*Hirundapus caudacutus)*, but are unlikely to be there regularly or depend on habitat within the site. Due to historical ground disturbance and vegetation clearance, native small mammals are not expected to persist within Simpson Barracks, a conclusion also reached by Kinhill (2000) and HLA (2007). Dense grassy habitats within Simpson Barracks are still likely to be used by common species of reptiles (such as Tiger Snake (*Notechis scutatus)*; Common and Blotched Blue-tongued Lizards (*Tiliqua scincoides* and *T. nigrolutea*).

The woodland and grassland habitats within Simpson Barracks support a small population of Eastern Grey Kangaroos (*Macropus giganteus*) and are used by other notable fauna such as Swamp Wallaby (*Wallabia bicolor*), Short-beaked Echidna (*Tachyglossus aculeatus*), and the Common Wombat (*Vombatus ursinus*).

Aquatic fauna

Simpson Barracks contains the headwater of Banyule Creek. The waterway habitats in the headwaters of Banyule Creek support very poor aquatic ecosystem conditions, as indicated by the very low diversity and pollution tolerance of the macroinvertebrate community collected in the Rapid Bioassessment. There is no suitable habitat for fish in Banyule Creek within Simpson Barracks.

Away from the main channel of Banyule Creek, a number of constructed wetlands are present that receive runoff from catch drains and appear to contain permanent water. These wetlands may provide good habitat for small bodied fish, although fish surveys found no fish were present.

Targeted surveys were undertaken in Banyule Creek and wetlands at Simpson Barracks for Dwarf Galaxias (*Galaxiella pusilla*), based on the possibility that an isolated population may occur in this protected habitat. No Dwarf Galaxias, or any other fish, were detected at Simpson Barracks. No EPBC Act-listed fish species are expected to occur at Simpson Barracks.

Further details of the existing flora and fauna environment are provided in PER Technical Appendix A – Flora and fauna technical report.

5.4 Relevant impacts and mitigation measures – plants

5.4.1 Involve medium or large-scale native vegetation clearance

Construction at Simpson Barracks would lose vegetation, through

- Direct removal of vegetation and habitat
- Degradation of vegetation and terrestrial habitat through erosion, sedimentation, dust, or contamination
- Degradation of vegetation and terrestrial habitat through soil compaction
- Detrimental changes to soil, surface water or groundwater conditions as a result of tunnel construction
- Drawdown of groundwater resulting in degradation of terrestrial or aquatic ecosystems.

Direct loss of native vegetation

This assessment conservatively assumes that all plants within the project boundary would be lost due to construction.

Simpson Barracks has been extensively studied and much is known about the flora values it supports. The site is situated on fertile soils that support Plains Grassy Woodland with a few sparse shrubs and a species-rich grassy and herbaceous ground layer (Jacobs, 2016), (HLA, 2007).

The area within Simpson Barracks that intersects with the project boundary largely comprises Plains Grassy Woodland (EVC 55), dominated by River Red Gum. The Plains Grassy Woodland (EVC 55) that exists within Simpson Barracks was investigated for its potential to be considered Grassy Eucalypt Woodland of the Victorian Volcanic Plain. Because the geology of the site is not volcanic in origin, the woodland within Simpson Barracks does not support Grassy Eucalypt Woodland as defined in (DSEWPAC, 2011).

Approximately 10.976 hectares of Plains Grassy Woodland would be directly removed by North East Link which is approximately 21 per cent of the 52.5 hectares of remnant native vegetation at Simpson Barracks. Contained within the 10.976 hectares are 34 large trees (that is, trees with a diameter at breast height >80 centimetres, according to the Plains Grassy Woodland EVC benchmark determined by Victoria's Department of Environment, Land, Water and Planning (DELWP). A further five scattered large trees and 12 scattered small trees occurring outside patches of native vegetation would also be removed.

Consequently, and in the context of Simpson Barracks alone, the action would involve medium-scale native vegetation clearance.

Overshadowing is not expected to result in vegetation loss on Commonwealth land.

Indirect loss of native vegetation

Some large trees may be affected by the groundwater drawdown discussed in Section 24 further below. Groundwater drawdown is modelled to result in a moderate to high risk of death or decline in health of an additional eight large trees (>80 centimetres DBH) at Simpson Barracks over the long term (2075). While some individual trees may die due to groundwater drawdown, all smaller trees, shrubs and understorey species would be expected to remain unaffected.

All large trees (>80 centimetre diameter at breast height (DBH)) within the modelled 10<20-metre groundwater depth zone were mapped in the field, with tree numbers likely to be impacted based on risk zones. A total of 45 large trees within Simpson Barracks would have a moderate to high chance of being negatively impacted by 2024 at the end of construction, and one further large tree would have a low chance of being impacted in the absence of any mitigation measures. Under the 2075 long-term scenario, eight large trees within Simpson Barracks would have a moderate to high chance of being negatively impacted, while a further eight large trees would have a low chance of being affected in the absence of any mitigation measures. These results are presented in Table 5-2.

All trees predicted to be impacted are River Red Gums, apart from nine (five high, four moderate) Studley Park Gum under the 2024 scenario and seven (three moderate, four low risk) Studley Park Gum under the 2075 scenario.

Table 5-2 Number of large trees expected to suffer premature mortality or condition decline due to groundwater drawdown

Risk	2024	2075
Very high	0	0
High	21 (5 Studley Park Gum)	0 (0 Studley Park Gum)
Moderate	24 (4 Studley Park Gum)	8 (3 Studley Park Gum)
Low	1 (0 Studley Park Gum)	8 (4 Studley Park Gum)
TOTAL	46 (9 Studley Park Gum)	16 (7 Studley Park Gum)

Although eight large trees within Simpson Barracks have the potential (moderate to high likelihood) to suffer premature mortality over the long term, there are currently thousands of other younger trees approximately 10 to 20 metres in height (with DBH ranging from 20 to 70 centimetres) within the moderate to high risk zones at Simpson Barracks. From the start of 2026 to 2075, these trees are expected to grow and self-thin (due to density-dependent mortality), with many trees likely to move through the ranks into the large tree category by 2075. While groundwater levels may be slightly lower over the long term, these trees are likely to have never accessed groundwater during their development, owing to their relatively smaller size at the time of the construction of North East Link, and so would unlikely be affected by the projected drawdown as they are not dependent on groundwater.

It is possible that large tree losses due to groundwater drawdown may be countered by other trees becoming large trees over time. For example, it is estimated that more than 200 trees ranging in size from 50 to 79 centimetres DBH occur in the moderate to high risk zones at Simpson Barracks.

While some of these trees may suffer premature mortality due to groundwater drawdown, many are likely to have root systems that do not penetrate deep enough to access groundwater, and by inference, drawdown would not affect these individuals. Over the 50-year timespan from the start of 2026 to 2075, many of these trees are likely to become large trees (conservatively adding girth of *c.* 0.5 centimetres per year (such as Bennetts, 2017 reported 0.44 centimetres year^{-1} growth in River Red Gum in floodplain forests).This would make it probable that no net loss of large trees from Simpson Barracks would occur.

Eight large trees (5 River Red Gum and three Studley Park Gum) within Simpson Barracks and abutting Commonwealth land, but outside the project boundary, are likely to be accessing groundwater on occasions (10<20-metre groundwater depth zone) and have a moderate to high likelihood of being negatively impacted by groundwater drawdown over the long-term (2075 scenario). This implies that in this groundwater depth zone, large trees have a reasonable likelihood of suffering a decline in health and/or premature death.

Watering during construction is a potential mitigation measure that is likely to reduce the number of trees impacted in the short-term. Any large trees predicted to be affected over the long-term would need to be offset in association with the offset strategy for North East Link. Consistent with other sections of this report, offsetting would be undertaken in accordance with DELWP requirements. Areas outside the 10<20 metres groundwater depth zone would unlikely be negatively impacted by groundwater changes.

5.4.2 Involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species

Clearance of vegetation at Simpson Barracks (see Section 5.4.1) would involve the removal of three listed threatened plant species:

- Matted Flax-lily (*Dianella amoena*) – endangered under the EPBC Act, Listed under the *Flora and Fauna Guarantee Act* (FFG Act), endangered on DELWP Advisory List
- The hybrid taxon, Studley Park Gum (*Eucalyptus* X *studleyensis*) – endangered on the DELWP Advisory List
- Arching Flax-lily (*Dianella longifolia* var. *grandis*) – vulnerable on the DELWP Advisory List.

Matted Flax-lily

Matted Flax-lily (Dianella amoena) is listed under the FFG Act and endangered on DELWP Advisory List. As it is also listed as endangered under EPBC Act impacts are discussed in detail in PER Technical Appendix A – Flora and fauna technical report.

Approximately 31 per cent (83 out of 271 plants/patches) of the Simpson Barracks population are likely to be impacted. With implementation of a successful salvage and translocation program similar to those that have been successfully implemented on other projects, the action would not lead to a significant decline in the Matted Flax Lily population.

Studley Park Gum

The Studley Park Gum is classified as endangered on the DELWP Advisory list and is a hybrid between River Red Gum and Swamp Gum. It occurs within the project boundary at Simpson Barracks. Cameron et al. (1999) identified 53 established trees but it is unclear how many of these occur inside the project boundary. At the time of the 1999 assessment, the authors of this assessment concluded that together with the Streeton Views estate population, the Simpson Barracks population is one of two hybrid swarms that are likely to remain genetically stable in the long term (Cameron, 1999). Their reasoning for this statement is that the hybrid is fertile, there is a high genetic difference between the parents, the hybrid has a high level of character stabilisation and is present in distinct swarms, and it displays niche differentiation from the two parent species.

The direct clearance of 44 mature individuals of Studley Park Gum within the project boundary at Simpson Barracks, and the additional indirect impact on three large Studley Park Gums outside the project boundary by groundwater drawdown over the long-term (2075 operational scenario based on further groundwater modelling) is likely to result in a long-term decline in a population, or threaten the viability, or reduce the occupancy of Studley Park Gum. Consequently, the unavoidable loss of at least 47 Studley Park Gum individuals is regarded as a significant impact.

In accordance with the EPBC Act Environmental Offsets Policy, this would trigger a requirement for offsets for impacts to Studley Park Gum on Commonwealth land. NELP proposes to contribute to the conservation of Studley Park Gum by establishing new habitat through the implementation of the Studley Park Gum Management Framework (PER Technical Appendix A – Flora and fauna, Appendix G). This approach is expected to result in a viable outcome noting that the creation of new habitat for a protected matter is a type of direct offset under the EPBC Act Environmental Offsets Policy. In addition to the above, at the State level native vegetation offsets would be provided based on the Victorian Guidelines (DELWP 2017a) to offset for the removal of native vegetation (which Studley Park Gum trees form part of) directly impacted by the project, and three Studley Park Gum trees expected to experience premature mortality due to long term groundwater drawdown. Implementing the Studley Park Gum Management Framework and State offsets is in line with the EPBC Act Environmental Offsets Policy and commensurate with the conservation status of the species.

Arching Flax-lily

The Arching Flax-lily is classified as vulnerable under the DELWP Advisory list. Two individuals were observed during field assessments at Simpson Barracks.

The residual impact of North East Link on this species is not considered significant.
The removal of two individuals would be unlikely to cause a long-term decline in a population, or threaten the viability of the species. The Arching Flax-lily individuals affected would be translocated to a suitable recipient site in accordance with the approved Matted Flax-lily Salvage and Translocation Plan to minimise impacts.

5.4.3 Introduce potentially invasive species

Without mitigation, construction could result in the spread of weeds, pathogens or pest species, but the introduction of new invasive species to or from Commonwealth land is considered unlikely. Given the history of urbanisation across the entire Melbourne area, weeds and non-native pest species (such as rats, foxes, rabbits, mynas) are already widespread and well-established throughout Melbourne, including Simpson Barracks.

5.4.4 Involve the use of chemicals which substantially stunt the growth of native vegetation

No chemicals that would substantially stunt the growth of native vegetation that would be retained are proposed to be used for North East Link.

5.4.5 Involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species

Controlled burning is not proposed for North East Link.

5.4.6 Proposed avoidance and mitigation measures

General

In consideration of the requirements for North East Link ie, traffic flow, TBM launching, safety, air quality, amenity and social requirements, within and beyond Commonwealth land), North East Link has adopted the smallest practicable area within Commonwealth land to avoid unnecessary loss of native vegetation. Refinement of the project boundary at the detailed design stage has the potential to minimise removal of native vegetation further.

Native vegetation

Based on the reference project design, there are no further opportunities to minimise the loss of 10.976 ha of native vegetation and 39 large trees within Simpson Barracks. An impact of this magnitude is likely to be regarded as significant, and consequently, offsets are required. During detailed design, the opportunity to minimise the impact would be further explored.

Where vegetation would be replaced by new road surface or infrastructure, the loss is permanent. Where vegetation would be lost to create space for construction (including for access, laydown, spoil storage, parking, offices), the loss would be shorter-term (two to eight years).

Given there is no formal mechanism for offsetting the removal of non-threatened native vegetation from Commonwealth land, based on advice from the Commonwealth, NELP has committed to meeting the assessment and offset requirements of the DELWP (2017a) *Guidelines for the removal destruction and lopping of native vegetation.*

A Native Vegetation Removal (NVR) report (dated 24 June 2019) has been completed that identifies general offset units and species offset units required for the vegetation removals. Enquiries have been made with DELWP-accredited offset brokers and NELP has received written assurance that sites are currently available on the market to offset the removal of 10.976 hectares of Plains Grassy Woodland and 39 large trees. While offsets are required for removal of flora, it would not reduce the local loss of these flora species. The proposed offset strategy for North East Link aligns with the principles of the EPBC Act Offsets Policy.

Where vegetation would be replaced by new road surface, the loss is permanent.
Where vegetation is lost to create space for the construction process (such as access, laydown, spoil storage, parking, offices), the loss would be shorter-term (two to eight years).

Studley Park Gum

Nine of the large Studley Park Gums at Simpson Barracks are modelled to be impacted due to groundwater drawdown during construction, three of which may also be impacted during operation). The project proposes to implement a Groundwater Dependent Ecosystem Monitoring and Mitigation Plan to monitor the health of those trees and implement mitigation measures (such as watering) throughout the construction phase of the project to maintain their health, thus avoiding and mitigating impacts. The proposed strategy which would form the basis of the plan with respect to the Studley Park Gum at Simpson Barracks is appended to PER Technical Appendix A – Flora and fauna technical report. It is anticipated that those trees experiencing groundwater drawdown during operation would be impacted permanently.

Construction Environmental Management Plan

To avoid inadvertent impacts to threatened or protected species of plants during construction, a Construction Environmental Management Plan (CEMP) and Tree Protection Plan (TPP) would be developed that clearly identifies measures to protect areas such as no-go zones and could include tree protection zones.

To avoid further loss of vegetation through soil compaction, clear access routes would be specified for all heavy vehicle traffic, as well as no-go zones for sensitive environmental areas. This would reduce the risk of soil compaction in sensitive environmental areas.

Best-practice hygiene measures during construction would help to reduce the potential for transmission of weeds, pathogens and pest animals into adjacent areas of native vegetation within the barracks. Management requirements for declared noxious weed species and known pathogens (such as Cinnamon Fungus, Amphibian Chytrid Fungus) would be incorporated into the CEMP during construction activities. A Spoil Management Plan (SMP) would be developed in conjunction with the CEMP to manage potentially contaminated construction spoil in a way to reduce the risk of spreading weeds and pathogens into or out of construction sites. To reduce the risk of exacerbating the impact of terrestrial pest animals, management measures would be implemented via a CEMP and appropriate management and minimisation of waste (including litter, which may attract pest animals) during construction and operation would be done in accordance with the *Environment Protection Act 1970*.

Tree Protection Plan

Tree Removal Plans would also be developed that clearly identify trees to be retained and those to be removed and the protocol for tree removal The Tree Protection plans would identify and establish Tree Protection Zones[1] (TPZs) to protect retained trees immediately outside the impact area from construction or related activities. Where TPZs would be encroached upon, it would clearly indicate where works can and cannot occur such that not more than 10 per cent of the TPZ would be impacted. In addition, where Structural Root Zones[2] (SRZs) are to be impacted, trees would be regarded as a loss.

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[1] TPZ: A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development. *TPZ = DBH × 12*. A TPZ should not be less than two metres nor greater than 15 metres (except where crown protection is required) (AS4970-2009).

[2] SRZ: The area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres. This zone considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which will usually be a much larger area. The SRZ is determined following the formula provided in AS 4970-2009 (Council of Australian Standards, 2009) where: $SRZ\ radius = (D \times 50)^{0.42} \times 0.64$, where D = trunk diameter, in m, measured above the root buttress.

Translocation

In the National Recovery Plan for Matted Flax-lily, translocation to bolster existing populations or establish new populations, is listed as one of eight specific objectives for the recovery of Matted Flax-lily. The EPBC Act Policy Statement Translocation of Listed Threatened Species (DSEWPAC 2013) notes that a key issue when considering translocation is the probability of long-term success.

Translocation of Matted Flax-lily has been successfully completed before for other major projects, with a success rate of around 80 to 90 per cent (over a period of five years) for salvage undertaken in 2004 from grasslands in Craigieburn and translocated into reserves in Craigieburn, Fawkner, Somerton and Whittlesea. In recent years, a number of large-scale Matted Flax-lily translocation projects have been approved and undertaken in the greater Melbourne area, including the Sugarloaf Pipeline Project (Yarra Glen), South Morang Rail Extension and the Level Crossing Removal Project (Mernda). The results of the Sugarloaf Pipeline Project translocation are further described in PER Technical Appendix A – Flora and fauna technical report, noting the outcomes for Matted Flax-lily were successful.

To minimise unavoidable residual impacts on the Matted Flax-lily, plants/patches within the project boundary are proposed to be salvaged and translocated to suitable alternative sites, some of which already support Matted Flax-lily, and some of which do not support the species but contain appropriate habitat. NELP is investigating potential recipient sites within the City of Whittlesea, City of Darebin and City of Banyule, as well as in the eastern section of Simpson Barracks. A draft Salvage and Translocation Plan has been developed, and is appended to PER Technical Appendix A – Flora and fauna technical report.

5.4.7 Residual impact – plants

Removal of approximately 11 hectares of Plains Grassy Woodland from Commonwealth land, including 39 large trees, is likely to be considered to be medium-scale vegetation removal, in the context of Simpson Barracks alone, which could constitute a significant impact on plants on Commonwealth land.

The removal of two listed threatened plant species (Matted Flax-lily *Dianella amoena* and Arching Flax-lily *Dianella longifolia* var. *grandis*) is not likely to result in a long-term decline in the population or threaten the viability, or reduce the occupancy of Matted Flax-lily or Arching Flax-lily in the context of impacts on Commonwealth land.

The project is expected to have a **significant residual impact** on Studley Park Gum *Eucalyputs X studleyensis* as an element of the environment on Commonwealth land (noting that Studley Park Gum is not listed under the EPBC Act). In accordance with the *EPBC Act Environmental Offsets Policy*, this would trigger a requirement for offsets for impacts to Studley Park Gum on Commonwealth land.

Under the *EPBC Act Environmental Offsets Policy*, offsets are defined as measures that compensate for the residual impacts of an action. Offsets can comprise a combination of direct offsets and other compensatory measures. An offset may include:

- Improving existing habitat for the protected matter
- Creating new habitat for the protected matter
- Reducing threats to the protected matter
- Averting the loss of a protected matter or its habitat that is under threat.

By its very nature, the known population of Studley Park Gum is small both in distribution and numbers of individuals, given it is a rare fertile hybrid of two commonly occurring species (the River Red Gum and Swamp Gum).

Because of its inherently small population, determining a direct offset that improves and secures an existing population which accounts for at least 90 per cent of the offset requirements is not possible. There is also a lack of existing known habitat. According to the offsets policy, deviation from the 90 per cent direct offset requirement is able to be considered where scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter.

Studley Park Gum itself is not a protected matter however the environment on Commonwealth land is a protected matter. Therefore, instead of delivering direct offsets that secures and manages an existing population or habitat for the Studley Park Gum, NELP proposes to contribute to the conservation of Studley Park Gum by establishing new habitat through the implementation of the Studley Park Gum Management Framework (the Framework) (see Appendix G in PER Techncial Appendix A – Flora and fauna). This approach is expected to result in a viable outcome noting that the creation of new habitat for a protected matter is a type of direct offset under the *EPBC Act Environmental Offsets Policy*.

The Framework has been developed as the proposed offset measure for the impacts to Studley Park Gum on Commonwealth land. The Framework commits to the following measures:

- Developing and implementing a 'seed collection and propagation plan', which provides detailed methods for the collection, storage and propagation of Studley Park Gum seeds
- Identifying a recipient site with appropriate conditions to enable establishment of a self-sustaining Studley Park Gum population
- Planting 288 Studley Park Gum saplings at the recipient site to achieve the establishment goal of a minimum of 98 Studley Park Gum plants after three years
- Developing and implementing a management plan for the recipient site, which includes detailed site-specific actions.

It is acknowledged that this approach has not previously been proposed for the taxon. Given this, uncertainties exist around the potential success (risk of failure) of the Framework. These uncertainties have been considered in the development of the Framework and the responses documented below:

- There is the potential that an insufficient volume of Studley Park Gum seed is collected.

  In response the Seed Collection and Propagation Plan (see the Framework for more detail) identifies five 'collections' of Studley Park Gum seed. At each collection numerous individual trees would be targeted and fruit and seed taken (two collections have been completed as at August 2019).
- There is the potential that the collected seed is not viable.

  The Royal Botanic Gardens of Victoria have been engaged to store and test seed viability through germination testing.
- The potential that saplings display morphological characteristics more closely aligned with one parent species.

  As part of the propagation process the horticulturalist would observe the morphology being expressed by the seedlings. Those plants that are clearly showing a strong tendency to the morphological characteristics of either River Red Gum or Swamp Gum would be excluded from the numbers of trees considered to be Studley Park Gum.

- Failure to reach the 2:1 target.

  The Framework has been conservative and assumes annual death of up to 30 per cent (year on year) of planted Studley Park Gums over the three years of the Framework. In reality, with appropriate planting, maintenance and management it is reasonable to assume that mortality would not be so high and that overall at least 50 per cent (144) of planted Studley Park Gums survive past three years.

- Contingency planning.

  There is still the potential that the Framework fails to meet its goal of the establishment of 98 Studley Park Gums displaying strong morphological affinities with other Studley Park Gums at Simpson Barracks. The Framework documents evaluation and contingency measures to be implemented if the Framework looks likely to fail.

It is proposed that once a recipient site(s) is selected, a more detailed Studley Park Gum Management Plan would be prepared and approved by DELWP.

In addition to the above, at the State level native vegetation offsets would be provided based on the Victorian Guidelines (DELWP 2017a) to offset for the removal of native vegetation (which Studley Park Gum trees form part of) directly impacted by the project, and three Studley Park Gum trees expected to experience premature mortality due to long term groundwater drawdown.

Implementing the Studley Park Gum Management Framework and State offsets is in line with the *EPBC Act Environmental Offsets Policy* and commensurate with the conservation status of the species.

The action is unlikely introduce a potentially invasive species to or from Commonwealth land. No chemicals that would substantially stunt the growth of native vegetation are proposed to be used. No controlled burning is proposed.

5.5 Relevant impacts and mitigation measures – animals (terrestrial)

5.5.1 Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals

PER Technical Appendix A – Flora and fauna technical report details the fauna present or likely to be present on Commonwealth land. The habitats within Simpson Barracks have moderate value for fauna, and contain non-threatened fauna which is bold, common and adaptable. Occasionally or rarely, these habitats may attract threatened fauna such as Powerful Owl (*N. strenua*), Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*); although this is likely to be for foraging only, and such species are not expected to breed or roost there frequently or regularly.

The woodland and grassland habitats within Simpson Barracks support a small population of Eastern Grey Kangaroos (*Macropus giganteus*). Approximately 52 hectare of the barracks provides suitable habitat for Eastern Grey Kangaroos. The carrying capacity at the site is unknown, and whether or not the site (which is securely fenced) is ‘closed’ to Eastern Grey Kangaroo migration is uncertain.

North East Link construction within Commonwealth land would include removal of vegetation that provides habitat for animals, which may result in the injuring or killing of animals.

Animals most at risk are those that reside in the habitats to be removed and that have limited mobility (such as frogs, small reptiles, possums, flightless invertebrates), and/or dependent or immobile young (such as young animals in a nest or den). Also at risk are animals that may stray into the construction area during a quiet time (such as overnight). Animals straying into a noisy active construction site during the day is considered unlikely.

Simpson Barracks is in the north-eastern suburbs of Melbourne, where animals most likely to be encountered in a construction site are common and even abundant species. Death or injury of some animals may occur during vegetation clearance, but is expected to involve small numbers of common animals only, and is most likely to affect individuals rather than populations or species. While killing an individual animal would be permanent, the population of a common species is unlikely to have any more than a negligible impact.

For North East Link, uncommon or threatened species on Commonwealth land may be present, but is expected to be rare. Death, injury or other harm to those threatened animals (which would be expected to have a longer-lasting and more significant flora and fauna impact) due to North East Link is expected to be extremely rare and highly unlikely.

The operation of North East Link would be unlikely to change existing levels of death, injury or harm to animals on or around Commonwealth land. Collision between animals and vehicles (roadkill) is the most likely operational-phase threat to animals, and that threat is not expected to increase because of the action. The Commonwealth land is already fenced (thereby preventing larger non-flying animals from leaving the Commonwealth land) and surrounded by roads and urbanised areas. That would not change.

Death, injury or other harm of common species impacted on Commonwealth land as a result of North East Link is not expected to cause a long-term decrease in, or threaten the viability of, a native animal population or populations. This includes the small population of Eastern Grey Kangaroo – individuals are not expected to be killed or harmed, and recent counts and density estimates suggest the population size would increase rather than decrease.

5.5.2 Displace or substantially limit the movement or dispersal of native animal populations

Construction impacts that could displace or substantially limit the movement or dispersal of native animal populations include:

- Removal and degradation of vegetation and habitat
- Disturbance of fauna through noise, vibration or lighting
- Fragmentation of terrestrial wildlife corridors creating barriers to terrestrial fauna movement.

The construction process would involve a range of demolition and construction work, potentially day and night. Construction activities have the potential to disturb and displace animals locally. The potential severity and ecological consequence of disturbance varies with species and location.

Because the western section of Simpson Barracks is already adjacent to an extremely busy, four-lane road the action is not expected to exacerbate existing levels of disturbance or displacement of animals. Disturbance and displacement of some animals on Commonwealth land would be unavoidable, but is expected to be minor. Disturbance would most likely affect individuals rather than entire populations or species, and is not expected to have a long-lasting effect on any population of animals that live in or visit Commonwealth land. Animals in this area already cope with an urban environment that is disturbed. It is therefore likely the fauna that still occur within the area, or visit the area, have coping mechanisms for persisting in urbanised environments.

Some animals (such as the Eastern Grey Kangaroo at Simpson Barracks) may move away from construction sites (and from busy roadways during the operational phase) during noisy periods, to better hear their surroundings (for potential predators). The extent of displacement is likely to vary, depending on the prevailing noise levels. At times of less noise, animals would be expected to re-enter the disturbed area and use it as normal habitat. Animals can become habituated to predictable disturbances (such as birds that use airfields as habitat).

Loss of habitat reduces foraging, nesting and dispersal opportunities for animals in the local area, and confines animals to the extent of suitable habitat that remains. Small proportional losses are less detrimental than large proportional losses. Animals that are unable to seek and obtain resources from alternative sources (closed population) are more disadvantaged by habitat loss than those that can freely move to and use other areas (open population).

Loss of habitat affects species differently. Some species are mobile and adaptable (such as the Red Wattlebird), and are able to use remaining habitats or even a degraded form of the same habitat. Others are more sensitive to habitat extent and condition, and may decline or disappear as habitat patches get too small or too degraded (such as the Eastern Yellow Robin).

As a military facility, Simpson Barracks is fenced all around, and the fence for the most part is substantial enough to prevent free movement of large fauna (such as the Eastern Grey Kangaroos). This effectively makes Simpson Barracks a closed site for some animal populations already. Other animal species that use Simpson Barracks (such as possums, birds) are not as constrained as the kangaroos in this way, because they are able to move more freely into and out of Simpson Barracks. The action would not change the ability of native animals to move into or out of the Commonwealth land.

North East Link is unlikely to displace or substantially limit the movement or dispersal of native animal populations on Commonwealth land that has any ecological consequence.

5.5.3 Substantially reduce or fragment available habitat for native species

Construction impacts that could reduce or fragment available habitat for native species include:

- Removal and degradation of vegetation and habitat
- Fragmentation of terrestrial wildlife corridors creating barriers to terrestrial fauna movement.

Loss of habitat reduces foraging, nesting and dispersal opportunities for fauna in the local area, and confines fauna to the extent of suitable habitat that remains. Loss of habitat affects species differently. Some species are mobile and adaptable (such as the Red Wattlebird), and are able to use remaining habitats or even a degraded form of the same habitat. Others are more sensitive to habitat extent and condition, and may decline or disappear as habitat patches get too small or too degraded (such as the Hooded Robin).

All habitats within and surrounding Simpson Barracks support non-threatened terrestrial animals, and clearing vegetation from that land would impact on those species. Most of the non-threatened native animals that persist in Simpson Barracks and in the Melbourne area generally (such as the Red Wattlebird, Rainbow Lorikeet, Noisy Miner, Crested Pigeon, Common Brushtail Possum, Common Ringtail Possum) are mobile and/or adaptable, and are persisting within a fragmented and degraded habitat landscape. These species are able to use remaining habitats or even a degraded form of the same habitat.

The action would be constructed in an already fragmented urban landscape. Species that use habitat patches as movement corridors in the project boundary tend to be highly mobile species already coping with a fragmented and degraded habitat landscape.

For the most part, habitat loss in Commonwealth land as a result of this action would be unlikely to result in significant flora and fauna impacts on fauna populations that use that habitat. Mobile fauna that use the patches are able to move into and also use adjacent patches. One species warrants more detailed discussion: the Eastern Grey Kangaroo.

Simpson Barracks contains a relatively large area of remnant eucalypt woodland in an otherwise urbanised part of Melbourne. This habitat is not accessible to the public and only used occasionally for defence activities. Simpson Barracks supports a healthy population of the Eastern Grey Kangaroo. As a defence facility, the site is fenced all around, and the fence for the most part is substantial enough to be kangaroo proof. This effectively makes the kangaroo population at the barracks a closed population, where space and resources are critical to the population's viability. Other animals that use Simpson Barracks (such as possums, birds) are not as constrained as the kangaroos in this way, because they are able to move more freely into and out of the barracks.

The kangaroo population at Simpson Barracks has been assessed numerous times in recent years (AECOM, 2015). AECOM (AECOM, 2015) reported that approximately 52 hectare of the barracks is grassy woodland vegetation that provides suitable habitat for kangaroos. In addition to the woodland areas, Simpson Barracks contains numerous areas around buildings where the grass is mowed, two large grassed sports fields and one large grassed parade ground (Long Green) that is watered during the summer (Wilson Environmental, 2014).

This action would permanently remove eight hectare of woodland habitat from Simpson Barracks. If this equates to loss of eight of the 52 hectares, then this would increase the kangaroo density estimates by 15.4 per cent. Grazing habitat would be lost as a result of the action, but given the presence of well-watered grassy areas (outside the project boundary), the habitat lost may not be the vital habitat that sustains the population within the barracks. Wilson Environmental, (Wilson Environmental, 2014) reported that 80 per cent of kangaroo observations were on the Long Green.

The carrying capacity for Eastern Grey Kangaroo at the site is unknown, and whether or not the site is truly 'closed' to Eastern Grey Kangaroo migration is uncertain (AECOM, 2015). However, with its reliable water sources and copious and well-watered lawns, the carrying capacity of Simpson Barracks for Eastern Grey Kangaroo is likely to be much higher than the current population size. While North East Link would remove free access for kangaroos to Banyule Creek, this is not expected to affect the Eastern Grey Kangaroo population. Other water sources are available (as noted above), and being adapted to dry conditions they would only need another water source when conditions are extremely dry. As Banyule Creek is ephemeral within Simpson Barracks, it would not assist the Eastern Grey Kangaroo during these dry conditions.

Additionally, the density of Eastern Grey Kangaroo at Simpson Barracks is likely to be far lower than density estimates for other kangaroo populations. For example, of five counts of Eastern Grey Kangaroos in the ACT between 1995 to 1997, the lowest density reported was 2.33 kangaroos/ha (reported as 233 per square kilometre; for Tidbinbilla Nature Reserve, ACT (ACT Parks & Conservation Service, 1997)). The proposed habitat loss is expected to be ecologically inconsequential for the Eastern Grey Kangaroo population, and would be highly unlikely to jeopardise the viability of the current Eastern Grey Kangaroo population at Simpson Barracks.

Density estimates for Simpson Barracks assume the barracks provide the only habitat available to the Eastern Grey Kangaroo population, and the population is a closed population. However, there are anecdotal reports of Eastern Grey Kangaroo occasionally being killed by vehicles on nearby roads. These may be Eastern Grey Kangaroo from surrounding suburban areas, or they may be Eastern Grey Kangaroo that sometimes get through the fence, which would suggest the population is not entirely enclosed. If it occurs, the most likely direction for immigration and emigration of Eastern Grey Kangaroo is to the east, as there is a seemingly safe route that offers continuous suitable habitat and few road crossings between Simpson Barracks and the Plenty River at Yallambie.

The action would affect the upper reaches of Banyule Creek, within Simpson Barracks and south to Lower Plenty Road. This upper section of Banyule Creek offers a very small fauna movement corridor between Simpson Barracks and the Yarra River floodplain. Through this section, the habitat corridor is narrow, degraded, and likely to be used mainly by common and adaptable mobile fauna for local movements only, rather than landscape-scale movements. This wildlife corridor is highly compromised in its current form in this local area – due to the absence of mid-storey and under-storey vegetation along the section of Banyule Creek north of Lower Plenty Road, the major barrier to ground-based fauna created by Lower Plenty Road itself, and the busy and urbanised landscape that surrounds Banyule Creek. The action is not expected to cause further loss of ecological function from corridor habitats along Banyule Creek.

The removal of native vegetation, the action would reduce available habitat for native species on Commonwealth land, but this reduction is not considered substantial and would not be to the extent that it has ecological consequences.

Loss of habitat from Commonwealth land for North East Link is not expected to cause further fragmentation of available habitat for native species.

5.5.4 Reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species

Construction impacts that could reduce or fragment available habitat listed threatened species are as for those listed in Section 5.5.3.

Loss of habitat reduces foraging, nesting and dispersal opportunities for fauna in the local area, and confines fauna to the extent of suitable habitat that remains, often increasing con-specific and inter-specific competition. Loss of too much habitat, relative to the original contiguous habitat patch, can threaten the viability of some populations that currently rely on the extent of habitat present. Small proportional losses are less detrimental than large proportional losses. Animals unable to seek and obtain resources from alternative sources (closed population) are more disadvantaged by habitat loss than those that can freely move to and use other areas (open population).

Because Simpson Barracks currently contains relatively large areas of remnant woodland in an urbanised landscape, it is likely to attract and support a range of fauna. However, because it is surrounded by urbanisation and has been considerably disturbed historically, it is generally degraded and consequently unlikely to support the full range of threatened and non-threatened fauna that would have occurred there historically.

Occasionally or rarely, habitats within Simpson Barracks are known to attract threatened fauna such as the Powerful Owl (*Ninox strenua)*, Swift Parrot (*Lathamus discolor)* and Grey-headed Flying-fox (*Pteropus poliocephalus)*; although this is likely to be for foraging only, and these species are not expected to frequently or regularly breed or roost there.

The Grey-headed Flying-fox is likely to use habitats within Simpson Barracks relatively frequently – it was seen there during surveys conducted for North East Link, and it is well known in the entire Melbourne area as a common visitor to flowering trees, in parks, gardens and reserves.

The Powerful Owls in this part of Melbourne appear to spend most of their time within Yarra River floodplain habitats (particularly Banyule Flats). However, Deakin University research results showed that at least one of the Banyule Flats Powerful Owls ventured as far as Simpson Barracks on one occasion. Because the Deakin University tracking data only covered 34 nights of activity, it remains possible or even likely that owls also use other parts of Simpson Barracks (outside the project boundary).

For Swift Parrots, there is one older (1992) VBA record of five birds in the eastern section of Simpson Barracks. A site assessment at the barracks determined that the western margin (within the project boundary) largely consists of non-favoured eucalypt species (mainly River Red-gum (*Eucalyptus camaldulensis*), dominated by aggressive nectar feeders such as Noisy Miners, Red Wattlebirds and Rainbow Lorikeets which are reported to disturb or out-compete Swift Parrots. The woodland on the eastern side of Simpson Barracks, which is not being impacted by the action, supports superior habitat that is dominated more by Yellow Box (*E. melliodora)*, a favoured eucalypt species for Swift Parrot foraging.

The White-throated Needletail has been recorded at Simpson Barracks historically. Needletails may forage occasionally in the airspace above Simpson Barracks, but because this species is reported to be almost exclusively aerial within Australia, they are unlikely to have a substantial association with the terrestrial habitats.

Species that are unusual or rare in the Melbourne area, such as the Grey Goshawk (*Accipiter novaehollandiae)*, Black Falcon (*Falco subniger)* and Barking Owl (*Ninox connivens)* may visit Simpson Barracks occasionally, but are unlikely to be there regularly, or to depend on habitat within the site.

Loss of habitat from Commonwealth land for North East Link is not expected to reduce or fragment available habitat for a listed threatened species to the extent that it displaces a population, results in a long-term decline in a population, or threatens the viability of the threatened species.

5.5.5 Introduce exotic species which will substantially reduce habitat or resources for native species

Without mitigation, construction could result in the spread of weeds, pathogens or pest species. However, this would unlikely result in the decline of habitat or resources for native species.

Weeds and non-native pest species (such as rats, foxes, rabbits, mynas) are already widespread and well-established throughout Melbourne, including at Simpson Barracks. One native species of bird (Noisy Miner (*Manorina melanocephala*)) is implicated in ecological deterioration, and is integral to a Key Threatening Process under the EPBC Act. This species is already common and well-established at Simpson Barracks.

Pathogens include Cinnamon Fungus and Amphibian Chytrid Fungus, which can have devastating impacts if introduced to novel areas. Neither pathogen is expected to increase in prevalence or impact due to North East Link. Transmission pathways for those pathogens are already numerous across the urbanised landscape of Melbourne, and the action would not increase the potential for transmission. Best-practice hygiene measures during construction would help to reduce the potential for transmission of pathogens.

North East Link would unlikely introduce exotic species that substantially reduce habitat or resources for native species.

5.5.6 Undertake large-scale controlled burning or any controlled burning in areas containing listed threatened species

Controlled burning is not proposed as part of the action.

5.5.7 Proposed avoidance and mitigation measures

In consideration of the requirements of North East Link (traffic flow, TBM launching, safety, air quality, amenity and social requirements, within and beyond Commonwealth land), the smallest practicable impact on Commonwealth land has been adopted for North East Link to avoid unnecessary loss of habitat. Refinement of North East Link in the detailed design stage has the potential to further minimise removal of native vegetation and animal habitat.

Loss of some animal habitat would be unavoidable. Measures to avoid harming fauna during construction and to manage any injured fauna would be specified in environmental management plans, including a Construction Environmental Management Plan (CEMP), Worksite Environmental Management Plans (WEMPs), and an Operations Environmental Management Plan (OEMP). Environmental management plans would be prepared and implemented in consultation with relevant councils, VicRoads, Melbourne Water, EPA Victoria and other authorities as required by NELP or under any statutory approvals. Prescribed fauna management measures, in compliance with Victoria’s *Wildlife Act 1975*, would enable appropriate management of fauna that may be displaced due to habitat removal.

To minimise impacts on animals during removal of vegetation, appropriate controls would be implemented before vegetation clearance.

Before removing vegetation, pre-clearance surveys would be undertaken to confirm the on-site location of fauna immediately before tree removal or, where relevant, works on waterways, and to assist fauna to safety as necessary. The CEMP could include requirements to relocate animals to appropriate locations outside the construction area.

The CEMP would include contingency and reporting procedures for the event that a listed threatened species is identified. If threatened fauna are found within the area proposed for vegetation removal and are at risk of harm, the CEMP could require clearing works in the vicinity to be stopped until an appropriate solution could be achieved to remove that animal from harm’s way.

Fauna that stray into or are found within an active construction site would be managed by a suitably qualified site environmental officer via the CEMP. Measures to avoid harming fauna, and to deal with any injured fauna would be specified in the CEMP.

Existing fencing around Simpson Barracks would be maintained (or relocated if removed for construction activities) as required, to keep Simpson Barracks secure and to keep larger fauna (such as Eastern Grey Kangaroo, Swamp Wallaby, Common Wombat) from straying onto nearby roads. The design and scale of the adjacent roadways would discourage most fauna from using or crossing the roads to reduce the incidence of them colliding with vehicles. However, birds would still be able to access and cross the roads with ease. Fauna-attracting habitat would not be reinstated in median strips of the roads so animals would not be encouraged to cross roadways to access that habitat.

To minimise disturbance on animals during construction, lighting would be designed to minimise impacts. For example, lights could be directed downwards rather than outwards as far as practicable, and screens could be used between construction sites and adjacent animal habitat. Measures to reduce lighting disturbance would be specified in the CEMP.

Best-practice hygiene measures during construction would help reduce the potential for transmission of weeds, pathogens and pest animals. Management requirements for declared noxious weed species and known pathogens (such as Cinnamon Fungus, Amphibian Chytrid Fungus) would be incorporated into the CEMP during construction activities. A Spoil Management Plan (SMP) would be developed in conjunction with the CEMP to manage potentially contaminated construction spoil to reduce the risk of spreading weeds and pathogens into or out of construction sites. To reduce the risk of exacerbating the impact of terrestrial pest animals, management measures would be implemented via a CEMP and appropriate management and minimisation of waste (including litter, which may attract pest animals) during construction. Operation would be in accordance with Victoria's *Environment Protection Act 1970*.

5.5.8 Residual impact – terrestrial animals

The action is expected to have only a minor impact on terrestrial animals on Commonwealth land. Animals that visit or reside at Simpson Barracks already tolerate various disturbances and dangers that are associated with the large city that surrounds the area. The action would not add any significant disturbance or threat to those animals not already present.

Habitat loss from Commonwealth land proposed for North East Link is expected to result in the loss or displacement of individuals of mostly common or abundant species, rather than entire populations or species, and rather than threatened species. The action is not expected to influence the long-term persistence or viability of any native terrestrial animal species.

5.6 Relevant impacts and mitigation measures – animals (aquatic)

5.6.1 Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals

Construction impacts that could cause a long-term decrease in or threaten the viability of a native aquatic animal population or populations through death, injury or other harm to individuals, include:

- Degradation of aquatic habitat through sedimentation or contamination
- Degradation of aquatic habitat through waterway modification or construction activities in and around waterways.

Banyule Creek is the only waterway that would be impacted by construction activities on Commonwealth land. Banyule Creek has intermittent flow, and only provides habitat for aquatic animals during periods of flow (during or following rain). Construction activities during a dry period would not cause the death, injury or other harm of aquatic animals in Banyule Creek at Simpson Barracks.

There is a handful of small manmade waterbodies within Simpson Barracks that provide permanent aquatic habitat. These waterbodies result from historical manmade modifications to the headwaters of Banyule Creek within Simpson Barracks. These waterbodies do not support fish, and support only a subset of aquatic macroinvertebrates that could be found in Melbourne's waterways. Invertebrates present are common species that tolerate degraded aquatic habitats. Removal of those waterbodies would result in the death of common aquatic macroinvertebrates, but death of aquatic vertebrate animals (fish) would not occur.

The death, injury or other harm to aquatic animals within Commonwealth land as a result of the action would not cause a long-term decrease in, or threaten the viability of, a native aquatic animal population or populations.

Downstream of Simpson Barracks, Banyule Creek is a poor quality aquatic ecosystem, with degraded aquatic macroinvertebrate communities. Fish surveys revealed the native Common Galaxias (*Galaxias maculatus*) was present in the downstream reaches near Banyule Road (approximately 1.7 kilometres downstream), in reaches that have baseflows which are maintained by groundwater inputs of water. However, the fish community of Banyule Creek was dominated by the exotic Oriental Weatherloach (*Misgurnus anguillicaudatus*) which was found in all reaches on Banyule Creek containing water. Banyule Creek showed evidence of scouring and bank erosion, likely caused by high flows from existing urban stormwater.

With appropriate management of construction activities in and near Banyule Creek within Commonwealth land, this action would not cause the death, injury or other harm to aquatic animals that leads to a long-term decrease in, or threatens the viability of, a native aquatic animal population or populations downstream of Commonwealth land.

5.6.2 Displace or substantially limit the movement or dispersal of native animal populations

Construction impacts that could displace or substantially limit the movement or dispersal of native aquatic animal populations include:

- Degradation of aquatic habitat through sedimentation or contamination
- Degradation of aquatic habitat through waterway modification or construction activities in and around waterways.

Construction Banyule Creek is the only waterway that would be impacted by construction activities on Commonwealth land. Within Simpson Barracks, Banyule Creek has intermittent flow, and only provides habitat for aquatic animals during periods of flow (during or following rain). It is the very headwaters of the waterway, and when flowing, does not provide a link to further aquatic habitat upstream.

Construction within Commonwealth land would not displace or substantially limit the movement or dispersal of native aquatic animal populations.

5.6.3 Substantially reduce or fragment available habitat for native species

Construction impacts that could substantially reduce or fragment available habitat for native aquatic species include:

- Degradation of aquatic habitat through sedimentation or contamination
- Degradation of aquatic habitat through waterway modification or construction activities in and around waterways.

Aquatic habitats may be reduced or fragmented in either of two ways: 1) sections may be removed entirely or 2) they may be degraded to the point they no longer provide suitable habitat for aquatic animals.

Banyule Creek is the only waterway that would be impacted by construction activities on Commonwealth land. The upper section of Banyule Creek would be considerably modified by the action – approximately 1,400 metres of channel extending within Simpson Barracks and downstream to Lower Plenty Road would be replaced by two pipes. Converting sections of a waterway to enclosed pipes would directly remove structural habitat for aquatic animals.

Banyule Creek has intermittent flow, and only provides habitat for aquatic animals during periods of flow (during or following rain). There is a handful of small constructed waterbodies within Simpson Barracks that provide permanent aquatic habitat, which result from historical catchment drainage modifications to the headwaters of Banyule Creek within the Barracks. The aquatic habitat that North East Link would directly impact supports only a subset of aquatic animals that could be found in Melbourne's waterways. Aquatic animals present are limited to common and opportunistic invertebrate species that are adapted to a highly modified urban environment, that can disperse to any available aquatic habitats and tolerate degraded aquatic habitats. No native fish or threatened aquatic species inhabit Banyule Creek within Simpson Barracks.

Removal of those waterbodies would reduce available habitat for aquatic native species on a very local scale, but would not have ecological consequences for broader populations of any of the native species.

The section of Banyule Creek on Commonwealth land to be piped are the headwaters of the waterway, and so there is no upstream habitat this section provides a link to. While enclosing the waterway would have a severe impact on that section of the waterway, the impacted sections of the creek are the small ephemeral waterway at the very top of the stream. This would not affect waterway connectivity to habitat for native aquatic species that inhabit Banyule Creek downstream of the barrier at Lower Plenty Road.

The headwaters of Banyule Creek are ephemeral and support temporary aquatic ecosystems able to tolerate drying phase or colonise during wetted periods. The loss of natural waterway in this reach of Banyule Creek has a very low risk of substantially reducing or fragmenting available habitat for native aquatic species.

5.6.4 Reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species

Construction impacts that could reduce or fragment available habitat for listed threatened aquatic species include:

- Degradation of aquatic habitat through sedimentation or contamination
- Degradation of aquatic habitat through waterway modification or construction activities in and around waterways.

The Yarra River is the only waterway within the project boundary likely to support threatened aquatic animals (fish). Banyule Creek, within and downstream of Simpson Barracks, does not support threatened aquatic animal species.

The headwaters of Banyule Creek are ecologically fragmented from downstream reaches by several major road crossings, which prevent the ability for upstream colonisation by aquatic fauna, including threatened species. However, this may be a positive attribute, as the pest exotic fish, Oriental Weatherloach may also be prevented from invading and degrading aquatic ecosystems from downstream reaches.

The action is not likely to reduce or fragment available habitat for listed threatened species which displaces a population, results in a long-term decline in a population, or threatens the viability of an aquatic animal species.

5.6.5 Introduce exotic species which will substantially reduce habitat or resources for native species

There are two mechanisms by which exotic species could reduce habitat or resources for native aquatic animals: 1) exotic aquatic plants could reduce habitat or resources for native aquatic animals; and 2) exotic aquatic animals could reduce habitat or resources for native aquatic animals.

Banyule Creek is the only waterway that would be impacted by construction activities on Commonwealth land. Banyule Creek has intermittent flow, and only provides habitat for aquatic animals or plants during periods of flow (during or following rain). There is a handful of small manmade waterbodies within Simpson Barracks that provide permanent aquatic habitat, and that support aquatic plants and common macroinvertebrates.

Banyule Creek is within an urbanised landscape and is directly connected to an urbanised stormwater network and runoff drainage, so is degraded to some degree already. Consequently, Banyule Creek supports aquatic fauna that have some tolerance for degraded, polluted and contaminated aquatic habitats, including exotic species that have established themselves in Melbourne's waterways. Surveys revealed the fish community of Banyule Creek (downstream of Simpson Barracks) was dominated by the exotic Oriental Weatherloach (*Misgurnus anguillicaudatus*) which was found in all reaches on Banyule Creek containing water.

Given the study area is already highly urbanised, and that Banyule Creek is already dominated by exotic aquatic species, North East Link is not expected to introduce an exotic species which would substantially reduce habitat or resources for native aquatic animals.

While not technically a species, Epizootic Haematopoietic Necrosis Virus (EHNV) is an Australian virus that has the potential to negatively impact several native fish species. Spread or introduction of this virus to Banyule Creek as a result of the action is considered highly unlikely.

5.6.6 Undertake large-scale controlled burning or any controlled burning in areas containing listed threatened species

Controlled burning is not proposed as part of the action.

5.6.7 Proposed avoidance and mitigation measures

In consideration of requirements for North East Link (traffic flow, TBM launching, safety, air quality, amenity and social requirements, within and beyond Commonwealth land), the smallest practicable impact on Commonwealth land has been adopted for North East Link to avoid unnecessary loss of habitat, terrestrial and aquatic. However, loss of some aquatic habitat along Banyule Creek would be unavoidable. The modification of Banyule Creek within Simpson Barracks and downstream to Lower Plenty Road by replacement with two pipes would effectively remove this reach of ephemeral aquatic habitat. Mitigation measures for aquatic habitat protection described in this section relate to aquatic habitat protection measures implemented on Commonwealth land. These are not expected to restore the loss of aquatic habitat due to channel modification, but are more intended to protect aquatic ecosystems downstream in Banyule Creek from impacts on Commonwealth land.

The most important method for preventing aquatic habitat degradation is through the design of North East Link to minimise the impacts from discharges and runoff, and to manage construction to protect aquatic habitat. Before construction started, discharges, runoff pathways and stockpiles would be designed to reduce the risk of contaminated flows, sediment, and discharges entering waterways and surrounding areas of vegetation. Modifications to all waterways would be designed and undertaken to mitigate the impacts of changes to flow, and minimise the potential for erosion, sediment plumes and exposure of contaminated material during construction.

Surface water facilities would be designed to manage discharge and run-off from North East Link to meet legislated standards for environmental protection. A Surface Water Management Plan would also be developed and implemented, setting out the requirements and methods for best-practice erosion protection, sediment and erosion control and monitoring, in accordance with EPA Victoria requirements.

The impacts of the action on fish passage can be minimised by reducing design impacts on aquatic habitats, including appropriate flow and water velocities. For the piped waterway sections, this might include management of surface water from North East Link to minimise scouring, and inclusion of measures to avoid the creation of new barriers downstream.

Modelling of flow velocity should be undertaken. Where drainage inputs to the natural waterway would likely result in ecologically significant changes to the magnitude or duration of peak flows, waterway channel modifications could be used to ameliorate the hydrological impacts. This may include bank stabilisation works at drainage outfalls, channel and/or floodplain storage capacity and engagement modifications to minimise the impacts of high flows on aquatic habitat, and provision of refuges for aquatic fauna.

The use of water sensitive urban design (WSUD) features would help mitigate this impact by capturing the additional run-off from the new road/ramp surfaces before it reached natural aquatic habitats. WSUD features would be required to manage the pollutant load from North East Link's new road/ramp surfaces to prevent transport of pollutants to waterways or natural wetlands.

To further reduce the risk of sedimentation, contamination and erosion, a Construction Environmental Management Plan (CEMP) would be prepared and require best-practice erosion protection, sedimentation and discharge controls, and management of chemicals, fuels and hazardous materials to be in place to reduce the risk of flora and fauna impacts to negligible.

Appropriate management of chemicals, fuels and hazardous materials would enable minimisation of chemical and fuel storage on-site and storage of hazardous materials and dangerous goods in accordance with the relevant guidelines and requirements. This would include development and implementation of management measures for dangerous substances – including appropriate disposing of hazardous materials, installation of bunds and precautions to reduce the risk of spills – and developing contingency and emergency response plans to handle fuel and chemical spills.

In the case of an accidental spill, a best-practice spill contamination procedure would be detailed in the CEMP and spill kits would be present on all construction sites.

Waste management measures would be implemented including waste minimisation during construction and operation in accordance with Victoria's *Environment Protection Act 1970*. Waste excludes soils, but includes litter management, construction and demolition wastes, washing residues, slurries and contaminated water, organic wastes and inert solid wastes.

Water quality monitoring would include a baseline surface water monitoring program developed and implemented before construction started to assess background water quality in all receiving waters. The monitoring and management of surface water quality and flow should include consideration of changed risks due to changes in rainfall and riverflow during wet periods with greater rainfall runoff.

The monitoring of water levels would also be done in areas of vegetation and wetlands potentially impacted by groundwater changes (Banyule Flats and Banyule Swamp). Monitoring should include changes to hydrology and habitat types suitable for threatened species (such as snipe, bitterns, owls, ducks, egrets) that use those habitats. A mitigation plan for any impacts to groundwater dependent ecosystems (GDEs) detected in the monitoring is also required.

Best-practice hygiene measures during construction would help reduce the potential for transmission of weeds, pathogens and pest animals. Management requirements for declared noxious weed species and known pathogens (such as Cinnamon Fungus, Amphibian Chytrid

Fungus) during construction activities would be incorporated into the CEMP. A Spoil Management Plan (SMP) would be developed in conjunction with the CEMP to manage potentially contaminated construction spoil to reduce the risk of spread weeds and pathogens into or out of construction sites. To reduce the risk of exacerbating the impact of terrestrial pest animals, management measures would be implemented via a CEMP and appropriate management and minimisation of waste (including litter, which may attract pest animals) during construction and operation would be done in accordance with Victoria's *Environment Protection Act 1970*.

5.6.8 Residual impact – aquatic animals

Banyule Creek within Simpson Barracks is an ephemeral stream, which flows intermittently after rainfall, but is dry for the majority of the time. There are no in-stream permanent pools, and from field assessment of the stream during low rainfall periods, no indication of groundwater-supplemented baseflow in these headwaters. The headwaters of Banyule Creek have been modified and include several catch drains and constructed artificial wetlands within Simpson Barracks that are not directly connected to the Banyule Creek. The headwaters of Banyule Creek are ecologically fragmented from downstream reaches by several major road crossings, which prevent the ability for upstream colonisation by aquatic fauna.

North East Link would permanently modify the natural headwater channel of Banyule Creek, and replace this ephemeral stream with a constructed drainage channel. This would entirely remove the aquatic ecosystem of the creek. Due to the ephemeral nature of this reach of Banyule Creek, its lack of connectivity and poor condition of the aquatic ecosystem, there would be little loss in the aquatic ecosystem. The impacts of this modification to Banyule Creek could change the hydrology of the creek, with greater runoff from larger areas of impervious surfaces. Changes to hydrology of the creek could impact Banyule Creek downstream of Simpson Barracks, including scouring and erosion of aquatic habitat. Appropriate water sensitive urban design (WSUD) applied to this modification to the natural drainage would mitigate this impact.

With adequate management of materials and controls of discharges, spills and runoff from the action, the residual impact of the action on aquatic animals in and around Commonwealth land is expected to be minor and non-significant.

6. Arboriculture

6.1 Introduction

Landscape Dept undertook an assessment of the impacts of the action on Commonwealth land on arboriculture. This section summarises the assessment's findings.

6.2 Assessment method

6.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land Table 6-1 summarises the other key policies and guidance relevant to the assessment.

Table 6-1 Key legislation, policy and guidance for arboriculture

Policy/guidance	Relevance
Guidelines for the removal, destruction or lopping of native vegetation (DELWP, 2017a).	Although aimed at native vegetation, these guidelines provide definitions that are applicable to the introduced species covered in the arboricultural assessment.
AS4970-2009 Protection of trees on development sites (Standards Australia, 2000).	This standard provides guidance on the principles for retaining and protecting trees on land subject to development during the different stages of the development process.
Local council by-laws, policies and guidance	Local councils have a range of documents relating to the management of trees and urban forest canopies in their areas. For example, Banyule City Council has an Urban Forest Strategic Plan, which aims to increase tree canopy cover on public land, encourage more tree canopy cover on private land, and maintain and improve landscape character. While these are not directly applicable to Commonwealth land, the assessment has taken account of local objectives.

6.2.2 Relevant assessment criteria

Arboricultural impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 7-1 summarises the performance of North East Link against these criteria.

6.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on planted amenity trees on Commonwealth land.

Direct impacts would occur within the project boundary (see Section 3.1). There would unlikely be indirect impacts on planted amenity trees beyond this. The assessment therefore examined impacts on the planted amenity trees on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks within the project boundary, as described in Section 4.2.2.

Arboricultural impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 7-2.

Scope of impacts considered

The impacts considered were:

- Removal of planted amenity trees for construction
- Impacts to trees on periphery of construction leading to death, damage or destabilisation
- Impacts from modification to adjacent soil profiles leading to tree death or damage
- Impacts from operational infrastructure preventing the re-establishment of urban forest canopy
- Impacts on growing conditions of trees by new structures during operation.

6.2.4 Description of environment

Existing conditions have been established by undertaking an inventory of planted amenity trees and tree groups located on Commonwealth land. Ground-based assessments were undertaken within the study area between April and October 2018.

Each tree or tree group has been identified to the specific level wherever possible and data was collected for each tree or tree group, as follows:

- Taxon
- Common name
- Origin
- DBH (estimated)
- Height (as a range)
- Width (estimated)
- Age
- Health
- Structure
- Useful life expectancy (ULE).

For the purposes of this report, a tree is defined as a woody perennial, usually having one dominant vertical trunk. The threshold of a canopy tree, as defined in the DELWP (2017a) *Guidelines for the removal, destruction or lopping of native vegetation* of three metres height has been used as the minimum size for assessments.

The assessment did not include shrubs nor shrubby forms of species such as Cotoneaster (*Cotoneaster* spp.), Swamp Paperbark (*Melaleuca ericifolia*) and Sweet Bursaria (*Bursaria spinosa*).

Tree assessments were undertaken by consultant arborists with minimum Australian Qualification Framework (AQF) Level 5 in arboriculture (or equivalent). All data was entered into hand-held computers and tree or tree group locations were recorded on satellite imagery or recorded using a global navigation satellite system receiver and Trimble TerraFlex software. Tree location plans have been generated using aerial imagery.

6.2.5 Information sources

The assessment was based on the results of the field survey work described above. Tree data for the council area was obtained from Banyule City Council in April 2018.

6.2.6 Impact assessment

Section 4 above discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to arboricultural impacts during construction and operation are listed in Table 6-2.

Table 6-2 Arboricultural assessment method

Phase	Approach
Construction	This study is primarily aimed at assessing the impacts to planted amenity trees. This assessment has been done by: • Assessing and mapping trees and tree groups within the North East Link project boundary • Reviewing detailed mapping of the reference project and identifying those trees within and close to construction areas that require removal or may potentially be impacted by North East Link.
Operation	It is anticipated there would be limited potential for impacts to planted amenity trees due to the ongoing operation of North East Link. These risks are primarily related to the growth of trees, including new plantings, and environmental changes that may limit their future growth and viability.

6.2.7 Assumptions

This assessment was undertaken against a reference project using a global navigation satellite system and marked up tree locations (such as aerial photography). The estimates provided in terms of tree removal within this study against the reference project are likely to be different to those of the final design of North East Link.

Data collected within this study is intended for a high-level assessment of arboricultural impacts for trees within the PER study area for North East Link.

Map-based collection of tree locations is insufficient to undertake a detailed arboricultural impact assessment based on the guidelines of AS4970-2009 *Protection of Trees on Development Sites*. That assessment would be undertaken once the detailed design for North East Link is complete.

6.2.8 Linked sections

Table 6-3 lists other technical assessments from which information has been drawn for this study.

Table 6-3 Linkages to other technical assessments

Reference	Topic	Link
Section 18	Historical heritage	Provides an assessment of impacts to heritage trees and landscapes.
Section 5	Flora and fauna	Provides an assessment of trees (and other vegetation) located within EVC communities, as well as indigenous trees categorised as 'scattered trees'. Includes an assessment of indigenous and planted trees with respect to habitat value and function of wildlife corridors. Arboriculture provides an assessment of planted amenity trees, as well as an overview of impacts to the entire urban forest which comprises remnant vegetation as well as planted amenity trees.
Section 20	Landscape and visual	Provides an assessment of landscape and visual impacts, including removal of trees and other vegetation.

6.2.9 Stakeholder consultation

Table 6-4 lists engagement activities specific to Commonwealth land related to arboricultural impacts.

Table 6-4 Stakeholder engagement undertaken for arboriculture

Activity	When	Matters discussed	Outcome
Email communication with Banyule City Council	10 April 2018	Request for existing tree data for the council area near the action	Tree data provided in April, and also reviewed in the assessment of trees on Commonwealth land
Meeting with DELWP	3 October 2018	Availability of state data relating to existing canopy	Data provided

6.3 Description of environment

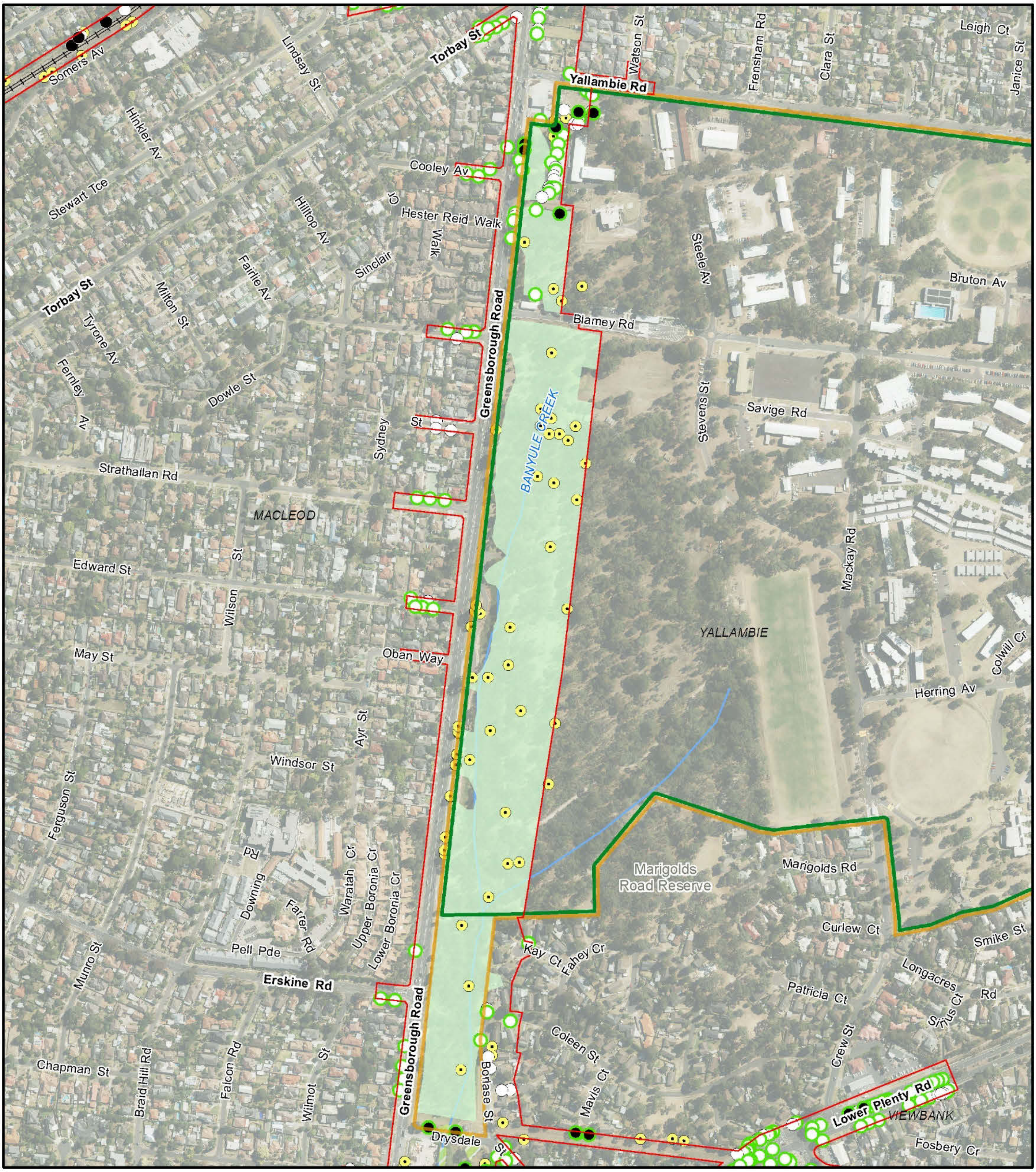
This section describes planted amenity trees as relevant to actions on Commonwealth land. Only a limited number of planted amenity trees are located within the North East Link project boundary on Commonwealth land, concentrated at the northern end of the strip of Commonwealth land within the EPBC boundary.

Vegetation within this zone predominantly consists of indigenous ecological vegetation classes assessed in PER Technical Appendix A – Flora and Fauna technical report, and primarily Plains Grassy Woodland and a small patch of Riparian Woodland in the southern-most extent of the Commonwealth land area.

The number of planted amenity trees assessed within this zone are listed in Table 6-5, with locations of trees shown in Figure 6-1 contains further tree assessment data for trees within the project boundary that are on Commonwealth land or within 500 metres of the action on Commonwealth land.

Table 6-5 Planted amenity trees within the EPBC boundary on Commonwealth land

Taxon	Common name	Origin	No. of trees
Agonis flexuosa	Willow Myrtle	Australia	2
Angophora floribunda	Rough-barked Apple	Australia	5
Casuarina cunninghamiana	River She-oak	Australia	1
Corymbia maculata	Spotted Gum	Victoria	1
Crataegus monogyna	Hawthorn	Exotic	2
Eriobotrya japonica	Loquat	Exotic	1
Eucalyptus nicholii	Narrow-leaved Peppermint	Australia	1
Eucalyptus sp.	Eucalypt	Australia	2
Eucalyptus tereticornis	Gippsland Manna Gum	Victoria	1
Fraxinus angustifolia subsp. *angustifolia*	Desert Ash	Exotic	4
Hakea drupacea	Sweet Hakea	Australia	1
Lophostemon confertus	Brush Box	Australia	4
Melaleuca armillaris	Giant Honey-myrtle	Victoria	2
Melaleuca nesophila	Showy Honey-myrtle	Australia	2
Melaleuca styphelioides	Prickly-leaved Paperbark	Australia	2
Pinus radiata	Monterey Pine	Exotic	16
Pittosporum undulatum	Sweet Pittosporum	Victoria	4
Ulmus procera	English Elm	Exotic	8
Total			**59**



Legend

Project boundary

- Project boundary - surface
- Commonwealth land
- Barracks fenceline
- Railway
- Stream
- Tree - Group (MLTV)
- Tree - Group
- Tree - Single (MLTV)
- Tree - Single
- Scattered Trees (RevC)

Vegetation Assessed

- Creekline Grassy Woodland (68)
- Plains Grassy Woodland (55)

Paper Size A4

0 40 80 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	C
Date	26/02/2019

Planted amenity trees within the EPBC project area

Figure 6-1

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Boreholes - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

6.4 Relevant impacts and mitigation measures

6.4.1 Impacts from removal of trees to facilitate construction on Commonwealth land

Impact description

Construction of the trenched section of North East Link, ventilation structure and use of adjacent of Commonwealth land during construction would require the direct removal of planted amenity trees.

Fifty planted amenity trees on Commonwealth land would be removed. These are listed in Appendix A – AR2 Planned tree removals. On the land to be occupied with traffic lanes and associated infrastructure this would be permanent, although there may be limited opportunities for tree replacement on the east side of the project boundary that lies within Commonwealth land.

Proposed avoidance and mitigation measures

Maximising tree retention through detailed arboricultural assessments against detailed designs would identify trees that can be retained where practicable, especially through the use of modified construction methodologies and limit the overall numbers of trees requiring removal. Due to the nature of works proposed within the PER study area, there is limited opportunity to retain trees, except to the periphery of the construction area.

Residual impact

The residual impact of removal of the small number of amenity trees on Commonwealth land to facilitate construction is low and is not considered a significant impact.

6.4.2 Impacts to trees on periphery of construction leading to death, damage or destabilisation

Impact description

There is the potential for damage to trees on the periphery of construction that may lead to death, damage or destabilisation, including mechanical impacts from cranes, piling rigs and vehicular access resulting in damage to tree crowns; lopping of tree crowns for installation of temporary aerial services leading to damage to trees by poor pruning practices.

Any potential impacts to trees on the periphery of construction are anticipated to be localised (that is, tree-by-tree) and isolated. Due to the small number of planted amenity trees within the PER study area proposed to be retained adjacent to construction activities, the overall impact is considered low.

Proposed avoidance and mitigation measures

The CEMP for North East Link would include a Tree Protection Plan (TPP) which is to be developed and implemented in accordance with AS4970-2009 *Protection of Trees on Development Sites* in consultation with key stakeholders. The TPP would provide details of any tree protection actions that would protect trees proposed to be retained from the impact of construction or related activities, before those works were undertaken. The TPP would be prepared based on detailed construction drawings and surveyed tree locations.

Residual impact

As a relatively small number of planted amenity trees may be potentially impacted to the periphery of construction, the residual impact is low and is not considered a significant impact.

6.4.3 Impacts from modification to adjacent soil profiles leading to tree death or damage

Impact description

There is the potential for modification of soil profiles resulting in drought stress, waterlogging and/or deoxygenation of root zones leading to reduced tree health or death primarily due to construction access, including set down areas resulting in soil compaction and reduced tree health.

Any potential impacts to trees by modification of soil profiles on the periphery of construction are anticipated to be localised (that is, tree-by-tree) and isolated. Due to the small number of planted amenity trees within the PER study area proposed to be retained adjacent to construction activities, the overall impact is considered low.

Proposed avoidance and mitigation measures

A TPP would be developed and implemented in accordance with AS4970-2009 *Protection of Trees on Development Sites* to protect trees proposed to be retained from the impact of construction or related activities.

Residual impact

As a relatively small number of planted amenity trees may be potentially impacted to the periphery of construction, the residual impact is low and is not considered a significant impact.

6.4.4 Impacts from operational infrastructure preventing the re-establishment of urban forest canopy

Impact description

The presence of permanent North East Link road infrastructure within on Commonwealth land would limit opportunities for replanting amenity trees and re-establishing urban forest canopy. While significant numbers of planted amenity trees would require removal within the project boundary, the number proposed to be removed within the PER study area that could not be replanted due to new road infrastructure is relatively limited and in this context the overall impact is considered low.

Proposed avoidance and mitigation measures

A Tree Canopy Replacement Program (TCRP) would be developed to replace removed trees to achieve a net gain in tree canopy cover by 2045. The TCRP would show the location, size and species of replacement trees, and be developed in consultation with relevant land managers. The TCRP would specify requirements to support the long-term viability of replacement plantings including appropriate soil requirements, establishment works and ongoing maintenance.

Residual impact

The limited area where replacement amenity trees could not be re-established means the residual impact is low and is not considered a significant impact.

6.4.5 Impacts on growing conditions of trees by new structures during operation

Impact description

Modification to growing conditions of trees is possible by new structures, such as overshadowing by the ventilation structure (see Section 8) and drawdown of groundwater (see Section 24) from tunnelling and excavation resulting in poor growing conditions and reduced urban forest canopy cover.

Only limited numbers of trees are proposed to be retained within the PER study area which could be impacted by modified growing conditions, and the overall impact is considered low.

Proposed avoidance and mitigation measures

The TCRP would be developed so that trees are appropriate to their planting location, considering potential overshadowing, buffering winds and soil conditions. This would enable an appropriate tree to be selected for the specific location.

Residual impact

The residual impact of impacts to trees by modified growing conditions by new structures within the PER study area is low and is not considered a significant impact.

6.5 Residual impacts

Table 6-6 summarises the residual impacts on planted amenity trees.

Table 6-6 Summary of residual impacts on planted amenity trees

Impact	Mitigation	Significance of residual impact
Removal of planted amenity trees for construction	Maximise tree retention including through arboricultural assessments	Not significant
Impacts to trees on periphery of construction leading to death, damage or destabilisation	Implement a TPP to protect trees to be retained	Not significant
Impacts from modification to adjacent soil profiles leading to tree death or damage	Implement a TPP to protect trees to be retained	Not significant
Impacts from operational infrastructure preventing the re-establishment of urban forest canopy	Implement a TCRP	Not significant
Impacts on growing conditions of trees by new structures during operation	Implement a TCRP	Not significant

7. Relevant impacts on flora and fauna

7.1 Simpson Barracks

Table 7-1 summarises the potential impacts of North East Link on flora and fauna on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks).

The impacts are assessed against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 7-1 Relevant impacts on flora and fauna – Simpson Barracks

Assessment criteria	Impact
Impacts on plants	
Is there a real chance or possibility that the action will:	
Involve medium or large-scale native vegetation clearance	**Direct loss of native vegetation** Approximately 10.976 hectares of Plains Grassy Woodland would be removed for North East Link (21 per cent of the 52.5 hectares of remnant native vegetation at Simpson Barracks), representing a medium-scale native vegetation clearance. This represents a significant residual impact for which an offset is recommended. These losses would be offset along with the rest of the vegetation lost due to North East Link (that is, outside Commonwealth land) under the Victorian process, meeting the assessment and offset requirements of the DELWP (2017a) *Guidelines for the removal destruction and lopping of native vegetation*. An NVR report has been completed that identifies general offset units and species offset units required for the vegetation removals. Enquiries have been made with offset brokers and NELP has received assurance that sites are currently available on the market to offset the removal of the 10.976 ha of Plains Grassy Woodland. **Indirect loss of native vegetation** Since the groundwater assessment was completed for the draft PER, additional data from the North East Link groundwater bore monitoring network has become available and further groundwater modelling has been undertaken. Using the furthergroundwater data, impacts to GDEs have been reassessed, and the updated finding discussed. A number of large trees on Commonwealth land are likely to rely on groundwater (between 10< and 20-metre depth to groundwater depth zone) under drought conditions and may be negatively affected by groundwater drawdown. At the end of construction, in the absence of any mitigation measures, 45 large trees would have a moderate to high chance of being negatively affected, and one would have a low chance of being impacted. Eight trees would have a moderate to high likelihood of being negatively affected by 2075, and so potential to decline in health and/or to die prematurely. A further eight trees would have a low chance of being impacted in the absence of any mitigation measures. Most trees predicted to be impacted are River Red Gums, apart from nine (five high, four moderate risk) Studley Park Gum by the end of construction and seven (three moderate, four low risk) Studley Park Gum by 2075.

Assessment criteria	Impact
	Short-term watering may reduce the number of trees impacted in the long-term. Any large trees predicted to be affected over the long-term would need to be offset. Consistent with other sections of this report, offsetting would be undertaken in accordance with the DEWLP (2017a) *Guidelines for the removal destruction and lopping of native vegetation.* **Planted amenity trees** There are a small number of planted amenity trees on Simpson Barracks. Some of these are native species but their loss is not considered significant.
Involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species	Clearance of vegetation from Simpson Barracks would involve direct permanent removal of three listed threatened plant species: • Matted Flax-lily (*Dianella amoena*), Endangered under EPBC Act, Listed under FFG Act, endangered on DELWP Advisory List. Approximately 30 per cent (83 out of 283 plants/patches) of the Simpson Barracks population are likely to be impacted. A salvage and translocation plan is being developed. With successful translocation, and the translocation risk spread across a number of potential receptor sites in the local area, the residual impact of the action on Matted Flax-lily is expected to be non-significant. The overall population size in the local area is expected to increase following construction of North East Link. No offsetting of Matted Flax-lily is proposed. • Arching Flax-lily (*Dianella longifolia var. grandis*), vulnerable on the DELWP Advisory List. Two individuals were observed during field assessments at Simpson Barracks. Removal of these individuals is unlikely to result in a long-term decline in a population and would not be a significant impact. These would be translocated as part of the Matted Flax Lily Salvage and Translocation plan discussed above. • Studley Park Gum (*Eucalyptus X studleyensis*), endangered on the DELWP Advisory List. The direct clearance of 44 mature individuals of Studley Park Gum within the project boundary at Simpson Barracks, and the additional indirect impact on three large Studley Park Gum's outside the project boundary by groundwater drawdown over the long-term (2075 operational scenario based on further groundwater modelling) is likely to result in a long-term decline in a population, or threaten the viability, or reduce the occupancy of Studley Park Gum. Consequently, the unavoidable loss of at least 47 Studley Park Gum individuals is regarded as a significant impact. In accordance with the EPBC Act Environmental Offsets Policy, this would trigger a requirement for offsets for impacts to Studley Park Gum on Commonwealth land. NELP proposes to contribute to the conservation of Studley Park Gum by establishing new habitat through the implementation of the Studley Park Gum Management Framework (the Framework) (PER Technical Appendix A – Flora and fauna, Appendix G). This approach is expected to result in a viable outcome noting that the creation of new habitat for a protected matter is a type of direct offset under the EPBC Act Environmental Offsets Policy. In addition to the above, at the State level native vegetation offsets would be provided based on the Victorian Guidelines (DELWP 2017a) to offset for the removal of native vegetation (which Studley Park Gum trees form part of) directly impacted by the project, and three Studley Park Gum trees expected to experience premature mortality due to long term groundwater drawdown. Implementing the Studley Park Gum Management Framework and State offsets is in line with the *EPBC Act Environmental Offsets Policy* and commensurate with the conservation status of the species.

Assessment criteria	Impact
Introduce potentially invasive species	Appropriate standard mitigation to prevent the spread of weeds, pathogens or pest species would be applied during the construction of North East Link. Given the urban nature of the environment, the introduction of new invasive species to or from Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks is considered unlikely.
Involve the use of chemicals which substantially stunt the growth of native vegetation, or	No chemicals that would substantially stunt the growth of native vegetation to be retained are proposed to be used for North East Link.
Involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species?	Controlled burning is not proposed for North East Link.
Impacts on animals	
Is there a real chance or possibility the action will:	
Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals	**Terrestrial fauna** Animals most likely to be encountered in construction sites are common and even abundant species. Death or injury of some animals may occur during vegetation clearance, but is expected to involve small numbers of common animals only, and would most likely affect individuals rather than populations or species. While the death of individual animal is a permanent impact, the population of a common species is unlikely to have any more than a negligible impact. Continuation of existing fencing during the operation of North East Link means that existing levels of death, injury or harm to animals on or around Simpson Barracks would unlikely change. **Aquatic fauna** Banyule Creek is the only waterway that would be impacted by construction activities at Simpson Barracks. Banyule Creek has intermittent flow, and only provides habitat for aquatic animals during periods of flow (during or following rain). With appropriate management of construction activities in and near Banyule Creek within Simpson Barracks, North East Link would not cause the death, injury or other harm to aquatic animals that leads to a long-term decrease in, or threatens the viability of, a native aquatic animal population or populations downstream of Simpson Barracks.

Assessment criteria	Impact
Displace or substantially limit the movement or dispersal of native animal populations	**Terrestrial fauna** Simpson Barracks is already a closed site for some animal populations. Most of the native animals that persist in Simpson Barracks are adaptable and common species, already coping with a fragmented and degraded habitat landscape. Some animals (such as the Eastern Grey Kangaroo) may move away from construction sites (and from busy roadways during North East Link's operation) during noisy periods. The extent of displacement would likely vary, depending on the prevailing noise levels. Disturbance and displacement of some animals on Simpson Barracks is unavoidable, but is expected to be minor. **Aquatic fauna** Construction at Simpson Barracks would not displace or substantially limit the movement or dispersal of native aquatic animal populations.
Substantially reduce or fragment available habitat for native species;	**Terrestrial fauna** The proposed habitat loss is expected to be ecologically inconsequential for the Eastern Grey Kangaroo population, and would be highly unlikely to jeopardise the viability of the current Eastern Grey Kangaroo population in Simpson Barracks. Fragmentation may occur due to the blocking of a habitat corridor along the upper reaches of Banyule Creek. However, this section of the corridor is narrow, degraded, and likely to be used mainly by common and adaptable mobile fauna for local movements only, rather than landscape-scale movements. By removing native vegetation, the action would reduce available habitat for native species on Simpson Barracks, but this reduction is not considered substantial and would not be to the extent that it has ecological consequences. **Aquatic fauna** The headwaters of Banyule Creek are the only waterway that would be impacted by construction activities at Simpson Barracks which when flowing, does not provide a link to further aquatic habitat upstream. Construction at Simpson Barracks would not displace or substantially limit the movement or dispersal of native aquatic animal populations.

Assessment criteria	Impact
Reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species	**Terrestrial fauna** Occasionally or rarely, habitats within Simpson Barracks are known to attract threatened fauna such as Powerful Owl (*Ninox strenua*), Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*); although this is likely to be for foraging only, and these species are not expected to frequently or regularly breed or roost there. Other species (White-throated Needletail, Grey Goshawk, Black Falcon, Barking Owl) may visit Simpson Barracks occasionally, but are unlikely to be there regularly, or to depend on habitat within the site. Loss of habitat from Simpson Barracks due to North East Link is not expected to reduce or fragment available habitat for a listed threatened species to the extent that it displaces a population, results in a long-term decline in a population, or threatens the viability of the threatened species. **Aquatic fauna** Although some aquatic habitat would be lost (ephemeral headwaters of Banyule Creek and a small number of manmade waterbodies at Simpson Barracks) vertebrates and invertebrates present are common species that are adapted to highly modified, degraded aquatic habitats. No threatened aquatic species inhabit Banyule Creek within Simpson Barracks. Removal of those waterbodies would reduce available habitat for aquatic native species on a very local scale, but would not have ecological consequences for broader populations of any native species.
Introduce exotic species which will substantially reduce habitat or resources for native species, or	**Terrestrial fauna** Appropriate standard mitigation would be applied during the construction of North East Link to prevent the spread of weeds, pathogens or pest species. Given the urban nature of the environment, the introduction of exotic species that substantially reduce habitat or resources for native species is considered unlikely. **Aquatic fauna** Appropriate standard mitigation to prevent the spread of weeds, pathogens or pest species would be applied during the construction of North East Link. Given the study area is already highly urbanised, and that Banyule Creek is already dominated by exotic aquatic species, the action is not expected to introduce an exotic species which would substantially reduce habitat or resources for native aquatic animals.

7.2 War Services easement

Table 7-2 summarises the performance of the action on Commonwealth land at the War Services easement on flora and fauna against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 7-2 Relevant impacts on flora and fauna – War Services easement

Assessment criteria	Impact
Impacts on plants	
Is there a real chance or possibility that the action will:	
Involve medium or large-scale native vegetation clearance	The War Services easement contains a four isolated trees and some minor amenity planting. Some of these are native species but their removal would not be considered medium or large-scale, and so it is not considered significant.
Involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species	No listed threatened flora species were recorded on the War Services easement.
Introduce potentially invasive species	Appropriate standard mitigation to prevent the spread of weeds, pathogens or pest species would be applied to North East Link. Given the urban nature of the environment, the introduction of new invasive species to or from the War Services easement is considered unlikely.
Involve the use of chemicals which substantially stunt the growth of native vegetation, or	No chemicals that would substantially stunt the growth of native vegetation to be retained are proposed to be used for North East Link.
Involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species?	Controlled burning is not proposed for North East Link.
Impacts on animals	
Is there a real chance or possibility that the action will:	
Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals	**Terrestrial fauna** Given the limited habitat present on the War Services easement, animals most likely to be encountered are common and even abundant species. Death or injury of some animals may occur during vegetation clearance, but is expected to involve small numbers of common animals only, and is most likely to affect individuals rather than populations or species. The population of a common species is unlikely to have any more than a negligible impact. **Aquatic fauna** There is no aquatic habitat present on the War Services easement.

Assessment criteria	Impact
Displace or substantially limit the movement or dispersal of native animal populations	**Terrestrial fauna** Given the limited habitat present on the War Services easement, animals most likely to be encountered are common and even abundant species. Movement of fauna to the west of the easement is limited by the existing Greensborough Bypass. The action on the War Services easement would not create additional barriers to movement. **Aquatic fauna** There is no aquatic habitat present on the War Services easement.
Substantially reduce or fragment available habitat for native species	**Terrestrial fauna** Given the limited habitat present on the War Services easement, animals most likely to be encountered are common and even abundant species. North East Link would involve a minor reduction in available habitat on the War Services easement, but would not fragment the remaining habitat. **Aquatic fauna** No aquatic habitat is present on the War Services easement.
Reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species	No listed threatened terrestrial or aquatic fauna species were recorded on the War Services easement.
Introduce exotic species which will substantially reduce habitat or resources for native species	Appropriate standard mitigation to prevent the spread of weeds, pathogens or pest species would be applied to North East Link. Given the urban nature of the environment, the introduction of new invasive species to or from the War Services easement is considered unlikely.

Part C People and communities

8. Land use

8.1 Introduction

GHD undertook an assessment of the impacts of the action on land uses on Simpson Barracks. This section summarises the assessment's findings.

8.2 Assessment method

8.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land.

8.2.2 Relevant assessment criteria

Land-use impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2. Table 16-1 summarises the performance of North East Link against these criteria.

8.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on land uses on Commonwealth land.

Although direct impacts would occur within the project boundary (see Section 3.1), indirect impacts on land use may occur beyond this boundary. The assessment therefore examined impacts on land use on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within the project boundary and on Commonwealth land up to 500 metres from the project boundary, as described in the PER Guidelines (see Section 4.2.2).

Land use impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The impacts considered were:

- Acquisition permanently changing land use
- Occupation temporarily changing land use
- Change in ongoing use of land due to construction traffic, air, noise, visual and overshadowing impacts
- Change in ongoing use of land due to operation traffic, air, noise and visual impacts and overshadowing.

8.2.4 Description of environment

Desktop assessment

To inform an understanding of existing conditions, a desktop assessment and baseline data review was undertaken using the information sources in Table 8-1.

Site visit

A site visit was conducted on 18 April 2018 to observe and photograph the study area and surrounds of the action, including land around Simpson Barracks. Information was sourced from site visits undertaken by other specialists, from inspections outside the barracks, and from information provided by the Department of Defence (DoD).

The site visit informed the assessment of existing conditions and evaluation of potential land use impacts.

8.2.5 Information sources

Data sources used in the land use assessment are presented in Table 8-1.

Table 8-1 Data sources for the land use assessment

Source	Type of data
Publicly accessible imagery and ground level photography	Publicly accessible aerial imagery and ground level photography, including aerial photography overlayed with the reference project.
DoD, Simpson Barracks	Information pertaining to strategic planning documents specific to Simpson Barracks, as provided by the DoD.

8.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land.

The impact assessment has assessed the land use planning impacts that North East Link may have on land use, land use character, built form and strategic policy directives within the study area.

The impact assessment included:

- Review of the reference project
- Identifying potential land use planning related impacts across construction and operational phases, including:
  - Permanent and temporary change in land use due to acquisition and occupation (assessed as construction impacts as the point at which they would commence)
  - Permanent and temporary changes in the ongoing use of land adjacent to North East Link during construction and operation
- Identifying measures to avoid, minimise or mitigate impacts related to land use planning.

8.2.7 Assumptions

The findings presented in this section are subject to the following limitations, uncertainties and assumptions:

- This section presents the acquisition requirements associated with the reference project. Temporary occupation discussed in the assessment is indicative
- A site visit for the land use assessment was not conducted at Simpson Barracks. Information was sourced from site visits undertaken by other specialists, from inspections outside Simpson Barracks, and from information provided by the Department of Defence (DoD)
- This technical assessment should be read in association with other impact assessments where linkages are identified and outlined in Table 8-2.

8.2.8 Linked sections

Table 8-2 lists other technical assessments from which information has been drawn for this study. The impact assessment team has liaised with the relevant technical specialists responsible for preparing the sections listed below, as appropriate.

Table 8-2 Linkages to other assessments

Reference	Topic	Link
Section 8	Social and community	Provides an assessment of the potential social impacts of North East Link. Information from the social and community assessment has informed the preparation of the existing conditions, and informed the impact assessment on land used for community facilities.
Section 9	Business	Provides an assessment of the potential impacts of North East Link on businesses by way of full or partial property acquisition, change in access or amenity-related impacts on businesses. Information from the business assessment has informed the preparation of the existing conditions section below, and informed the impact assessment.
Section 11	Traffic and transport	Provides an assessment of the impacts of North East Link on the transport network. Information related to changes to local and regional access and connectivity due to North East Link have informed the policy analysis and impact assessment in this section.
Section 12	Noise and vibration	Provides an assessment of the potential surface noise and vibration impacts during construction and operation. Findings from the noise and vibration assessment have informed the assessment of the ongoing use of land and the potential for impact through changes in noise and vibration conditions.
Section 14	Air quality	Provides an assessment of North East Link's potential to impact air quality during construction and operation. Findings from the air quality assessment have informed the assessment of the ongoing use of land and the potential for impact through changes in air quality conditions.
Section 20	Landscape and visual impacts	Identifies sensitive receptors and provides an assessment of North East Link's potential visual and landscape impacts. Linkages to land use planning include impacts on built form and strategic policy outcomes, which have informed the policy analysis and built form impact sections of this report.

8.2.9 Stakeholder consultation

Table 8-3 summarises stakeholder engagement specific to Commonwealth land that was conducted to support preparation of the land use component of the PER.

Table 8-3 Stakeholder engagement undertaken for land use

Stakeholder	When	Matters discussed	Outcome
Banyule City Council	May 2018 ongoing	Discussions to gain an understanding of localised land use planning related matters, including: • Significant policy and strategy considerations • Planning scheme amendment requests that may not have reached public exhibition stage • Major development applications.	Information obtained informed assessment
Simpson Barracks, DoD	August to October 2018	Considerable consultation has been undertaken with the DoD by NELP. Requests were made for information relating to the land uses at Simpson Barracks.	Information obtained informed assessment

8.3 Description of the environment

8.3.1 Simpson Barracks land use planning

The Commonwealth land affected by North East Link is predominantly occupied by Simpson Barracks and owned by the DoD. The use of land within Simpson Barracks is informed by the 2014 Zone Plan for Simpson Barracks. The sensitive nature of the detailed zone plan has meant it was not available for a detailed review or to include as part of this assessment.

Commentary received from Simpson Barracks management indicates that while a number of projects are planned for the barracks in the coming years that could affect land uses, these projects would not affect the area proposed for acquisition, which is located within an 'open space zone'.

8.3.2 Simpson Barracks land uses

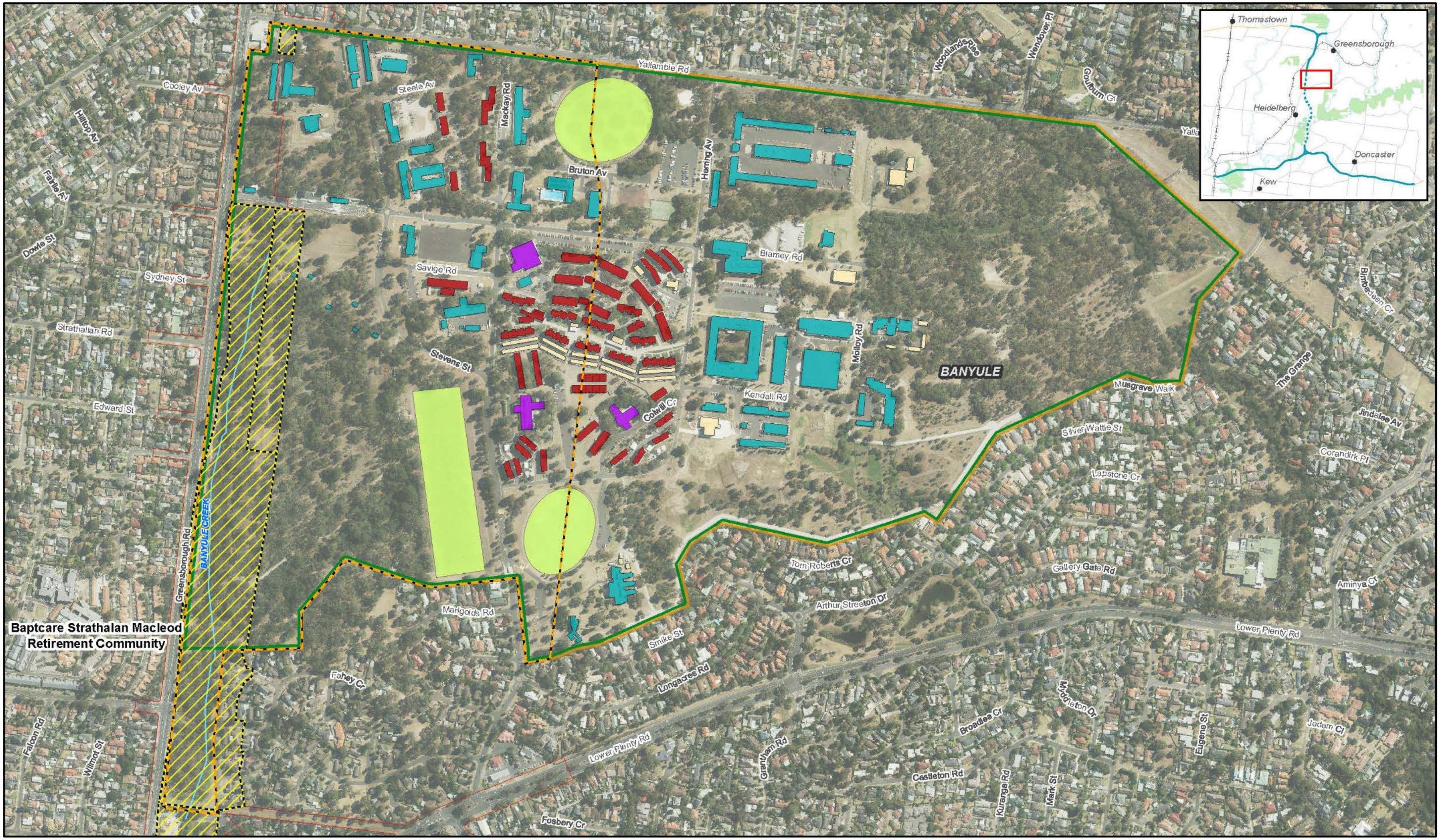
The land use activities at Simpson Barracks are generally associated with signalling and training activities. The barracks land is fenced and not accessible to the public. Key land uses are shown in Figure 8-1.

Land at Simpson Barracks is used for accommodation, offices and training facilities, areas for memorial activities, mess and canteen facilities, recreational facilities (including a pool, tennis courts and gym) and a range of other uses such as for a hairdresser, bank and chapel.

Simpson Barracks also includes a number of active open space land uses (Long Green, Silcock Oval and Main Oval) and passive open spaces such as the Banyule Creek Area and Rentons Ridge.

The area of Simpson Barracks land adjacent to Greensborough Road is generally undeveloped and characterised by vegetation, the Banyule Creek area open space corridor, and minimal built structures (such as training and office facilities) and the Blamey Road entrance to the barracks.

The Commonwealth land includes the publicly accessible Commonwealth land south of Simpson Barracks. This area is characterised by a continuation of the vegetation on the barracks land and part of the Banyule Creek.



Paper Size A4

0 50 100 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Legend

Simpson Barracks Land Use (Based on Simpson Barracks Base Map (Department of Defence, August 2016))

- Accomodation
- Messes
- Training/Office
- Open space
- Other
- Construction Compounds
- EBPC 500m buffer
- Barracks fenceline
- Commonwealth land
- LGA
- Watercourse

Project boundary

- Project boundary - **surface**

NORTH EAST LINK PROJECT

North East Link **Project**
Public Environment Report

Job Number	31-35006
Revision	D
Date	28 Feb 2019

Public Environment Report
Key Land Uses

Figure **8**-1

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | Commonwealth Land, LGA, Road, Watercourse - Vicmap, 2018 | NEL road design, Land Use - GHD/AECOM - 2018. Created by:mjshrives

8.4 Relevant impacts and mitigation measures

8.4.1 Change of land use as a result of acquisition

Impact description

North East Link would require the permanent acquisition of all of the publicly accessible Commonwealth land south of Simpson Barracks and part of Simpson Barracks for road widening, trench, cut and cover, land bridges and northern ventilation structure at Yallambie Road, shown in Figure 8-1.

The publicly accessible Commonwealth land south of Simpson Barracks is vegetated and part of the Banyule Creek corridor. This land would be used during construction for the purposes of a construction compound and during operation would be occupied by project structures.

The area of Simpson Barracks that would be acquired is on the east side of Greensborough Road and mainly comprises vegetated, undeveloped open space crossed by the barracks access (Blamey Road), as shown in Figure 8-2. The land to be acquired would initially be used to accommodate North East Link construction compounds. After construction, the majority of acquired land would be required for operation of North East Link, including its structures.

The area of Simpson Barracks land that would be permanently acquired (the majority of which would temporarily accommodate construction compounds) is located along the east side of Greensborough Road and is predominantly vegetated with limited built structures, generally associated with training/office facilities and the access to the barracks at Blamey and Greensborough roads. As such, while the acquisition of land from Simpson Barracks would result in a permanent change to the undeveloped and open space areas, a large portion of remaining undeveloped and open space area at the barracks that would remain unaffected.

Proposed avoidance and mitigation measures

As landowner the Commonwealth Department of Defence would be consulted with the view to agreeing to terms for possession of the land, and to minimise disruption to owners and users of land, to the extent practical.

Temporary impacts (of up to seven years) on affected land uses would be minimised within the project boundary, avoiding the need for temporary occupation to the extent practical.

Planning for the future use and development of land surplus to North East Link would have regard to relevant strategic land use plans and policies and occur in consultation with relevant land managers or other authorities. Land bridges proposed for North East Link would also provide opportunity to contribute to open space and the land use character of the area.

Residual impact

While acquisition of part of the Commonwealth land would mean a permanent change in land use, a large portion of remaining undeveloped/open space areas at Simpson Barracks would remain. The temporary occupation of Commonwealth land is not expected to have impacts on land use that are significant beyond the impacts of permanent acquisition.

The avoidance and mitigation measures discussed above would assist in managing impacts. The overall impact on Commonwealth land uses from acquisition or occupation is not considered to be significant.

8.4.2 Impacts to ongoing use of land as a result of construction traffic, air, noise, visual impacts, overshadowing and utilities diversions

Impact description

Above-ground construction activities could indirectly impact the ongoing use of land adjacent to North East Link, as activities such as the widening of existing roads using surface and open cut methods, as well as cut and cover tunnelling have potential to generate construction traffic, noise, air, visual and overshadowing changes. Further details are set out the other relevant sections of this section.

The land is not accessible to the public, except for the for the accessible Commonwealth land south, Simpson Barracks which is generally used for open space.

Construction activities may impact on some land uses on the western side of Simpson Barracks, although most of the western side of Simpson Barracks is not used intensively for operating the barracks. These impacts could include:

- Impacts on traffic access to Simpson Barracks (see Section 11) – noting access would be maintained via Blamey Road during construction
- Construction noise – impacts would exceed criteria for three buildings and would require detailed modelling and potentially mitigation (see Section 12)
- Air quality impacts from dust and odour (see Section 14)
- Visual changes – these would affect the barracks but are unlikely to affect land use.

Utilities used by Simpson Barracks may be affected by North East Link. Section 3.2.7 of the PER main document lists the key utilities that would need to be protected, relocated or avoided to maintain their function. Works close to Simpson Barracks may also require alterations to minor utilities. Potential in-situ impacts on minor utilities from vibration and ground movement are discussed in Sections 13.4.2 and 21.4.1 respectively.

Proposed avoidance and mitigation measures

Specific mitigation strategies to minimise the impact on the ongoing use of land from construction traffic, noise, air quality and visual impacts would be delivered in accordance with environmental strategy and management plans (such as a CEMP) and would include:

- Implementing Transport Management Plan(s) (TMP). Traffic access to Simpson Barracks would be maintained via Blamey Road during construction
- Minimising access and amenity impacts on businesses during construction
- Implementing a Construction Noise and Vibration Management Plan (CNVMP) to manage noise and vibration impacts on amenity and structures
- Implementing a Dust and Air Quality Management and Monitoring Plan (DAQMMP) to minimise air quality impacts during construction
- Implementing a Communications and Community Engagement Plan
- Minimising impacts and remedying damage on third-party property and infrastructure
- Designing North East Link to reflect its Urban Design Strategy (UDS)
- Minimising landscape impacts during construction
- Minimising construction lighting impacts
- Minimising overshadowing from elevated structures and noise walls to open spaces, waterways and valuable natural habitats through detailed design.

Where required, relocation and protection of utilities would occur in consultation with the service provider and/or asset owner and DoD to minimise, to the extent practicable, impacts to, and interference with, the operation and capabilities of Simpson Barracks. Any damage to property or infrastructure by North East Link would be appropriately remedied in consultation with the property or asset owner.

Residual impact

Construction activities are temporary in nature and the implementation of established standards and North East Link mitigation measures would minimise the likelihood of a change in land use from construction air, noise, traffic, visual and overshadowing impacts associated with construction.

Overall, construction air, noise, traffic, visual and overshadowing impacts are not expected to significantly impact the use of Commonwealth land.

8.4.3 Impacts to ongoing use of land as a result of operational traffic, air, noise, overshadowing and visual impacts.

Impact description

Above-ground operation activities (such as traffic movements and presence of North East Link structures) could generate traffic, noise, air quality, visual and overshadowing impacts, potentially leading to impacts on the ongoing use of adjacent Commonwealth land.
Further details of operation air, noise, traffic and visual and overshadowing impacts are set out in the relevant sections of this section.

It is unlikely there would be a significant impact on land use following construction as:

- The western side of Simpson Barracks is not used intensively for operating the barracks
- Traffic (see Section 11) would directly access the Greensborough Road which would have reduced traffic levels
- Operational noise impacts (see Section 12) are not considered significant
- Operational air quality impacts on personnel at Simpson Barracks are of low significance and unlikely to affect land use (see Section 14)
- Visual changes would affect Simpson Barracks but are unlikely to affect land use.

Proposed avoidance and mitigation measures

Specific mitigation strategies to minimise the impact on the ongoing use of land from impacts from construction traffic, noise, air quality and visual impacts include:

- Delivering North East Link in accordance with environmental strategy and management plans such as an Operations Environmental Management Plan (OEMP)
- Designing tunnel ventilation system to meet EPA Victoria requirements for air quality
- Monitoring ambient air quality and ensuring compliance of in-tunnel air quality and ventilation structure emissions
- Monitoring traffic noise and achieving traffic noise limits
- Designing tunnel ventilation system to meet EPA Victoria requirements for noise and monitoring noise from tunnel ventilation system
- Implementing a Communications and Community Engagement Plan

- Designing North East Link to reflect its Urban Design Strategy (UDS)
- Minimising operation lighting impacts
- Implementing traffic monitoring for the first two years after North East Link opened.

Further, overall ongoing uses of residential, open space and community facility land near North East Link would, depending on location, experience minor increases or reductions in surface noise emissions (discussed in Section 12). Ongoing land uses across the north-east would likely benefit in terms of connectivity and access from improved travel times and less congestion due to North East Link.

Residual impact

The implementation of established standards and mitigation measures means the likelihood of any change in Commonwealth land use from air, noise, traffic and visual impacts associated with North East Link's operation is minimised. No significant impacts on the use of Commonwealth land are expected.

8.4.4 Construction impacts of a northern TBM launch site

Launching the tunnel boring machines (TBMs) from the north would not change the overall project boundary in relation to Commonwealth land, or the degree of permanent acquisition required, nor would it alter the impacts to land use described in the previous sections.

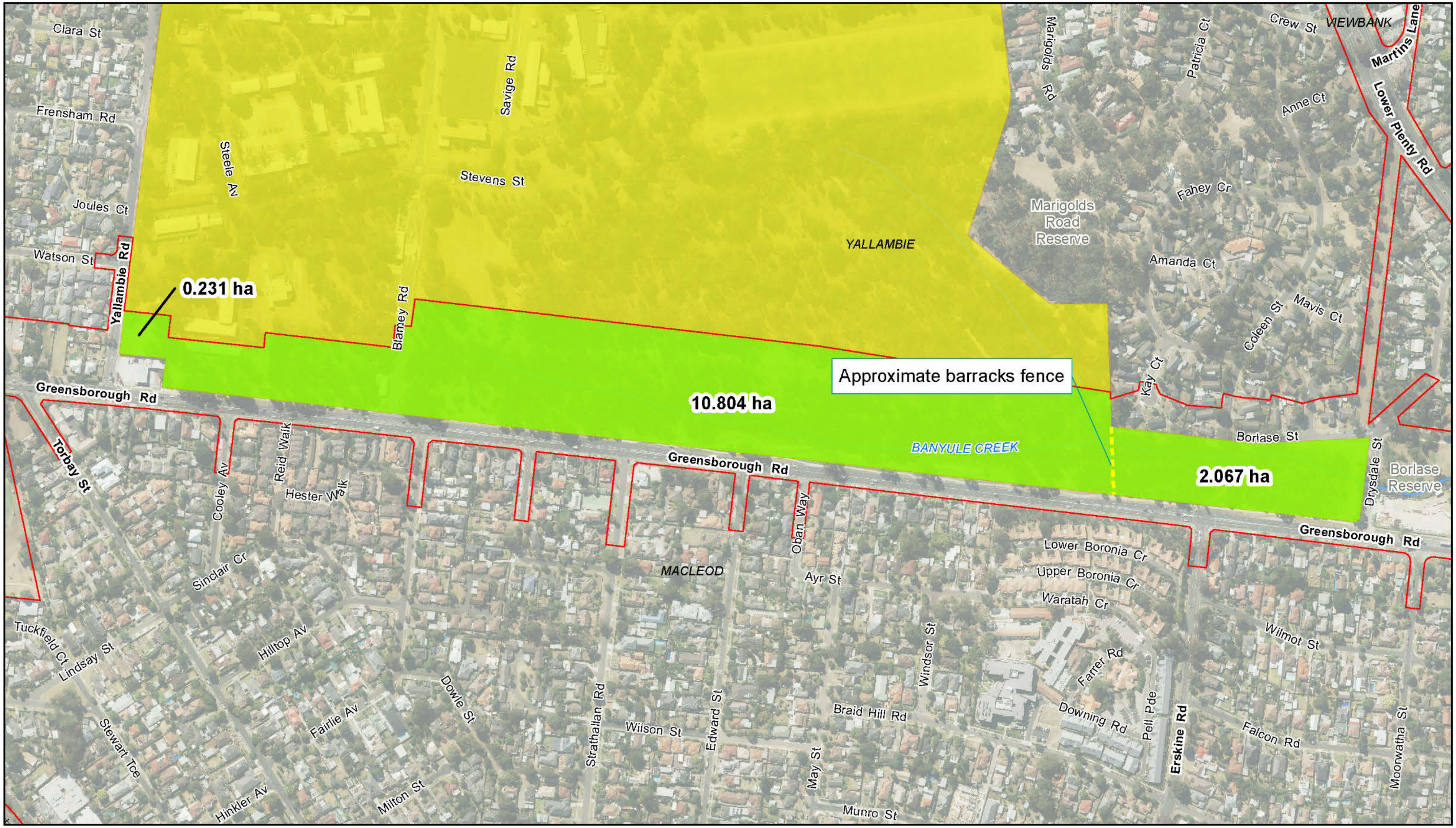
8.5 Residual impacts

Table 8-4 summarises the residual impacts on land use.

Table 8-4 Summary of residual impacts on land use

Impact	Mitigation	Significance of residual impact
Change of land use within Simpson Barracks from acquisition or temporary occupation	Agreement would be sought on the terms for possession of the Commonwealth land with disruption to be minimised to the extent practical. Minimise the area within the project boundary. Consult land managers and agencies responsible for implementing relevant planning policies and strategic plans.	Not significant
Impacts to ongoing use of Simpson Barracks land from amenity impacts from construction traffic, air, noise, visual and over-shadowing impacts	Impacts to ongoing use of land during construction would be addressed in accordance with the mitigation measures set out in the relevant sections of this section. Key measures include: • Delivering North East Link in accordance with environmental strategy and management plans such as a CEMP • Implementing a DAQMMP • Implementing a CNVMP • Implementing a Communications and Community Engagement Plan • Minimising landscape and construction lighting impacts during construction • Implementing TMPs.	Not significant

Impact	Mitigation	Significance of residual impact
Impacts to ongoing use of Simpson Barracks land from operational traffic, air, noise and visual impacts.	Impacts to ongoing use of land during operation would be addressed in accordance with the mitigation measures set out in the relevant sections of this section. Key measures include: • Delivering the action in accordance with environmental strategy and management plans such as an OEMP • Monitoring ambient air quality and ensuring compliance of in-tunnel air quality and ventilation structure emissions • Monitoring traffic noise and achieving traffic noise limits • Designing to reflect the North East Link UDS • Implementing traffic monitoring for the first two years after North East Link opened.	Not significant



Paper Size A4

0 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

Project boundary

- Project boundary - surface
- Commonwealth land
- Approximate Barracks Fence
- Area of commonwealth land required
- Railway
- Stream

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number | 31-35006
Revision | C
Date | 26/02/2019

Area of Commonwealth land to be acquired

Figure 8-2

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: trighetti

9. Business

9.1 Introduction

Matters More undertook an assessment of the business impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

9.2 Assessment method

9.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land.

9.2.2 Relevant assessment criteria

Business impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

9.2.3 Assessment scope

Study area

The assessment looked specifically at impacts to businesses on Commonwealth land as well as the consequent impacts on people on Commonwealth land that use local businesses. The latter may arise from impacts such as acquisition and displacement of businesses and changes to access to businesses – including businesses located on Commonwealth land as well as those located in the area surrounding North East Link.

While this assessment only considers impacts on businesses and users of business located on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, the study area also includes the local area where businesses potentially used by inhabitants of the barracks may be located. This local area has been defined as a distance of 500 metres from the project boundary, as described in the PER Guidelines (see Section 4.2.2).

Business impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The impacts considered were:

- Disruption to business supply of goods and services due to disruption to utilities from construction activities
- Permanent displacement of a small number of businesses with disruption of business services and local jobs
- Amenity of sensitive receptors – businesses and customers of businesses on Greensborough Road affected by noise, vibration and dust from road works
- Inconvenience and annoyance to sensitive receptors (customers) due to changed traffic conditions or altered access to businesses.

9.2.4 Description of environment

The assessment of existing businesses covered:

- Activities relating to business occurring on the Commonwealth land environment (Simpson Barracks) and identification of likely receptors
- Business activities in the environment surrounding the Commonwealth land (the study area) which may be impacted and have implications for users within the Commonwealth land area.

9.2.5 Information sources

Data sources used in the business assessment are presented in Table 9-1.

Table 9-1 Data sources for the business assessment

Source	Type of data
Site investigations	Site investigation of the study area outside Simpson Barracks to understand the context and confirm the location of concentrations of businesses.
Publicly available information	Data about business activities at Simpson Barracks.
DoD	Specific responses to specialists' questions on business activities at Simpson Barracks.
Consultation with local businesses	Consultation with businesses in the neighbourhood centres of Macleod Village and Watsonia Village to establish nature of the businesses (industry, turnover, employment) and the businesses appreciation of and expectations of North East Link impacts.

9.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to business impacts during construction and operation are listed in Table 9-2.

Table 9-2 Business impact assessment method

Phase	Approach
Construction	• Identification of businesses in the study area that have the potential to be affected by interruption to utilities. • Identification of businesses that would be displaced by the action. This included quantification of the number of businesses, and estimated turnover. • Estimation of displacement of local employment (total over all businesses displaced), and assessment of severity of this impact on the local economy (proportion of number of businesses, proportion of number of jobs). • Establish whether businesses are located in key business areas, local business areas, within a localised area or dispersed through the study area. • Identification of businesses in the study area that have the potential to be affected by interruption or difficulty with access and likely impacts on customer convenience, deliveries, and business functionality.
Operation	• Identification of businesses that would be affected by noise, dust or visual appearance of the action. • Identification of businesses that would be affected by permanent changes in access arrangements and assess likely impacts on customer convenience, deliveries, and business functionality. • Identification of employment affects if the impacts are of a severity to reduce business functionality. • Establish whether these businesses are located in key business areas, local business areas, within a localised area or dispersed through the study area.

9.2.7 Assumptions

The findings of this section are subject to the following assumptions and limitations:

- Information about activities at Simpson Barracks have been garnered from publicly available resources and information provided by the DoD.
- This section does not assess any changes in business or property values due to the action, nor does it attempt to quantify changes to business turnover that may result from the construction and operation of North East Link.
- In some instances, one business occupies multiple properties, and in other cases multiple businesses occupy one property. The count of businesses affected by land acquisition provided in this section is based on the number of businesses affected by acquisition, not the number of properties acquired.
- It is possible that some businesses are operated from residential properties within the study area. However, without signage, these businesses cannot be easily identified. Home-based businesses that would be displaced by land acquisition have been included. Impacts on home-based businesses identified through the North East Link stakeholder engagement process have also been considered.
- This section was in part developed through consideration of other technical sections (see Section 9.2.8). These sections are subject to their own limitations and assumptions.

9.2.8 Linked sections

Table 9-3 lists other technical assessments from which information has been drawn for this study.

Table 9-3 Linkages to other assessments

Reference	Topic	Link
Section 12	Noise and vibration	Provides an assessment of the potential surface noise and vibration impacts during construction and operation. Findings from the noise and vibration assessment have informed the assessment of potential disruption to businesses.
Section 14	Air quality	Provides an assessment of North East Link's potential to impact air quality during construction and operation. Findings from the air quality assessment have informed the assessment of potential disruption to businesses.
Section 8	Social and community	Provides an assessment of North East Link's potential social impacts. Information from the social and community assessment has assisted in the preparation of the existing conditions section of this assessment, and informed the impact assessment on land used for community facilities.

9.2.9 Stakeholder consultation

Table 9-5 lists engagement activities specific to Commonwealth land related to business impacts.

Table 9-4 Stakeholder engagement undertaken for business

Stakeholder	When	Matters discussed	Outcome
Banyule City Council	March to November 2018	Banyule economic development strategy, business impacts, assessment of impacts on activity centres, potential locations for business relocations, and possible mitigation and support measures	Information obtained
Businesses in Greensborough Road and Watsonia Village	March to November 2018	Surveys to understand nature of local businesses	The surveys informed the existing conditions and the business impact assessment
Simpson Barracks, Commonwealth DoD	August to October 2018	Requests were made for information relating to business in relation to Simpson Barracks	A response was received on 29 October 2018
Watsonia Traders Association and Greensborough Chamber of Commerce	November 2018	Meetings to obtains information about the action and discuss feedback on business impacts	Information obtained

9.3 Description of the environment

9.3.1 Activity centres

Simpson Barracks is located within the City of Banyule, which has nearby major activity centres in the north and south of the municipality. The closest centres to the barracks are Greensborough Major Activity Centre in the north and Heidelberg Major Activity Centre in the south. Greensborough is the more popular major activity centre for people at Simpson Barracks, according to staff at the DoD. It includes retail, commercial and community uses along Grimshaw Street, Main Street and Church Street as well as the Greensborough Plaza Shopping Centre.

The Greensborough Plaza Shopping Centre is accessible via Greensborough Road and Delta Road from Simpson Barracks, Para Road to the south-east, Henty Street to the south, Grimshaw Street to the west, and Main Street to the north-east. Main Street provides the only major crossing of the Hurstbridge rail line within one kilometre of the shopping centre.

The City of Banyule also has a network of smaller neighbourhood centres. The two closest to Commonwealth land are the Macleod and Watsonia villages. Macleod Village is a strip shopping centre located in Aberdeen Road, approximately one kilometre west of Simpson Barracks and Greensborough Road offering a range of specialty and convenience shops, including restaurants, cafés, takeaway food, florist, pharmacy, bottle-shop and newsagent. Watsonia Village is north of Simpson Barracks along Greensborough Road and comprises approximately 65 businesses with the majority being in retail, health care and social assistance, and accommodation and food.

9.3.2 Businesses near Simpson Barracks

Individual businesses near Simpson Barracks are identified in Table 9-5.

Table 9-5 Businesses near Simpson Barracks

Business	Address	Description of location	Distance from Barracks
Shell petrol station incorporating a Coles Express minimarket	230 Greensborough Road Yallambie VIC 3085	At the north-west corner of the barracks. Located on privately held land.	< 10 metres
Road Runner Asphalt Driveways	272 Greensborough Road, Watsonia VIC 3087	North of the north-west corner of the barracks. Located on VicRoads land.	220 metres
PitStop Coffee Lounge	254-256 Greensborough Rd, Macleod VIC 3085	North of the north-west corner of the barracks on VicRoads land.	130 metres
Comfort Inn Greensborough	245 Greensborough Road Greensborough VIC 3085	Opposite Shell Coles at the north-west corner of the barracks on privately held land.	50 metres
Warringal Chiropractic	159-161 Greensborough Rd, Macleod VIC 3085	Opposite the barracks on the Macleod side of Greensborough Road on privately held land.	< 30 metres
Baptcare Strahalan Macleod	2-34 Erskine Rd, Macleod VIC 3085	West of the barracks on Greensborough Road	< 30 metres

Business	Address	Description of location	Distance from Barracks
Azco Electrical Solutions	5 Colleen Street, Yallambie VIC 3085	Home-based business located in residential property.	< 50 metres
Popcorn supplies	26 Borlase Street, Yallambie VIC 3085	Home-based business located in residential property.	< 50 metres
Dr. Peter Pleunik & associates	271 Greensborough Bypass, Macleod VIC 3085	North of the barracks on Greensborough Road	270 metres
Locks Unlimited mobile services	10 Dowle St, Macleod VIC 3085	Home-based business located in residential property	450 metres
North of the Yarra, new & second-hand school books	52-56 Strathallan Rd, Macleod VIC 3085	West of the barracks on Strathallan Road	450 metres
Kimmy Rose hairdressing	48 Strathallan Road Macleod VIC 3085	West of the barracks on Strathallan Road	450 metres
Maven Home Loans	7 Edwards Street, Macleod VIC 3085	Home-based business located in residential property on the Macleod side of Greensborough Road.	65 m
7-Eleven Yallambie incorporating Mobil fuel sales	371 Lower Plenty Road, Yallambie VIC 3085	Near the southern exit from the barracks in a hub with McDonalds and Viewbank Podiatry. Located on privately held land.	300 m
McDonalds Yallambie	375 Lower Plenty Road, Yallambie VIC 3085	Near the southern exit from the barracks. Located on privately held land.	300 m
Viewbank Podiatry	15 Martins Lane, Viewbank VIC 3084	Near the southern exit from the barracks in a hub with McDonalds and 7-Eleven. Located on privately held land.	400 m

9.3.3 Activities at Simpson Barracks

Simpson Barracks (formerly known as Watsonia Army Camp) is an Australia Army facility that occupies a 55-acre parcel of land. The property comprises military barracks, schools, administrative buildings, workshop and service areas and training buildings. The base is also host to the Army Communications training centre. It can be occupied by approximately 1,500 personnel at any one time, and provides housing for approximately 500 personnel.

Land uses comprise a mix of:

- Offices
- Training facilities
- Mess facilities
- Accommodation
- Outdoor and indoor sports facilities.

Accommodation is in the form of barracks. According to information provided by DoD, a large number of barracks inhabitants stay temporarily between two weeks to two years. Inhabitants are generally from outside the broader area (not from the City of Banyule) and stay on base most of the time while undergoing training.

The interior part of the site is developed to accommodate core activities, and the remainder presents as parkland. There is limited access for the public. The following organisations have been identified as being on the site:

- Defence Force Schools of Signals (a Tri-Service educational facility)
- Royal Australian Corps of Signals Museum
- 402 Squadron – Australian Air Force Cadets
- Australian Military Bank
- Defence Bank
- Hairdressers
- Café
- Clothes shop.

A component of the barracks' population are permanent staff. Many of the permanent staff live in close proximity to Simpson Barracks. A large number of Defence Housing Association homes are located to the south of the barracks. Other staff commute from locations within the local area (likely from locations in City of Banyule).

No information has been supplied about services provided on-site by businesses that are based external to Simpson Barracks. However, maintenance of military vehicles occurs on-site.

9.4 Relevant impacts and mitigation measures

The assessment by Matters More identified no businesses on Commonwealth land that would be displaced or impacted by North East Link. However, impacts to businesses outside Commonwealth land could have impacts on the barracks community that uses those businesses.

9.4.1 Disturbance to businesses used by the barracks community Impact description

Impact description

The assessment identified potential impacts on operation of businesses near the Commonwealth land which could affect their use by members of the barracks community, namely:

- Disruption to businesses from disruption to utilities
- Permanent displacement of a small number of businesses
- Noise, vibration and dust from road works affect amenity at businesses and customers of businesses on Greensborough Road.

Impact to utilities

Temporary disruption to utilities (electricity supply, water, sewerage) during construction could impact the ability of nearby businesses to provide goods and services.

Business displacement

Five businesses in Greensborough Road providing services and goods are expected to be displaced by North East Link. The displacement of these businesses would likely be permanent, as there are no obvious locations along Greensborough Road where replacement businesses could be established. The decision whether to re-establish locally or further afield is an individual business decision.

Some of these businesses serve the local population (and some commuters), including the Simpson Barracks community, by providing drive-through coffee, fuel, and convenience goods. A contractor that provides asphalting services for driveways and an electrical services contractor would also be displaced. However, other mobile contractors are available for on-site services (electrical, asphalt) within a four-kilometre radius.

The displacement of the businesses is likely to affect the convenience of access to fuel sales and associated services (such as an air compressor) and to convenience items sold at the Coles Express.

Amenity impacts

Businesses near North East Link on Greensborough Road would likely experience disturbance and amenity impacts (noise, dust) from construction activities, which may last up to several years. Specific businesses include a chiropractor, a retirement and aged care facility, a dental practice, a motel, a hairdresser, bookshop and various home-based businesses in the area. The Simpson Barracks community uses the motel for temporary accommodation of contractors and other visitors to the barracks and the chiropractor’s services.

While the impact would likely inconvenience customers, overall there is a low probability of businesses reducing their activities or moving their premises permanently because of construction activities. The motel located on Greensborough Road is most likely to experience reduced quality of service due to noisy construction activity (particularly at night).

Proposed avoidance and mitigation measures

No specific mitigation is proposed for the barracks community. A range of mitigation measures for impacts on business from construction activities would be implemented through the Environmental Management Framework (EMF) and EPRs as part of the Victorian EES process. Mitigation of impacts on businesses would in turn minimise indirect impacts on the barracks community.

Residual impact

Residual impacts on the barracks community from these impacts would mostly be temporary, limited to during specific phases of construction, and other businesses in the wider area provide the same or similar services. Most goods and services provided by displaced or impacted businesses are available from other providers within a two-kilometre radius, although the loss of a fuel service station on Greensborough Road would be noticeable for commuters and the travelling public. Alternative fuel sales are available at the 7-eleven store in Yallambie on Lower Plenty Road which is near a southern exit from Simpson Barracks.

The residual impacts are not considered to be significant.

9.4.2 Impacts of altered access during construction

Impact description

A small number of businesses and their customers near Commonwealth land would likely experience access and traffic issues during construction. Increased numbers of heavy vehicles and other vehicles on the road network could reduce the attractiveness of businesses, and changed traffic conditions could affect deliveries to businesses.

These businesses are located along Greensborough Road, west of Greensborough Road or along Lower Plenty Road. Some of these businesses would be home-based businesses. The Simpson Barracks community uses the services provided by these businesses and may be inconvenienced by altered access arrangements during construction.

The impact would likely inconvenience customers, but there is a low probability of businesses reducing their services or moving their premises permanently because of altered access or changed traffic conditions, with the exception of a business at 159–161 Greensborough Road located adjacent to the tunnel access roads.

Proposed avoidance and mitigation measures

Impacts would be confined to the construction period and addressed by requiring the contractor to minimise access impacts on businesses during construction. Any reduction in the level of access or function of any business or commercial facility would be minimised to the extent and duration necessary to carry out the relevant construction-related works. Potentially affected business and commercial facilities would be provided with adequate notification of potential impacts and temporary access arrangements, and emergency access would need to be maintained at all times. Access would be maintained for customers, delivery and waste removal unless there has been prior arrangement with affected businesses.

Residual impact

The residual impact on the barracks community of altered access arrangements for businesses during construction is not considered to be significant.

9.4.3 Impacts from permanent altered access arrangements

Impact description

The reconfiguration of the road network around the Lower Plenty Road interchange would permanently change some access arrangements for businesses located west of Simpson Barracks. In particular, access to 159–161 Greensborough Road would be via a new service road. This business provides chiropractic services and other health services, including to employees at Simpson Barracks. Customer access to the business would be retained, but access may not be as convenient as is currently the case.

Proposed avoidance and mitigation measures

All permanent access to business and commercial facilities affected by the works would need to be restored, or relocated as agreed with the relevant property owner, including associated landscaping and restoration works, and temporary access arrangements put in place for the duration of construction must be removed when construction has ceased.

No further mitigation is provided for customers of businesses or businesses that would have their access arrangements permanently changed. The new access arrangements would comply with relevant road and safety standards.

Residual impact

The residual impact on the barracks community of permanently altered access arrangements for businesses is not considered significant.

9.4.4 Construction impacts of a northern TBM launch

Launching the TBM from the north would not alter the business impacts described in the previous sections.

9.5 Residual impacts

Table 9-6 sets out the significance of residual impacts on businesses.

Table 9-6 Summary of residual impacts on business

Impact	Mitigation	Significance of residual impact
Works to utilities from construction activity disrupt businesses used by the barracks community.	Utility assets would be protected or, where required, relocated, to the reasonable satisfaction of the service provider and/or asset owner. Any damaged caused to property or infrastructure would be appropriately remedied in consultation with the property or asset owner.	Not significant
Displacement of five businesses near Commonwealth land. that are used by the barracks community	Acquisition of business properties would be in accordance with Victoria's *Land Acquisition and Compensation Act 1986* (LAC Act). It is not proposed to provide mitigation for customers.	Not significant
Amenity impacts from construction on businesses used by the barracks community	Construction noise abatement measures would be provided as set out in a construction noise and vibration management plan, and construction noise monitoring would be required. A complaints process and community engagement would assist with identifying and addressing noise issues.	Not significant
Changed traffic conditions or altered access to businesses used by the barracks community during construction cause inconvenience	The contractor would be required to minimise access impacts on businesses during construction, including through implementation of a Transport Management Plan (TMP). Emergency access would be maintained at all times.	Not significant

10. Social and community

10.1 Introduction

GHD undertook an assessment of the social and community impacts of the action on Commonwealth land. This section summarises the assessment's findings.

10.2 Assessment method

10.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 10-1 summarises the other key policies and guidance relevant to the assessment.

Table 10-1 Key legislation, policy and guidance for social and community assessment

Policy/guidance	Relevance
Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects (Vanclay, IAIA, Esteves, Aucamp, & Franks, 2015).	The International Association of Impact Assessment (IAIA) defines Social Impact Assessment (SIA) as the process of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment. These guidelines provide a framework for the preparation of a SIA.
Planning Institute of Australia Social Impact Assessment Position Statement (Planning Institute of Australia, 2010)	The Planning Institute of Australia position on SIA states that: • Impact assessment is an important part of planning and decision making processes • Proposals for change which require an environmental or economic impact assessment also require a SIA • A SIA of policies or plans should be sufficiently robust to anticipate the impact of proposals made under the plan and minimise the need for further assessment • Without limiting the matters about which a SIA may be appropriately required, proposals for a significant change of land use, including new highways, should be fully assessed for their social impacts in a SIA • A SIA should be undertaken by appropriately trained and qualified personnel using rigorous social science methodologies and with a high degree of public involvement. A SIA should be a public document.
Environmental Impact Assessment Practice Note – Socio-economic assessment (Roads and Maritime Services NSW, 2013)	• This practice note provides a framework for assessing socio-economic impacts of transport infrastructure projects to enable impact assessments to be carried out consistently, to a high standard, and be properly integrated with other environmental assessments, design development and management processes. A socio-economic impact assessment would provide a description of the existing socio-economic conditions, including the baseline conditions of potentially affected groups or communities, impact assessment including identifying and analysing the likely benefits or impacts of a project and assessing the magnitude, duration and likelihood of identified benefits and impacts, and identification of mitigation and monitoring measures.

10.2.2 Relevant assessment criteria

Social and community impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

10.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on receptors of social and community impacts that are on Commonwealth land. Impacts, which can relate to issues of movement and access, can be beyond the project boundary (see Section 3.1) affecting those across the whole of the Commonwealth land. The PER Guidelines require recognition of the Defence personnel 'as a distinct community' to which impact may occur.

The assessment therefore examined the impacts on people and communities across the whole of Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks.

The assessment also included impacts on receptors on Commonwealth land, from potential loss of access to community facilities in the local area. A distance of 500 metres from the project boundary (see Section 4.2.2) was used to define that local area.

Social and community impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The impacts considered were:

- The social impact of community use of Commonwealth land not currently occupied by the DoD
- The social impact on defence stakeholders of changes to Commonwealth land affecting visual, noise and air quality amenity
- The social impact on defence stakeholders of changes to Commonwealth land affecting roads, traffic, and shared use path
- The social impact on defence stakeholders of changes to Commonwealth land affecting community infrastructure facilities.

The assessment considers impacts on DoD estate planning and how the use of the affected area would be managed in consultation with DoD regional environmental personnel.

10.2.4 Description of environment

The existing conditions assessment was used to establish a baseline of the study area (see Section 10.2.3) and provide a profile of the current social environment. This includes the demographic characteristics, community values and community infrastructure for the community surrounding Simpson Barracks, based on the information available.

Demographic characteristics

Specific information on the demographic characteristics of the personnel residing at the barracks was not available, with only high level information provided through consultation with the management of Simpson Barracks. However, the relevant demographic characteristics of the community within the area intersected by North East Link have been identified. This includes information on population, mobility, income and information on relative socio-economic advantage and disadvantage within the local communities.

Community values

Community values, or a sense of community, are generally accepted to be the social ties established within a community, in part based around the features and qualities of the built environment that encourage these social ties and contribute to quality of life and wellbeing.

Features that contribute to community values include tangible (physical) elements such as parks, buildings, and landscape, and intangible (social) elements such as sense of belonging and community diversity.

The community values were assessed against the following indicators to the extent possible given the information available:

- **Amenity and character** – distinctive character of community and impacts of existing impacts on amenity
- **Community cohesion** – community or social bonds, community interactions, trust, safety and reciprocity
- **Connectivity** – movement through the community and safety and convenience of access to places in and outside the community.

Community values were identified through:

- Discussions with the management of Simpson Barracks to gain an understanding of the operation of the facility and the nature of the staff and other occupants
- Site visit to observe location of key transport routes, and overall characteristics of the study area
- Stakeholder engagement activities to validate and elaborate the assessment team's understanding of the social baseline conditions.

Community infrastructure

The location and type of community infrastructure facilities and services located approximately 500 metres from Simpson Barracks were identified through a review of geographic information system (GIS) mapping, Google map searches and a site visit and the discussions with the Simpson Barracks management.

The definition of community infrastructure facilities is based on the Community Infrastructure Development Framework (City of Melbourne, 2014) and includes education and child care facilities, aged care, health centres and services, disability services, justice and emergency services, libraries, youth and community spaces, indoor and outdoor sport and recreation, and passive open space such as parks and gardens.

10.2.5 Information sources

Information on the barracks was obtained from publicly available sources and communication with Simpson Barracks management. The sensitive nature of the operations at Simpson Barracks limited the information that could be provided.

Data sources used in the social and community assessment are presented in Table 10-2.

Table 10-2 Data sources for the social assessment

Source	Type of data
North East Link Business Case, 2018 (NELA, 2018)	Social and economic information
DoD, Simpson Barracks	Consultation with affected stakeholders to understand the current environment and their views on potential changes due to North East Link
Other PER technical sections	Review of the findings of relevant technical assessments to gather evidence to assess social implications of changes due to North East Link

10.2.6 Impact assessment

This study has assessed the planned (known) and potential social impacts, both positive and negative, that North East Link may have on the social fabric of the community with regard to wellbeing, community cohesion, functionality and access to goods, services and facilities.

All social impacts are assessed qualitatively, and recognise the existing baseline conditions, people's adaptability, attitude and sensitivity to such changes. The significance of the social impacts of North East Link considers the severity and/or the duration of the impact and the capacity of the community to adapt to the change.

10.2.7 Assumptions

The SIA should be read with the following qualifications:

- This section reflects the existing conditions within the social study area as of July 2018 and information drawn from ABS Census 2016
- The assessment of social impact is based on information and findings of other technical assessments listed in Section 10.2.8 available at the time of section preparation
- This section includes feedback from key stakeholders and local governments based on their views at the time of consultation
- The opinions, conclusions and recommendations in this section are based on information available at the date the section was prepared. They are based on the assumption that mitigation set out in this section are implemented
- The assessment does not assess impacts on particular vulnerable groups (socio-economically vulnerable, ageing populations, populations with high percentages of children, culturally and linguistically diverse (CALD) groups, and people with disabilities) as these are unlikely to have significant representation within the barracks.

10.2.8 Linked sections

Table 10-3 lists other technical assessments from which information has been drawn for this study.

Table 10-3 Linkages to other assessments

Reference	Topic	Link
NEL UDS	UDS	The Urban Design Strategy (UDS) provides the design guidelines to inform the urban design requirements and establishes the minimum quality expected in terms of performance outcomes and benchmarks for quality. The approach to urban design has informed the SIA of changes to amenity and character, and access and connectivity.
Section 8	Land use planning	Provides an assessment of North East Link's impact on land uses within the study area, including an understanding of changes to residential, commercial, industrial, open space and community land use. Findings from the land use planning assessment have informed the existing conditions section of this section, and the SIA of land and relocation and acquisition impacts, changes to amenity and character, access and connectivity, and community infrastructure facilities.
Section 9	Business	Provides an assessment of North East Link's impacts on businesses within the section study area from changes in access and full or partial property acquisition. Findings from the business assessment have informed the SIA of relocation and acquisition impacts, and changes to community infrastructure facilities.
Section 11	Traffic and transport	Provides an assessment of North East Link's impacts on the transport network within the study area. Information related to changes to local and regional access and connectivity due to North East Link have informed the preparation of this section's existing conditions and assessment of social impacts of changes to community access and connectivity, and community infrastructure facilities.
Section 12	Noise and vibration	Provides an assessment of North East Link's potential noise and vibration impacts on sensitive receptors within the section study area. Findings from the noise and vibration assessment have informed the assessment of social impacts of changes to amenity and character, and community infrastructure facilities.
Section 13	Tunnel vibration	Provides an assessment of North East Link's potential vibration impacts specifically related to tunnelling activities during construction only. Findings from the tunnel vibration assessment have informed the assessment of social impacts of changes to amenity and character, and community infrastructure facilities.
Section 14	Air quality	Provides an assessment of North East Link's impacts on local air quality within the study area. Findings from the air quality assessment have informed the assessment of social impacts of changes to amenity and character, and community infrastructure facilities.
Section 18	Historic heritage	Provides an assessment of heritage values and documents North East Link's potential impacts on historical assets. Findings from the historic heritage assessment have informed the assessment of social impacts of changes to amenity and character.
Section 20	Landscape and visual impacts	Provides an assessment of the visual impact of North East Link's design on sensitive receptors within the study area. Findings from the landscape and visual impact assessment have informed the assessment of social impacts of changes to amenity and character, and community infrastructure facilities.

10.2.9 Stakeholder consultation

Table 10-5 lists engagement activities specific to Commonwealth land related to social and community impacts.

Table 10-4 Stakeholder engagement undertaken for social and community

Stakeholder	When	Matters discussed	Outcome
Meeting with Banyule City Council	17 May 2018	Information on North East Link was presented. Existing socio-economic conditions of the community as they may relate to North East Link were discussed. This included socio-economic characteristics, existing amenity, location and usage of key community infrastructure facilities, vulnerable groups, connectivity. Concerns from construction and operation of North East Link and thoughts on managing concerns.	Information gained on existing conditions in each council area was incorporated into the SIA. Discussions also informed the specialists' understanding of potential impacts that could occur and have been incorporated into the SIA.
Simpson Barracks, Commonwealth DoD	August to October 2018	Requests were made for information relating to the population and community facilities at the barracks.	A brief response was received on 29 October 2018.
Simpson Barracks, Commonwealth DoD	August to October 2018	Requests were made for information relating to contamination at the barracks.	Written responses were received and discussed during a telephone meeting.

In the wider community, consultation was undertaken between April and September 2018 including: meeting with key community groups, interviews and surveys with a sample of community infrastructure facilities managers/owners and user groups, attendance at information sessions and community workshops.

10.3 Description of the environment

10.3.1 Local context for Simpson Barracks

The City of Banyule is bound by the Yarra River to the south and the Darebin Creek to the west, both of which are associated with large and in some cases regionally significant open spaces. The City of Banyule is also part of the Melbourne Riverlands and Plenty Yarra Community Tourism Association tourist areas, which are valued for their natural landscapes and cultural heritage (Aboriginal and non-Indigenous) (City of Banyule, 2015b). The area surrounding Simpson Barracks includes primarily residential areas in Macleod and Yallambie.

10.3.2 Demographic profile

Specific demographic data was not available for occupants of the Simpson Barracks. Accommodation provided at the facility is single quarters, so the facility hosts a working age population, and does not cater for families or the elderly.

Personnel associated with Simpson Barracks include:

- Full time personnel – 672
- Reservists – 431
- Trainees – 1,000
- Cadets – 100
- Public servants – 80
- Contractors 80.

Based on consultation with DoD, it is understood that the majority of full time personnel live within the surrounding community (within 30 minutes commute), with 10 to 15 per cent of full time personnel living at Simpson Barracks. All trainees are housed at the barracks.
The barracks provides accommodation for 1,000 personnel, with surge capacity for an additional 200 personnel.

10.3.3 Local connectivity

The area surrounding Simpson Barracks includes a number of arterial roads, including Greensborough Road, Yallambie Road and Lower Plenty Road. There are road bicycle paths along Greensborough Road, and off-road pedestrian paths are along Greensborough and Yallambie roads. Active transport as a commuting mode is 4 per cent within Viewbank-Yallambie, compared with 3 per cent within Greater Melbourne. However, for those employed in the defence industry in Viewbank-Yallambie, around 50 per cent of people either walked or cycled to work (ABS, 2018a), likely reflecting those who live at the barracks.

Due to the nature of the facility, connectivity with the local area is intentionally low. Simpson Barracks is fenced and gated with active security. However, personnel do leave the barracks to access local facilities and, for most full time staff, to travel to and from work. Access is via four gates.

There is a degree of informal connectivity across the publicly accessible Commonwealth land south of Simpson Barracks, where pedestrians can use informal paths to cross from the east side of Greensborough Road to Coleen Street.

10.3.4 Community facilities

Community facilities within Simpson Barracks

Simpson Barracks is owned by the DoD. Land at Simpson Barracks is used for accommodation, offices and training facilities, areas for memorial activities, mess and canteen facilities, recreational facilities including a pool, tennis courts and gym and a range of other uses such as a hairdresser, bank and chapel (see Figure 8-1).

The barracks also includes a number of active open space land uses (Long Green, Silcock Oval and Main Oval) and passive open spaces such as the Banyule Creek Area and Rentons Ridge.

Simpson Barracks land adjacent to Greensborough Road is generally characterised by vegetation, the Banyule Creek Area open space and minimal built structures, such as training and office facilities and the Blamey Road entrance to the barracks. This is the primary entrance to the barracks.

The publicly accessible Commonwealth land south of Simpson Barracks is just north of Borlase Reserve, this connects to the River Gum Walk, in addition to providing pedestrian connectivity, has amenity and wildlife values (City of Banyule, 2016b). This area of land is generally characterised by a continuation of the vegetation on the barracks land and is a part of Banyule Creek.

External community facilities accessible to Simpson Barracks personnel

A number of nearby community centres may be used by Simpson Barracks personnel:

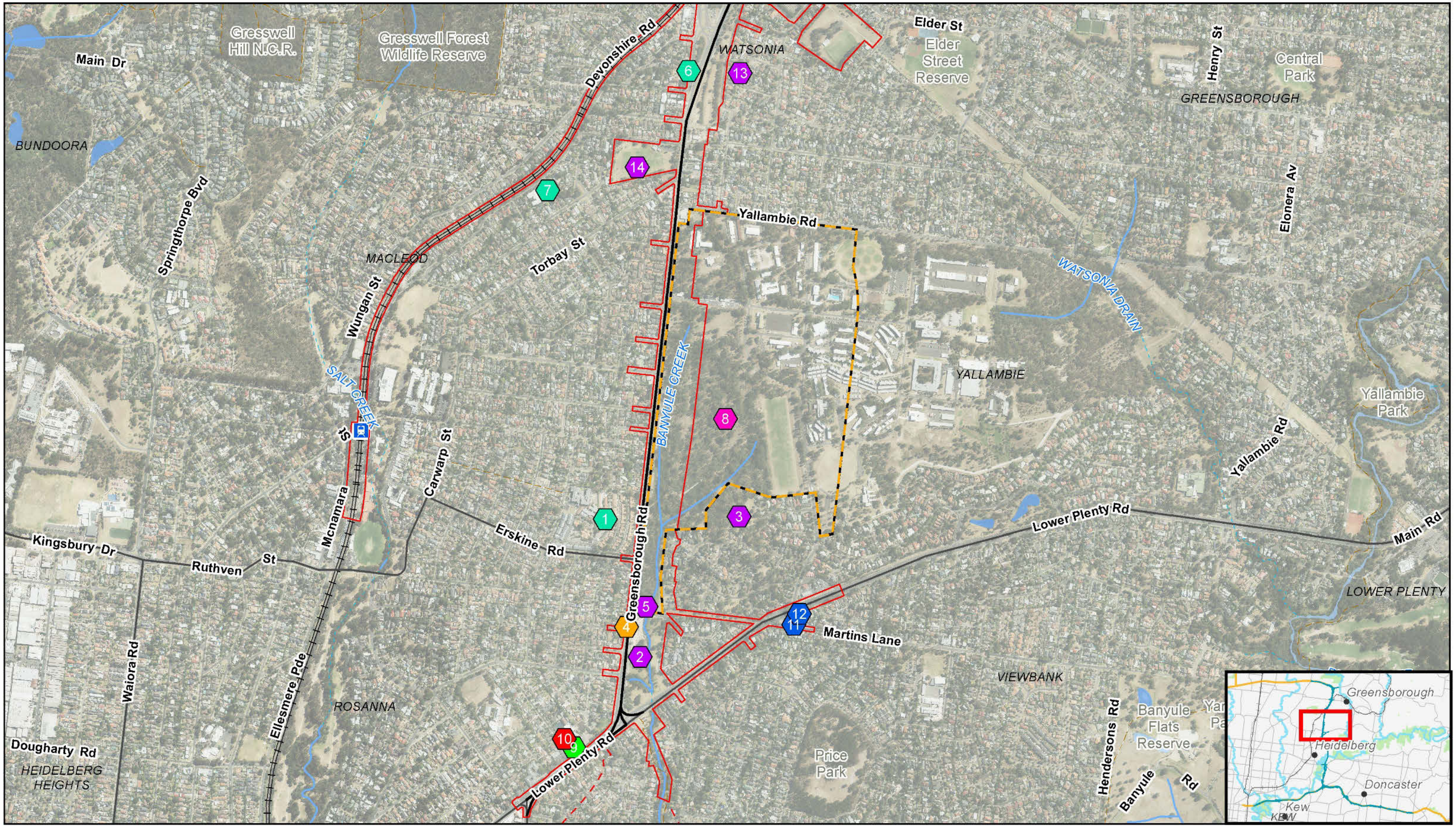
- The Greensborough Activity Centre, the Heidelberg Activity Centre and the Ivanhoe Activity Centre, the Macleod Village Activity Centre and the Watsonia Village Neighbourhood Centre. These areas provide a range of retail and commercial services and spaces, in addition to municipal services, such as libraries
- Banyule hosts a significant range of health facilities, including the Austin and Repatriation Medical Centre, the Warringal Private Hospital and the Banyule Community Health Centre.

There are a number of community facilities within 500 metres of the action on Commonwealth land which are listed in Table 10-5, including open space and recreational facilities, schools, aged care facilities and medical facilities. Of specific interest are:

- Winsor Reserve is located to the north of Simpson Barracks used for formal and informal recreation, and includes an oval, general playground, basketball/netball courts and on-site car parking
- Schools located nearby include St Martin of Tours Catholic Church and Primary School and, the Greensborough Road Early Learning and Kinder facility
- Two medical facilities are located in the local study area, including Macleod Maternal and Child Health, the Viewbank Family Medical Group and Viewbank Podiatry
- These community infrastructure facilities have been included in this assessment as they may be used by defence personnel and their families. Although located outside the local study area, it is likely that defence personnel use services located at the Watsonia Neighbourhood Centre.

Table 10-5 Key community infrastructure within 500 metres of Commonwealth land affected by North East Link

Community infrastructure facility	Suburb	Map code
Baptcare Strathalan Macleod	Macleod	1
Borlase Reserve	Yallambie	2
Coleen Reserve	Yallambie	3
Greensborough Road Early Learning and Kinder	Macleod	4
Melbourne Water easement	Yallambie	5
MS Society Retirement Village	Watsonia	6
Regis Macleod	Macleod	7
Simpson Barracks	Yallambie	8
St Martin of Tours Catholic Church	Rosanna	9
St Martin of Tours Catholic Primary School	Rosanna	10
Viewbank family medical group	Viewbank	11
Viewbank podiatry	Viewbank	12
West Mayling Reserve	Watsonia	13
Winsor Reserve	Macleod	14



Paper Size A4

0 120 240 360 480

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- PER 500m buffer

Roads

- Highway
- Major road
- Walking or cycling path
- Railway
- Train station
- Stream
- Drain/channel/other
- Watercourse
- Lake

Project boundary

- Project boundary - sub-surface
- Project boundary - surface

Community Infrastructure

- Aged Care
- Child Care
- Community Centre
- Education
- Health
- Library and Cultural Space
- Open Space and Recreation

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	E
Date	03/04/2019

Community infrastructure local study area

Figure 10-1

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: bkaemmerling

10.4 Relevant impacts and mitigation measures

10.4.1 Land acquisition and relocation

Impact description

The reference project would require acquisition of an 11-hectare parcel of land at Simpson Barracks land on the east side of Greensborough Road. The land is predominantly vegetated with no built structures and is defined as an 'open space zone' within the 2014 Zone Plan for Barracks. The parcel includes the main barracks entrance at Blamey Road and associated security and access infrastructure. Impacts to access and connectivity from land acquisition are discussed in Section 10.4.3.

Consultation with the DoD indicates the land to be acquired has limited operational use.

The land to be acquired would include Assembly Place and Commemorative Plantings located south of Blamey Road within Simpson Barracks. Assembly Place would be removed including the mound, flagpole, commemorative tree plantings and associated plaques. However, this area has not been used for ceremonial purposes for several years and would not be expected to be reused for ANZAC day or other services following North East Link construction. Although this area has not been used officially for some time, it likely has some social value for barracks' personnel.

North East Link would also require the permanent acquisition of a two-hectare area of publicly accessible Commonwealth land south of Simpson Barracks. This area is characterised by vegetation and part of the Banyule Creek and is used informally by the public, valued for its ability to provide access to and views of 'woodland'-like areas. Although the removal of this informally used area would reduce local residents' and barracks' personnel access to informal open space recreational areas, there is considerable open space available within the suburbs in the local study area. Consequently, the loss of this informal open space would likely to have a limited impact on people's access to open space areas and the associated social benefits.

Proposed avoidance and mitigation measures

Removal of the Assembly Place and Commemorative Plantings would take place in consultation with the management of Simpson Barracks. This is discussed further in Section 18.

Residual impact

The removal of the Assembly Place and Commemorative Plantings is expected to result in a minor impact on defence personnel, assuming that its ceremonial and commemorative function is relocated and maintained elsewhere within the barracks. The acquisition of the small section of publicly accessible Commonwealth land south of Simpson Barracks is expected to have a negligible impact on residents' and defence personnel's access to open space in the local study area.

The social impacts that would occur within the Commonwealth land from land acquisition are not expected to be significant.

10.4.2 Construction amenity impacts

Impact description

Visual amenity

Simpson Barracks is identified as a culturally significant landscape with views that are considered valuable and require protection under local policy. Within Commonwealth land, construction activities would include the removal of existing vegetation along the eastern side of Greensborough Road and the presence of a construction site within Simpson Barracks.

Defence personnel, including those who reside within the barracks (approximately 250 metres from the alignment) are not expected to experience direct views of construction sites and activities due to the densely vegetated buffer between the uses within the barracks and the North East Link corridor. Landscape and visual impacts are discussed further in Section 20.

Noise amenity

Construction noise impacts are discussed in Section 12. Noise modelling identified three locations at Simpson Barracks (two identified as training/office and one as accommodation) where possible exceedance of construction noise guideline targets may occur (above which there may be some impact on people and communities within).

Some construction activities would be required outside daytime construction hours including tunnelling works and other unavoidable works such as delivery of oversized plant or structures, and other works required out of hours to enable the works to be carried out safely, or to avoid significant traffic disruption or major traffic hazards. The associated increase in noise levels from these activities is expected to be temporary in duration and intermittent.

Air quality

Air quality impacts are discussed further in Section 14. Construction activities such as site clearing, construction, operation of equipment, and demolition activities within the North East Link corridor would result in intermittent dust and odour, as well as combustion emissions from construction vehicles and machinery.

Proposed avoidance and mitigation measures

Visual amenity

Avoidance and mitigation measures for landscape and visual impacts are discussed in Section 20 based around provision of temporary landscaping and management of temporary and construction works in generally accordance with the Urban Design Strategy guidance on using design to help manage construction impacts. Measures would be developed to minimise light spill impacts during construction.

Noise and vibration

A range of avoidance and mitigation measures for construction noise and vibration are discussed in Section 12. These would be managed and implemented through a Construction Noise and Vibration Management Plan (CNVMP) in consultation with Simpson Barracks.

Air quality

Avoidance and mitigation measures for construction air quality impacts are discussed further in Section 14. These would be managed through a Construction Environmental Management Plan (CEMP) and a Dust and Air Quality Management and Monitoring Plan (DAQMMP).

Consultation

A Communications and Community Engagement Plan and Community Liaison Group would be established to engage with stakeholders, keep stakeholders informed about construction activities, and provide the opportunity to give feedback to NELP.

Residual impact

Following the implementation of avoidance and mitigation measures discussed above, the temporary social impacts of visual, noise and air quality change on nearby residents are expected to have only minor to moderate social impacts and are not considered significant.

10.4.3 Access and connectivity impacts during construction

Impact description

Road access

The main Blamey Road entrance to Simpson Barracks and its associated security and access infrastructure would be relocated from their current position within the acquired land, but the function would be maintained at all times as required by the DoD. Other access points are expected to be maintained throughout construction, and defence personnel would continue to be able to access the barracks.

Traffic changes due to broader construction activities would temporarily increase the travel time of defence personnel for daily commute or usual trips on these roads, including commutes to Melbourne CBD.

Additional time spent travelling is likely to reduce the time people spend with families and undertaking leisure and social activities. Construction sites and changed traffic conditions along Greensborough Road would likely increase perceived barriers to travel across the road for defence personnel. However, since such traffic changes would be temporary and alternative routes and access would be available, it is unlikely this temporary and infrequent deterrence would lead to social isolation. Traffic impacts are discussed further in Section 11.

Shared use paths

Construction of North East Link would require widening the existing path between Yallambie Road and Lower Plenty Road adjacent to Commonwealth land, and a new path in the reserve north of Drysdale Street between Greensborough Road and Lower Plenty Road. There is potential that shared use path changes would temporarily disrupt or increase travel times for defence personnel who use these paths for daily commute or recreation.

Proposed avoidance and mitigation measures

Access

Access to the barracks would be maintained throughout construction. If an alternative access to the barracks is required it is expected this would have only a minor impact on the operation of the barracks.

Construction-related traffic volumes would be managed to be generally within the existing capacity of roads and during off-peak hours. Lane and road closures would be minimised and as far as possible occur during off-peak hours. Residents would be engaged with before and during construction, allowing traffic changes to be anticipated.

Shared use paths

Measures would be implemented to provide for pedestrian and active transport access during construction, including engaging with stakeholders regarding any diversions.

Residual impact

The overall social impact to defence personnel and the community from changes to traffic and transport outside the barracks is not expected to be significant.

Changes to shared use paths are not expected to significantly impact access and connectivity for defence personnel.

10.4.4 Construction impacts on community infrastructure facilities and users

Impact description

Construction activities may indirectly affect defence personnel by affecting the function and viability (that is, the ability of facilities to continue providing community services) of community infrastructure facilities nearby.

Open spaces and recreational facilities

There are five open space areas near Commonwealth land. Four of these open spaces provide mainly passive recreational areas and Winsor Reserve includes a number of active recreational nodes. Borlase Reserve, the Melbourne Water Easement, and Winsor Reserve in particular would be temporarily occupied by North East Link. These facilities are outside Commonwealth land but may be used by defence personnel and experience changes due to impacts on Commonwealth land.

The reduction in access to open space for defence personnel may reduce opportunities for active and passive recreation, and community interaction. For open space not temporarily occupied, construction activities are likely to generate noticeable levels of noise temporarily and intermittently especially in areas close to construction activities. This may temporarily and discontinuously disturb passive recreational activities when the timing of high noise-generating construction activities would coincide with these activities. Disturbance would mean that passive recreational spaces may not be appealing for use during these periods.

However, defence personnel have considerable opportunity for active and passive recreation within the barracks and in the broader area, limiting the effect of noise or a temporary reduction in open space on defence personnel.

Educational, child care facilities and religious facilities

St Martin of Tours Catholic Church and Primary School and Greensborough Road Early Learning and Kinder are near Commonwealth land and may be used by defence personnel and their families, and may experience change due to impacts on Commonwealth land.

These changes could be from temporary and intermittent increase in noticeable levels of noise which could disturb conversation, impact people's capacity to participate in work and learning activities, and outdoor play. Changes to the traffic and transport environment due to changes on Commonwealth land may result in defence personnel and their families needing to cross busy roads, could temporarily increase their travel times during school pick up and drop off times, or require them to make alternative arrangements.

Emergency and medical services

The Viewbank Family Medical Group and Viewbank Podiatry may be used by defence personnel who may experience increased travel times to these services. However, it is unlikely that connectivity to the facility would be reduced to an extent to deter users.

Proposed avoidance and mitigation measures

Noise impacts on community facilities would be minimised and managed using the same measures discussed above in Section 10.4.2, including a Construction Noise and Vibration Management Plan (CNVMP) and a Communications and Community Engagement Plan.

The development of a Transport Management Plan (TMP) is expected to minimise traffic and transport disruptions within the local study area and the Communications and Community Engagement Plan would facilitate engagement with residents before and during construction. This would allow users of facilities to anticipate traffic changes and plan their journey.

Residual impact

Following the implementation of avoidance and mitigation measures, changes in the operation of community facilities including open space areas, education and childcare and medical facilities are expected to result in only negligible to moderate social impacts on defence personnel on Commonwealth land. None of these impacts are considered significant.

10.4.5 Operational amenity impacts

Impact description

Visual

Landscape and visual impacts are discussed further in Section 21.4. North East Link would alter the character of the land by creating permanent new infrastructure on Commonwealth land and modifying Banyule Creek.

For defence personnel, the existing densely vegetated buffer between the estate and North East Link corridor would screen the other infrastructure and lower half of the ventilation structure. Only part of the proposed ventilation structure would be visible from within Simpson Barracks but it would be a visually dominant feature for some defence personnel living at the barracks and with views towards the infrastructure.

Noise

Noise impacts are discussed further in Section 12. During operation, North East Link would reduce traffic-related noise for defence personnel due to traffic diversion to North East Link and the presence of new noise walls which may contribute to slightly quieter residential amenity. The noise assessment indicated there would be no residual impacts associated with the ventilation structure's noise impacts to Simpson Barracks.

Air quality

Improved air quality is predicted for the 2026 and 2036 scenarios on Greensborough Road south of Strathallan Road to Lower Plenty Road due to diversion of traffic to North East Link. Improved air quality is expected to enhance the air quality amenity of defence personnel at this section of Greensborough Road.

For some defence personnel in areas north of Strathallan Road, North East Link's operation would increase air quality impacts. The northern ventilation structure would result in minor exceedances in dust (PM_{10} and $PM_{2.5}$) for the 2026 and 2036 scenarios in the surrounding area primarily due to high background concentration. However, an increase in dust is not likely to change people's lifestyle or day-to-day activities.

Proposed avoidance and mitigation measures

Visual

Design would be generally in accordance with the Urban Design Strategy (UDS) which would influence the amount of available space for planted buffers. During detailed design the action would also minimise landscape and visual impacts to the extent practicable, and maximise opportunities to enhance amenity.

Noise

Measures would be implemented to verify compliance with noise and vibration requirements for traffic and tunnel ventilation system noise. Remedial action must be taken as soon as practicable in the event that the external traffic noise performance requirements are not met.

Air quality

Proposed avoidance and mitigation measures would require an ambient air quality monitoring program in consultation with EPA Victoria to measure impacts of North East Link and measure in-tunnel air quality and ventilation structure emissions to demonstrate compliance with emission standards. Remedial action would be taken in the event that the standards set out are not met.

Residual impact

Following the implementation of avoidance and mitigation measures, the operational impacts of visual changes, noise and air quality changes are not expected to be significant.
Defence personnel in some areas of Simpson Barracks are expected to experience positive social impacts resulting from improved noise levels and air quality because of changes in traffic flow due to North East Link.

10.4.6 Operational access and connectivity impacts

Road and traffic impact description

During operation, access points to Simpson Barracks are not expected to change and defence personnel would continue to be able to access areas within the barracks.

Large decreases in traffic volumes including trucks are predicted along Greensborough Road due to diversion to North East Link. Decreased traffic would improve traffic flow and travel times for defence personnel accessing Greensborough Road by cars, trucks, buses and cyclists. This would potentially allow more time available for people to spend with families and undertaking leisure and social activities.

Shared use paths impact description

The new shared use path on Greensborough Road would restore cyclist and pedestrian access for defence personnel. It would provide connection to other shared use paths proposed for the action which would benefit commuter and recreational cyclists. Increased access to shared use paths for defence personnel may improve access to nearby community facilities.

Residual impacts

Improvements to roads and traffic and to the shared use path network would lead to positive social impacts for defence personnel. There would be no significant adverse impacts.

10.4.7 Operational community infrastructure facilities and users

Impact description

Due to the overall positive benefits that North East Link would generate during its operation, as discussed in previous sections of this section, it is considered that social impacts of the operation of North East Link on most types of community infrastructure facilities (as categorised in Section 10.3.4) would be positive.

Defence personnel using community infrastructure facilities along Greensborough Road would experience a change in visual amenity, with the removal of vegetation within Simpson Barracks land and establishment of new infrastructure, including new noise walls along much of the Commonwealth land that is currently vegetated. Users would also adjust to visual changes over time and visual amenity is not related to the core function of community infrastructure facilities in the area that would experience these changes.

Reduced traffic noise levels may be expected in areas adjacent to Greensborough Road north of Erskine Road. This would improve the value of community infrastructure facilities that provide outdoor activities, including open space and recreational areas, and schools. A small number of community infrastructure facilities south of Erskine Road would experience marginal increases of traffic-related noise. This increase is not expected to result in a loss of noise amenity or impact on the function of these facilities.

Improved air quality is predicted for both 2026 and 2036 scenarios on Greensborough Road south of Strathallan Road to Lower Plenty Road due to diversion of traffic to North East Link. Improved air quality is expected to enhance the air quality amenity of users of community facilities in this section of Greensborough Road. However, community infrastructure along Greensborough Road could expect minor increases in dust (PM_{10} and $PM_{2.5}$) for the 2026 and 2036 scenarios in the surrounding area primarily due to high background concentrations. Increased dust would reduce the amenity of residents of accommodation facilities and users of other community infrastructure facilities.

Large decreases in traffic volumes are predicted along Greensborough Road due to diversion to North East Link. This decreased traffic would likely improve accessibility to and from community infrastructure facilities for defence personnel. This would act to tenable community infrastructure facilities to maintain users and their functionality, which would act to facilitate social cohesion and the provision of key social services in the longer term.

Improved connectivity and accessibility to and between open space areas and shared use paths has the potential to positively impact on the communities' social cohesion, sense of wellbeing and ability to engage in active and recreational lifestyles. Defence personnel may experience a negligible to minor benefit from these changes, as it is likely they would primarily access open space within the barracks. However, this improved connectivity would be particularly beneficial for defence users of the schools in the area.

Proposed avoidance and mitigation measures

As discussed above, a range of measures would be implemented to manage negative amenity impacts from the operation of North East Link.

Residual impact

The operation of North East Link on Commonwealth land is expected to result in changes to visual amenity, noise and air quality that would potentially have minor social impacts and benefits to community infrastructure facilities and defence personnel using those facilities. Changes to traffic conditions and shared use pathways are expected to result in a negligible to minor benefits to all users of community infrastructure facilities. These impacts are not considered significant.

10.4.8 Construction impacts of a northern TBM launch

Launching the TBM from the north would not change the social and community impacts described in the previous sections.

10.5 Residual impacts

Table 10-6 summarises the residual social and community impacts.

Table 10-6 Summary of residual social and community impacts

Impact	Mitigation	Significance of residual impact
Construction		
Social impacts from acquisition of Commonwealth land	Consultation with Simpson Barracks on the removal of Assembly Place and possible relocation of elements. No specific mitigation is proposed for social impacts from the acquisition of the publicly accessible Commonwealth land south of Simpson Barracks as considerable alternative open space is available.	Not significant
Social impacts from construction amenity impacts (visual, noise and air quality)	A CNVMP would be developed and implemented to manage construction noise and vibration impacts. Construction air quality impacts would be managed through a CEMP and DAQMMP. This would include measures to monitor and minimise the impacts of construction dust. A Communications and Community Engagement Plan would be implemented to provide stakeholders with North East Link updates and information on progress and construction activities to enable affected stakeholders to plan activities with consideration to construction impacts.	Not significant
Social impacts from changes to access and connectivity during construction	A TMP would be developed and implemented to minimise disruption to traffic, car parking, pedestrian and bicycle movements and existing public facilities during all stages of construction. Access to the barracks would be maintained throughout construction.	Not significant
Social impacts from changes to the operation of community infrastructure and facilities during construction	A CNVMP would be developed and implemented to manage construction noise and vibration impacts on community facilities. A TMP would be developed and implemented to minimise transport and access related disruption to existing public facilities during all stages of construction. A Communications and Community Engagement Plan would be implemented to provide stakeholders with North East Link updates and information on progress and construction activities to enable affected stakeholders to plan use of community facilities.	Not significant

Impact	Mitigation	Significance of residual impact
Operation impacts		
Social impacts from operational amenity impacts (visual, noise and air quality)	North East Link would be designed to be generally in accordance with the UDS. Urban Design and Landscape Plans (UDLPs) would be developed and implemented for permanent above-ground buildings and structures. The design response would, to the extent practicable minimise landscape and visual impacts and maximise opportunities to enhance public amenity. Noise standards for traffic and the tunnel ventilation system would be met. Overall, North East Link is expected to reduce traffic noise within the barracks. The tunnel ventilation system would be designed to meet the requirements of the State Environment Protection Policy (Air Quality Management) and the requirements of the EPA Victoria Works Approval. An air quality monitoring program would be undertaken in consultation with EPA Victoria, with remedial action undertaken in the event standards are not met.	Not significant
Social impacts from changes to access and connectivity	It is expected that North East Link would improve traffic flow and cycle and pedestrian connectivity for the defence personnel and the local community surrounding the barracks. No specific mitigation measures are proposed.	Not significant
Social impacts from changes to the operation of community infrastructure and facilities	North East Link would be designed to be generally in accordance with the UDS. UDLPs would be developed and implemented for permanent above-ground buildings and structures. The design response would, to the extent practicable minimise landscape and visual impacts and maximise opportunities to enhance public amenity North East Link would be designed to achieve project traffic noise objectives, with remedial action taken in the event that measured traffic noise levels exceed North East Link traffic noise objectives. An air quality monitoring program would be undertaken in consultation with EPA Victoria, with remedial action undertaken in the event standards are not met. There are expected to be only minor net changes to the ability of the barracks community to access community facilities and therefore no specific traffic or access mitigation measures are proposed.	Not significant
Social impacts from acquisition of Commonwealth land.	Consultation with Simpson Barracks on the removal of Assembly Place and possible relocation of elements. No specific mitigation is proposed for social impacts from the acquisition of the publicly accessible Commonwealth land south of Simpson Barracks as considerable alternative open space is available.	Not significant

11. Transport

11.1 Introduction

Smedley Technical & Strategic undertook an assessment of the transport impacts of the action on Commonwealth land. This section summarises the assessment's findings.

11.2 Assessment method

11.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land.

11.2.2 Relevant assessment criteria

Traffic and transport impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

11.2.3 Assessment scope

Study area

The assessment looked specifically at traffic and transport impacts that North East Link may have on receptors on Commonwealth land at Simpson Barracks. These impacts may result from traffic and transport impacts on roads outside the Commonwealth land boundary. The study area is as follows:

- For impacts affecting Commonwealth land users of local roads – the area following Greensborough Road between Grimshaw Street and Lower Plenty Road (see Figure 11-1) for impacts on journey times to and from the barracks – the greater Melbourne area.

Traffic and transport impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The impacts considered were:

- The impact of construction activities such as spoil haulage, materials delivery and construction workforce traffic on traffic conditions for road users from Commonwealth land (Simpson Barracks) on roads around the Commonwealth land
- Traffic flow impacts on road users from Commonwealth land (Simpson Barracks), from diversions or closures during construction on roads around Commonwealth land
- Traffic volume, travel time and performance impacts for road users from Commonwealth land (Simpson Barracks) on roads around Commonwealth land as a result of the operation of North East Link.

11.2.4 Description of environment

The baseline for this assessment is based on collection of data on existing roads and traffic levels (see Section 11.2.5) as well as modelling baseline scenarios against which to examine changes due to the proposed action (Section 11.2.6).

11.2.5 Information sources

Existing data has been obtained from a number of sources (including VicRoads, Transport for Victoria and local councils) to provide a summary of current levels of congestion, travel time, freight movements, public transport coverage and walking/cycling connections.

Traffic information is largely derived from surveys conducted in 2017 and 2018 across the north-eastern road network. This data was originally collected during the development of the business case for North East Link in 2017, although additional sites were surveyed once a preferred corridor was identified. This allowed the data collection to be concentrated on areas closer to the project boundary. All current and historical data analysed and their sources are presented in Table 11-1.

Table 11-1 Traffic data referenced in this section

Source	Type of data	Data collection date
North East Link surveys	Traffic volume – Automatic Traffic Counts (ATC)	March 2017
North East Link surveys	Traffic volume – ATC Origin-destination surveys	June 2017
North East Link surveys	Traffic volume – ATC	September 2017
North East Link surveys	Origin-destination surveys	October 2017
North East Link surveys	Traffic volume – ATC	November 2017
North East Link surveys	Traffic volume – ATC	February 2018
VicRoads SCATS data	Traffic volume – SCATS	2017 – 2018
VicRoads	Crash data	2012-2016

11.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to transport impacts during construction and operation are listed in Table 11-2.

Table 11-2 Traffic and transport assessment method

Phase	Approach
Construction	The construction methodology involves an assessment of the spoil and delivery movements by individual month over the construction period of North East Link. Construction truck assumptions have been provided by NELP for this assessment. The assessment also considers the impact of closures and diversions on the study area road network. For the purposes of this assessment, forecast truck numbers, site workforce and a proposed construction program have been provided by NELP. The assessment assumes the launch site of the TBM to be from Manningham Road. Construction activity for North East Link is predicted to occur over a seven-year period, with different construction segments mobilising and demobilising throughout that time.
Operation	Traffic volumes, travel times and road performance has been predicted using a combination of strategic, spreadsheet and microsimulation modelling. The assessment examines 2036 scenarios with and without North East Link.

11.2.7 Assumptions

The following limitations and assumptions have been made in the development of this traffic and transport impact assessment:

- The output from the strategic transport model is suitable for use and meets the validation and calibration requirements of VicRoads.
- The input assumptions which underpin the strategic modelling results (such as population and employment forecasts) have been sourced from the Victorian Government. It is assumed these inputs reflect a 'business as usual' future with respect to the economic performance, government policy, travel behaviour and investment in the transport network.
- Victoria in Future (VIF) 2015 population and employment forecasts, as provided by the Victorian Government, have been used in this assessment. The VIF 2015 forecasts were the latest available (at the time of developing this report) in the format required for transport modelling.
- No forecast data or government policy is available for road pricing, ride-sharing or new forms of travel such as autonomous or flying vehicles. As such, no allowance for these types of vehicles is made in this assessment.
- Local roads (residential access or lower-order collectors) are not able to be analysed as part of this assessment. This is because the assessment is underpinned by strategic modelling, which is not granular enough to provide forecasts for local roads. As such the assessment is focused on generally higher-order collectors and arterial roads, and it is assumed that any change on these roads would be similar to nearby local roads. Local roads would typically receive net benefits as the decongestion on adjacent roads reduces the need for rat-running.
- The existing traffic data collected is reflective of typical conditions on the road network.
- The assessment has been performed on average weekday conditions only, and does not account for weekends or holiday periods.
- The construction impact assessment is based on advice provided by NELP. This is an assumed construction methodology and timeline as provided at the time of writing this assessment. The successful contractor may propose a different methodology which may alter the impacts associated with the construction of North East Link.
- Mitigating measures (such as intersection upgrades) have not been identified for the construction haulage routes as the actual haulage routes have not yet been confirmed. Any intersection upgrades/treatments would be identified as part of the traffic management plans the contractor would need to develop before works started, and is recommended as part of this assessment.

Changes in traffic volumes or travel times between the North East Link business case and this section are due to changes in the design and further development of the strategic transport model. Assumptions made in this study are typical of those made on assessments for major infrastructure projects of this kind.

11.2.8 Linked sections

While a number of other technical assessments use information from the transport assessment, this study does not draw on any other assessments.

11.2.9 Stakeholder consultation

Stakeholders and the community were consulted to support the preparation of the North East Link EES and PER and to inform the development of North East Link and understanding of potential impacts.

Table 11-3 lists specific engagement activities relating to traffic and transport, with more general engagement activities occurring at all stages of North East Link. A broader description of North East Link stakeholder engagement is provided in PER Chapter 14 – Consultation.

Table 11-3 Stakeholder engagement undertaken for traffic and transport

Stakeholder	When	Matters discussed	Outcome
Meetings between NELP and DoD, management of Simpson Barracks	Ongoing	Specific matters of traffic and access	Ongoing consideration of traffic and access issues
Risk Workshop (NELP offices) – AECOM/GHD, DELWP, Boroondara City Council, Banyule City Council	13/03/2018	Introduction to the risk assessment process	Defined impacts and consequence guide to inform risk register development
Banyule City Council	Fortnightly meetings	Update on transport impacts, redistributions and mitigating measures	Ongoing design development
Transport for Victoria	Ongoing	Public transport services and patronage	Provision of forecasting assumptions for public transport services
VicRoads	Ongoing, embedded within NELP	Traffic performance on the VicRoads network, VicRoads design and ITS requirements	Ongoing design development
Bicycle Network Victoria	Ongoing	Walking and cycling infrastructure	Ongoing design development

11.3 Description of the environment

This section describes the traffic and transport environment as relevant to actions on Commonwealth land. It outlines traffic conditions with respect to volumes and travel times for 2017 and 2036 ‘no project’ conditions. The latter assessment would provide an overview of traffic conditions in 2036 without North East Link. Traffic performance of the 2036 ‘no project’ scenario would also be assessed within the study area.

11.3.1 Transport network

An overview of the study area transport network is presented in Figure 11-1. Its key elements are provided below:

Roads

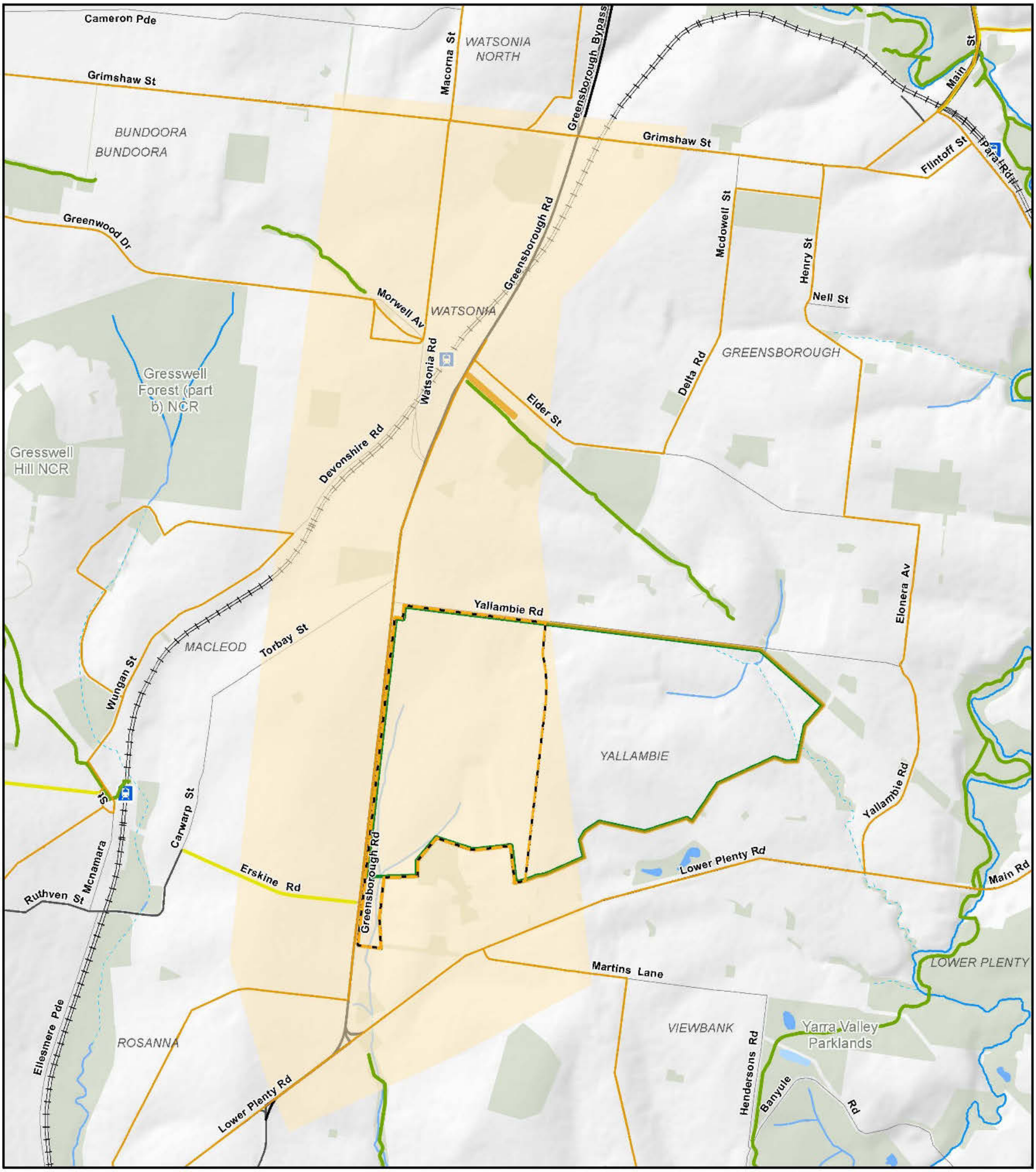
- Access points into and out of Simpson Barracks are shown by the black arrows. The main access is via Blamey Road which connects directly to Greensborough Road. Two alternative access points are provided along Yallambie Road, with a fourth access point provided along Crew Street (local access road) which connects to Lower Plenty Road.
- Greensborough Bypass/Greensborough Road is a major arterial servicing north-south traffic and is directly adjacent to Simpson Barracks. It is one of the busiest arterials in the north-east, feeding traffic between the M80 Ring Road and Lower Plenty Road.
- Yallambie Road connects Greensborough Road with a number of private access roads to Simpson Barracks, as well as local residential streets.
- Erskine Road connects Greensborough Road with the La Trobe precinct to the west.
- Grimshaw Street is a major east-west arterial intersecting with Greensborough Bypass. It provides direct connectivity to the Greensborough town centre.
- Watsonia Road services the Watsonia town centre and station precinct, and provides a north-south connection between Greensborough Bypass and Grimshaw Street.
- Lower Plenty Road is another major east-west arterial, connecting Greensborough Road with Rosanna Road (another major north-south arterial) to the south.
- A large number of local residential streets are also within the study area.

Public transport

- The Hurstbridge rail line crosses into the study area boundary, servicing Watsonia railway station (accessed by Watsonia Road and Greensborough Bypass/Greensborough Road) as well as Macleod Station to the west of Greensborough Road. No tram services operate in the study area.
- Several metropolitan bus routes operate through the study area, including:
  - 513 (Eltham – Glenroy) along Greensborough Bypass/Greensborough Road and Lower Plenty Road
  - 566 (Lalor – Northland Shopping Centre) along Grimshaw Street and Watsonia Road
  - 902 orbital SmartBus route (Airport West – Chelsea) along Grimshaw Street.

Walking and cycling

- An off-road shared use path on the eastern side of Greensborough Road south of Yallambie Road, providing connectivity to Lower Plenty Road and the River Gum Walk trail to the south.
- On-road cycling lanes along Erskine Road and northbound along Greensborough Road.



Legend

PER traffic study area	**Roads**	Railway	**Watercourses**	**Waterbodies**	Off road cycling
PER 500m buffer	Highway	Train station	River	Lake	On road cycling
Commonwealth land	Major road		Stream	Watercourse	Parks & reserves
Barracks fenceline	Local road		Drain/channel/other	PTV_Metropolitan bus route	

Paper Size A4

0 135 270 540

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Overview of study area transport network

Figure 11-1

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti

11.3.2 Traffic volumes

Surveys have been conducted in the study area to assess traffic volumes and road network performance. The results of the survey are presented in Figure 11-2 and reflect 2017 conditions. The map shows daily traffic volumes in the defined study area. The volumes have also been provided in Table 11-4. Key observations are:

- Greensborough Bypass/Greensborough Road carries up to 68,000 vehicles per day south of Watsonia Road. It is likely the majority of trips to and from Simpson Barracks would be facilitated by this road. The road provides connectivity between the M80 Ring Road to the north and the north-east and is likely to be heavily relied upon by many transport network users within the study area.
- Yallambie Road and Watsonia Road service local precincts and carry up to 5,500 and 16,000 vehicles per day respectively.
- Grimshaw Street carries up to 29,000 vehicles per day west of Watsonia Road and 38,000 vehicles per day east of Greensborough Bypass.
- There are many local roads throughout the study area, many of which carry lower-order traffic volumes across the day. However due to the high traffic volumes along many of the arterial roads through the region 'rat-running' can often occur through local roads.
- Traffic volumes accessing the Simpson Barracks are low throughout the day, with the bulk of vehicles accessing the site being cars. However, there can be peaks of activity depending on operations within the barracks, which may raise traffic volumes and include a greater use of heavy vehicles.

Table 11-4 Key traffic volumes in the study area, 2017

Road name	Location	Total daily traffic volume in 2017 (two-way)
Erskine Road	West of Greensborough Road	7,000 – 9,000
Greensborough Bypass/ Greensborough Road	Between Yallambie Road and Watsonia Road	52,000 – 68,000
Grimshaw Street	East of Greensborough Bypass	29,000 – 38,000
Grimshaw Street	West of Watsonia Road	21,000 – 29,000
Lower Plenty Road	East of Greensborough Road	26,000 – 34,000
Watsonia Road	Between Grimshaw Street and Greensborough Bypass	12,000 – 16,000
Yallambie Road	East of Greensborough Road	3,500 – 5,500

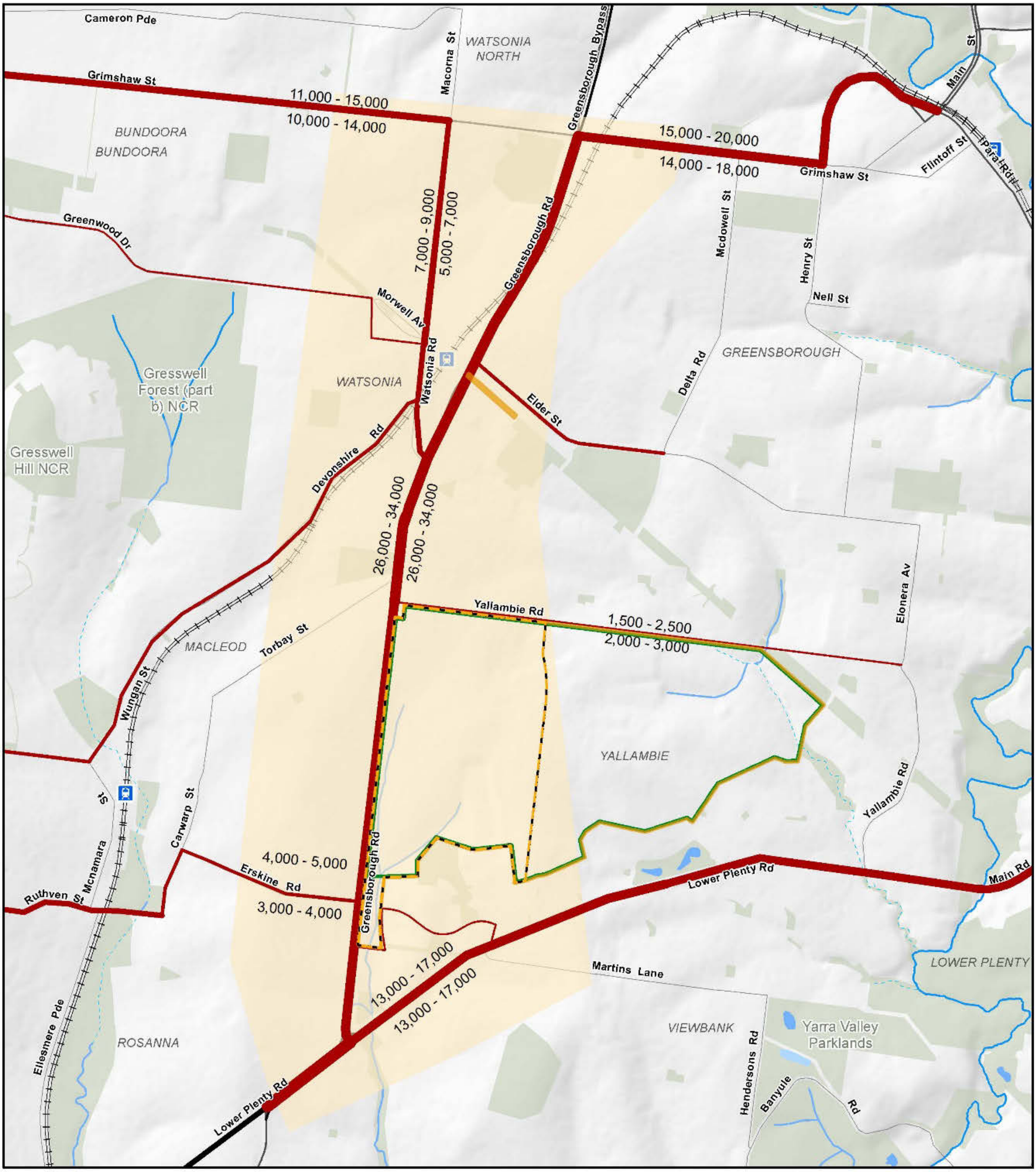
The forecast growth in daily traffic volumes between 2017 and the 2036 'no project' scenario is presented in Figure 11-3. Absolute daily traffic volumes in the 2036 'no project' scenario are presented in Figure 11-3 and are summarised in Table 11-5.

Key observations include:

- Traffic volumes are predicted to increase on all roads assessed in the study area. This growth takes into account the forecast increase in population and employment between 2017 and 2036, which has been sourced from the Victorian Government's Victoria in Future (VIF) projections.
- Traffic volumes along Greensborough Road are forecast to grow by approximately 12,000 vehicles per day. This indicates the corridor is likely to remain the primary north-south route servicing the study area transport network.
- Growth along Yallambie Road is predicted to be more moderate at less than 1,000 vehicles per day. Watsonia Road is predicted to grow by approximately 2,500 vehicles per day. Both roads service local suburban precincts.
- Traffic volumes along Lower Plenty Road are forecast to increase by approximately 5,200 vehicles per day east of Greensborough Road.
- The forecast growth in traffic volumes locally as well as across the road network are likely to increase travel times and accessibility within the study areas transport network.
- While local roads have not been quantitatively assessed, it is anticipated that rat running would increase due to additional traffic and congestion on the arterial roads.

Table 11-5 Predicted changes in traffic volumes on key roads

Road name	Location	Change in daily traffic volume between 2017 and 2036 'no project' (two-way)
Erskine Road	West of Greensborough Road	+1,600
Greensborough Bypass/ Greensborough Road	Between Yallambie Road and Watsonia Road	+12,000
Grimshaw Street	East of Greensborough Road	+9,700
Grimshaw Street	West of Greensborough Road	+4,300
Lower Plenty Road	East of Greensborough Road	+5,200
Watsonia Road	Between Grimshaw Street and Greensborough Bypass	+2,500
Yallambie Road	East of Greensborough Road	+700



Legend

- PER traffic study area
- PER 500m buffer
- Commonwealth land
- Barracks fenceline

Roads

- Highway
- Major road
- Local road
- Railway
- Train station

Watercourses

- River
- Stream
- Drain/channel/other

Waterbodies

- Lake
- Watercourse
- Parks & reserves
- Total Daily Traffic

Paper Size A4

0 135 270 540

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Total average weekday traffic volumes (AWDT), 2017

Figure 11-2

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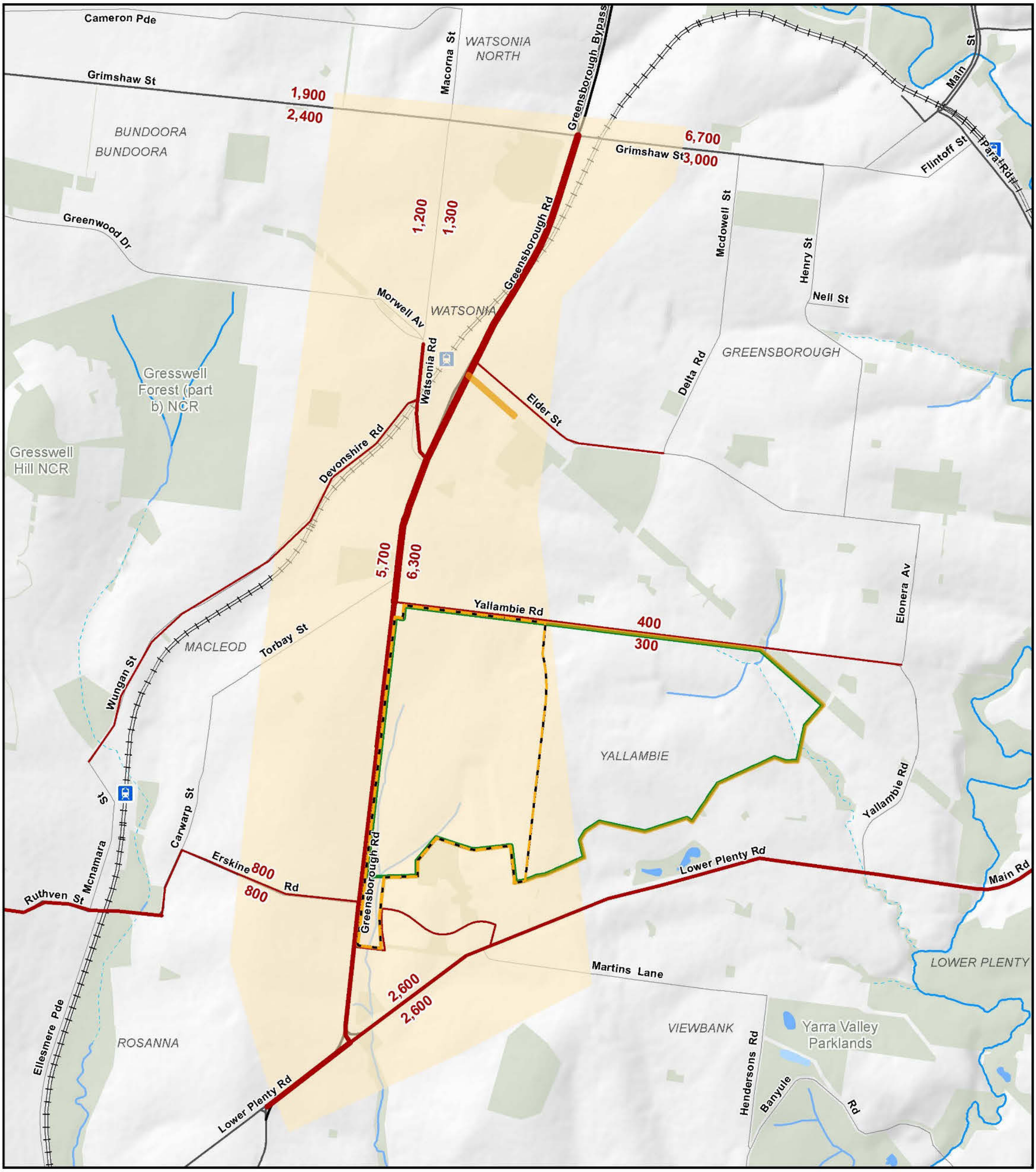
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti



Legend

PER traffic study area
PER 500m buffer
Commonwealth land
Barracks fenceline
Roads
Highway
Major road
Local road
Railway
Train station
Watercourses
River
Stream
Drain/channel/other
Waterbodies
Lake
Watercourse
Parks & reserves
Total volume changes
Traffic increase

Paper Size A4
0 135 270 540
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Total average weekday traffic volumes (AWDT), 2036 no project vs 2017

Figure 11-3

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com
Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti

11.3.3 Travel times

Car travel times from the barracks in the AM and PM peaks are presented in Figure 11-4 and Figure 11-5 respectively. The charts show that a trip from the barracks can reach destinations such as Epping, Doncaster, Melbourne Airport and Ringwood within one hour.

The charts also show that travel times are generally lower in the PM peaks with additional destinations such as Sunshine and the CBD accessible within a one-hour trip. This indicates that congestion levels are generally lower in the PM peak relative to the AM peak.

Travel times for the 2036 ‘no project’ scenario are presented Figure 11-4 and Figure 11-5 for the AM and PM peaks respectively. Between 2017 and 2036 ‘no project’ congestion is forecast to increase across both periods, increasing journey times to all destinations. Travel times from the barracks are forecast to worsen particularly for trips to the western and inner suburbs, to destinations such as Sunshine, the CBD and Melbourne Airport. This is largely due to the growth in population and employment between 2017 and 2036, which is forecast to increase the overall number of trips completed across the road network.

2016 / 2036 'no project' scenario

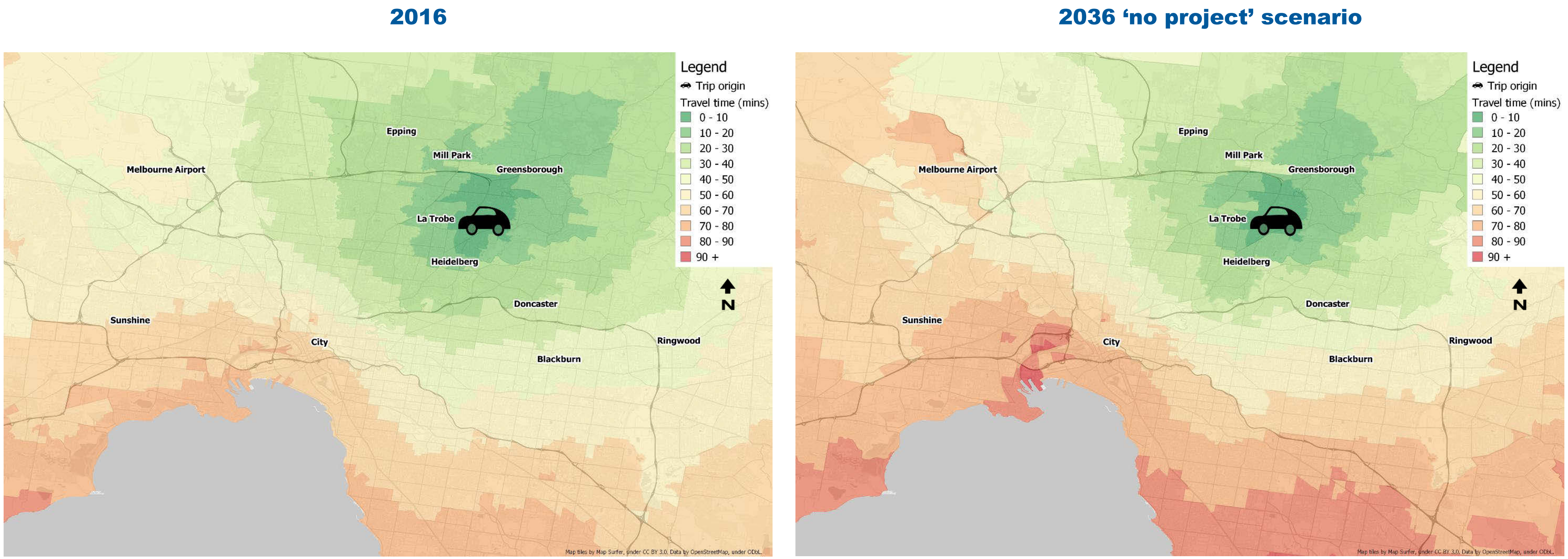


Figure 11-4 Travel times from Simpson Barracks by car, AM peak – 2016 and 2036 'no project' scenarios

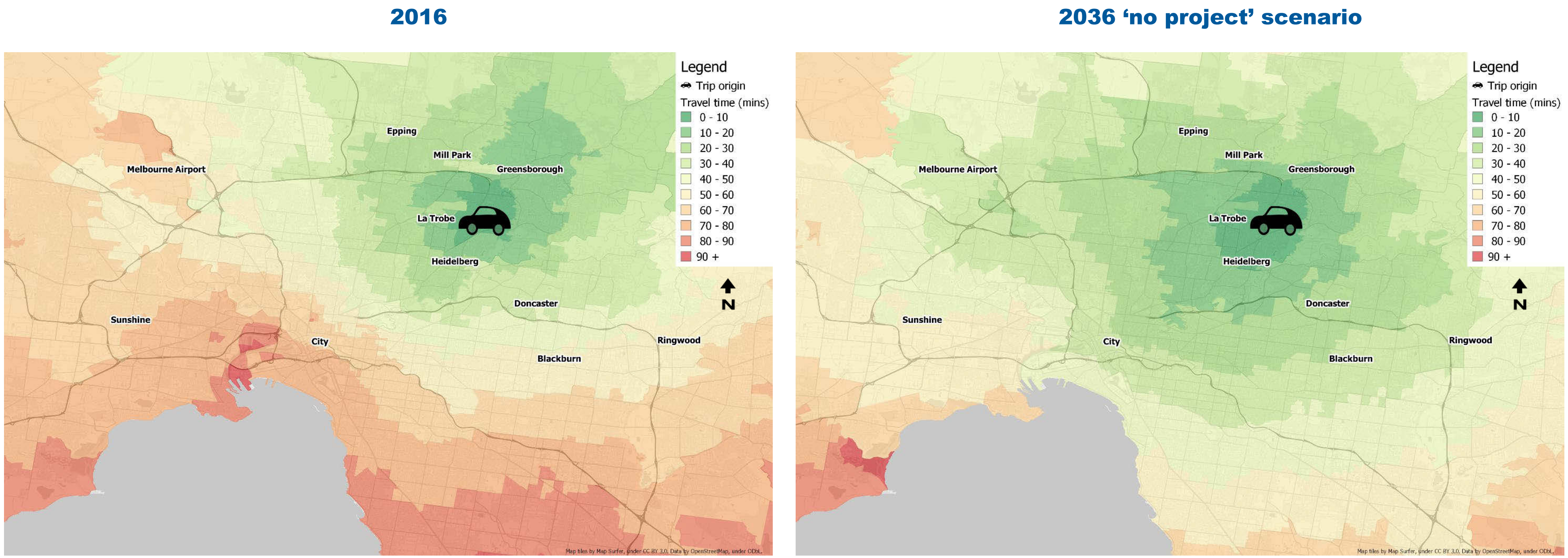


Figure 11-5 Travel times from Simpson Barracks by car, PM peak – 2016 and 2036 'no project' scenarios

11.4 Relevant impacts and mitigation measures

11.4.1 Impact of construction activities such as spoil haulage

Impact description

Construction activities such as spoil haulage, materials and delivery have the potential to directly impact travel times to and from Commonwealth land, and/or access to Simpson Barracks. Forecast truck activity during construction of North East Link was assessed for:

- Traffic impacts associated with the haulage of spoil associated with all construction sites across the entire North East Link for the base case scenario (southern TBM launch)
- Deliveries to site compounds for materials storage.

The bulk of hourly truck movements are related to the haulage of spoil, with trucks travelling to and from the north via the M80 Ring Road. Close to Simpson Barracks, only Greensborough Road and Lower Plenty Road are anticipated to be used to haul spoil.

Truck movements would continue for approximately 42 months and would have a peak daily volume of 1,730 in Q1 2023.

An assessment was been performed for the TBM launch sites based on the following alternative options for truck haulage operations:

- 20 hours per day (101 trucks per hour)
- Eight hours per day (observing the truck curfew period of 10:00 pm to 6:00 am) (216 trucks per hour).

If construction vehicles are not permitted to operate during the curfew period, over twice as many trucks would be required to access the site per hour during the day. Analysis of the traffic volumes along Greensborough Road (between Erskine Road and Strathallan Road), shows there is potentially spare capacity in the order of 600 vehicles per hour between the AM and PM peaks. This increases to over 2,650 vehicles per hour after the PM peak until the AM peak.

The Greensborough Road/Greensborough Bypass corridor could accommodate this demand outside the peak periods. However, the Greensborough Bypass and Grimshaw Street intersection would unlikely accommodate this additional truck traffic during peak periods. The delivery of materials and spoil haulage should occur outside peak periods when spare capacity exists on the road network.

The volume of trucks generated by the construction activity is expected to have a minimal direct impact on the access points to the Commonwealth land due to the spare capacity along Greensborough Road, particularly outside peak periods. However, it is likely there would be some small increases in travel time due to reduced speed limits and temporary traffic signals. An overview of the site and its proposed access points is presented in Figure 11-6. Access to the construction site will be via Greensborough Road, at Drysdale Street and near Erskine Road (indicated by the red arrows).

Proposed avoidance and mitigation measures

Before the start of construction, the appointed contractor would be required to develop and implement Transport Management Plans (TMPs) to minimise disruption to affected local land uses, traffic, car parking, public transport (rail, tram and bus), pedestrian and bicycle movements and existing public facilities during all stages of construction.

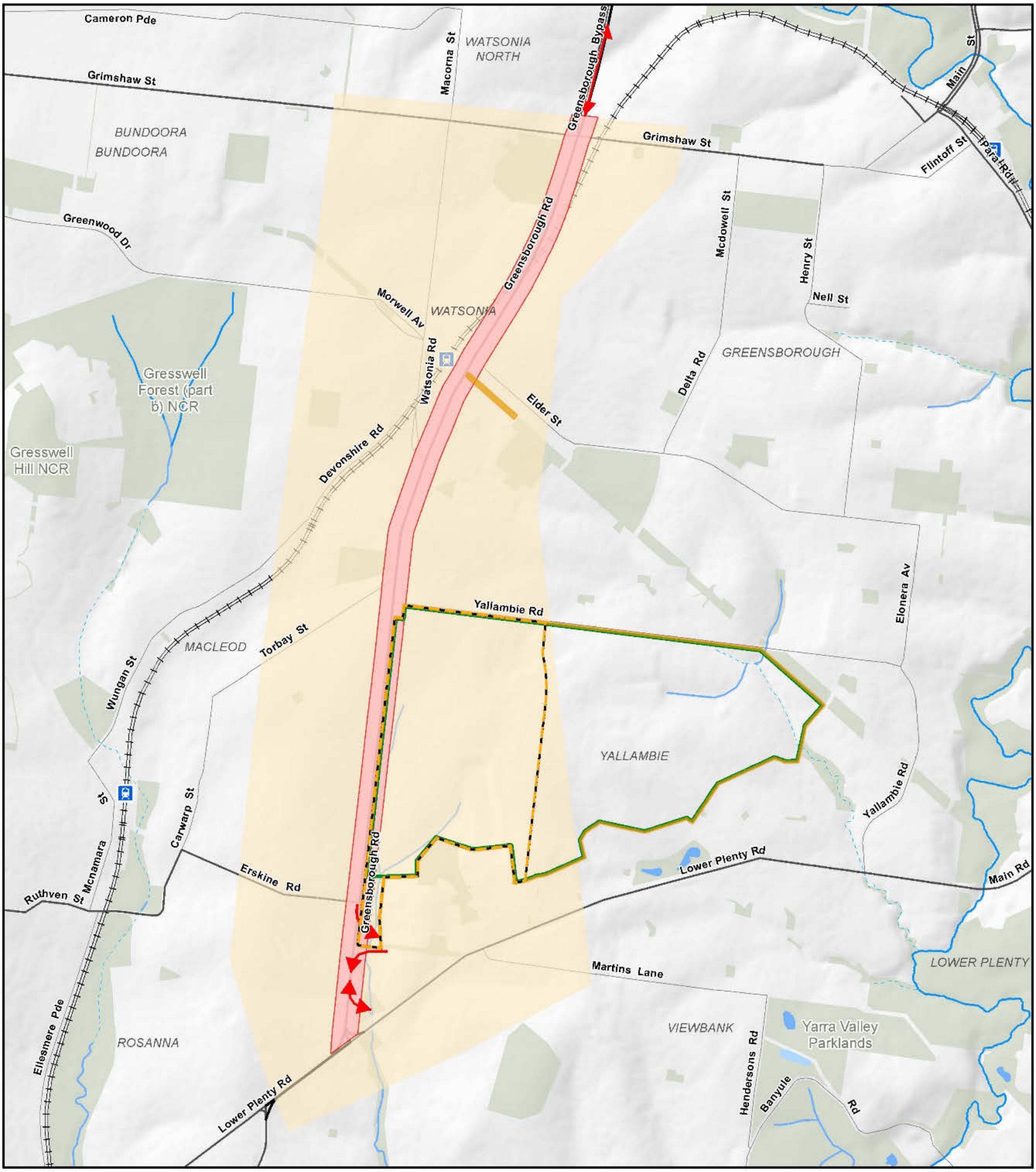
The TMPs would need to consider how access to and from Simpson Barracks and study area transport network is maintained. Each TMP would be authorised by the relevant authorities (such as VicRoads and relevant local councils) before any works started. The TMPs would need to consider the impact of the curfew period in minimising the hourly impacts on the network.

The TMPs may require temporary signals at the intersection of Greensborough Road/Drysdale Street to assist trucks accessing the construction site. The access point to the north of Erskine Street may require turn lanes in the southbound direction to minimise the impact to through traffic on Greensborough Road.

The TMPs would also need to consider impacts on public transport (such as bus stops along Greensborough Road) as well as walking and cycling infrastructure (such as the shared use path along Greensborough Road) and implement temporary diversions or other treatments as appropriate. These measures would be required to be fully developed prior to authorisation of the TMPs and the works starting.

Residual impacts

The implementation of mitigation is expected to reduce the impact from construction truck movements to the barracks community. The overall impact of truck traffic on Commonwealth land during construction is considered not significant for either the eight or 20 hour per day truck movement alternatives.



Legend

PER traffic study area
PER 500m buffer
Commonwealth land
Barracks fenceline

Roads
Highway
Major road
Local road

Railway
Train station

Watercourses
River
Stream
Drain/channel/other

Waterbodies
Lake
Watercourse
Parks & reserves

Indicative Kempton St to Northern Portal work zone

Paper Size A4

0 135 270 540

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Indicative Kempton St to Northern Portal work zone

Figure 11-6

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Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti

11.4.2 Impact of construction workforce traffic

Impact description

The movement of construction workforce to and from worksites has potential to directly affect traffic movement around Commonwealth land during construction, including for travel to and from Simpson Barracks.

- The majority of work zones would be operating for nine hours a day, typically between 7:00 am and 5:30 pm meaning this workforce would arrive before the morning peak and exit during or after the afternoon peak. In the work zones that may operate 24 hours a day, the on-site workers would typically work in two 12-hour shifts typically running between 7:00 am to 7:00 pm. Again, this means the workforce arriving before the morning peak and exiting during or after the afternoon peak.

Proposed avoidance and mitigation measures

As worker start and finish times would not generally occur during the AM or PM peak travel times, and the work force would be distributed across a large area, no specific avoidance or mitigation measures are considered necessary.

Residual impact

The impact of construction workforce movement on the barracks community is not considered significant.

11.4.3 Impact of construction diversions or closures

Impact description

Construction of North East Link would require two temporary diversions and one temporary road closure near Commonwealth land.

Greensborough Bypass diversion

During construction of North East Link under Grimshaw Street, north-south traffic on Greensborough Bypass would need to be temporarily diverted onto side-tracks built next to Greensborough Bypass, slightly reducing the capacity of the bypass.

Traffic modelling has found the reduction in north-south capacity along the Greensborough Bypass would redistribute some traffic away from the corridor to alternative routes such as Watsonia Road, Para Road and Plenty Road.

Grimshaw Street diversion

To allow for the construction of the Grimshaw Street interchange and replacement of the signalised intersection, travel along Grimshaw Street would need to occur on a side-track. This side track would maintain two lanes in each direction but traffic capacity could be slightly reduced due to the lower speed limit and the need for vehicles to deviate onto the side-track.

Modelling estimates that traffic would divert away from the construction site using alternative routes to access their destinations, including:

- The northern section of Watsonia Road (an increase of up to 1,000 vehicles a day)
- The southern section of Watsonia Road (an increase of up to 3,000 vehicles)
- The Greensborough Bypass (an increase of up to 1,700 vehicles)
- Diamond Creek Road (an increase of up to 1,400 vehicles).

Drysdale Street closure

Drysdale Street between Greensborough Road and Borlase Street would need to be closed to allow for tunnelling and trenching works along the eastern side of Greensborough Road. The large amount of works in this location could require this section of Drysdale Street to be closed for up to 132 weeks. Vehicles would need to detour to Lower Plenty Road via Coleen Street and Crew Street.

This section of Drysdale Street has low volumes, typically carrying between 800 and 900 vehicles per day, with a peak of approximately 90 vehicles an hour, these low volumes would be able to be accommodated on the proposed diversion route.

Proposed avoidance and mitigation measures

The contractor would be required to develop and implement Transport Management Plans (TMPs) before relevant works started. The TMPs would be required to outline diversion routes and access for all modes of transport including public transport and walking and cycling. The TMPs would be authorised by the relevant authorities (such as VicRoads, relevant local councils) before any works started. The contractor would develop specific mitigation measures as part of each TMP. Examples of measures that may be included in a TMP relating to the diversions are:

- Traffic signal changes at the intersections of Watsonia Road/Greensborough Bypass/ Greensborough Road and Watsonia Road/Grimshaw Street to minimise the likelihood of traffic diversion onto local roads such as Watsonia Road
- Review operation of the signalised intersection of The Circuit and Main Street to facilitate traffic around Greensborough.

Residual impact

Any changes in traffic volume due to these diversions and closures would be temporary and would be spread across the network. The impacts of this on the barracks community are not expected to be significant.

11.4.4 Operational traffic volume changes

Impact description

The operation of North East Link would directly affect traffic volumes on roads around Commonwealth land. Forecast changes to average weekday traffic volumes between the 2036 ‘no project’ and ‘with project’ scenarios are presented in Table 11-6.

Table 11-6 Key traffic volumes in the study area, 2036 'no project'

Road name	Location	Change in daily traffic between 2036 'no project 'and 'with project' (two-way)
Erskine Road	West of Greensborough Road	+2,300
Greensborough Bypass/ Greensborough Road	Between Yallambie Road and Watsonia Road	-18,800
Grimshaw Street	East of Greensborough Road	-2,000
Grimshaw Street	West of Greensborough Road	-2,500
Lower Plenty Road	East of Greensborough Road	+2,800
Watsonia Road	Between Grimshaw Street and Greensborough Bypass	+4,000
Yallambie Road	East of Greensborough Road	-600

Local roads cannot be quantitatively assessed using the transport models. However, it is anticipated that traffic volumes on local roads would be static or decrease. This is due to the decongestion of arterial roads which diminishes the need for 'rat-running' along local roads. These localised impacts are therefore likely to have a negligible to positive impact on access roads to Commonwealth land, such as Blamey Road.

Despite some localised increases in traffic volumes, the significant decrease in traffic along Greensborough Bypass/Greensborough Road are predicted to result in a net improvement in accessibility and travel times for the study area transport network. While traffic volumes on some smaller roads (such as Watsonia Road and Erskine Road) are forecast to increase, these impacts are considered small with the roads having sufficient capacity to accommodate the additional demand.

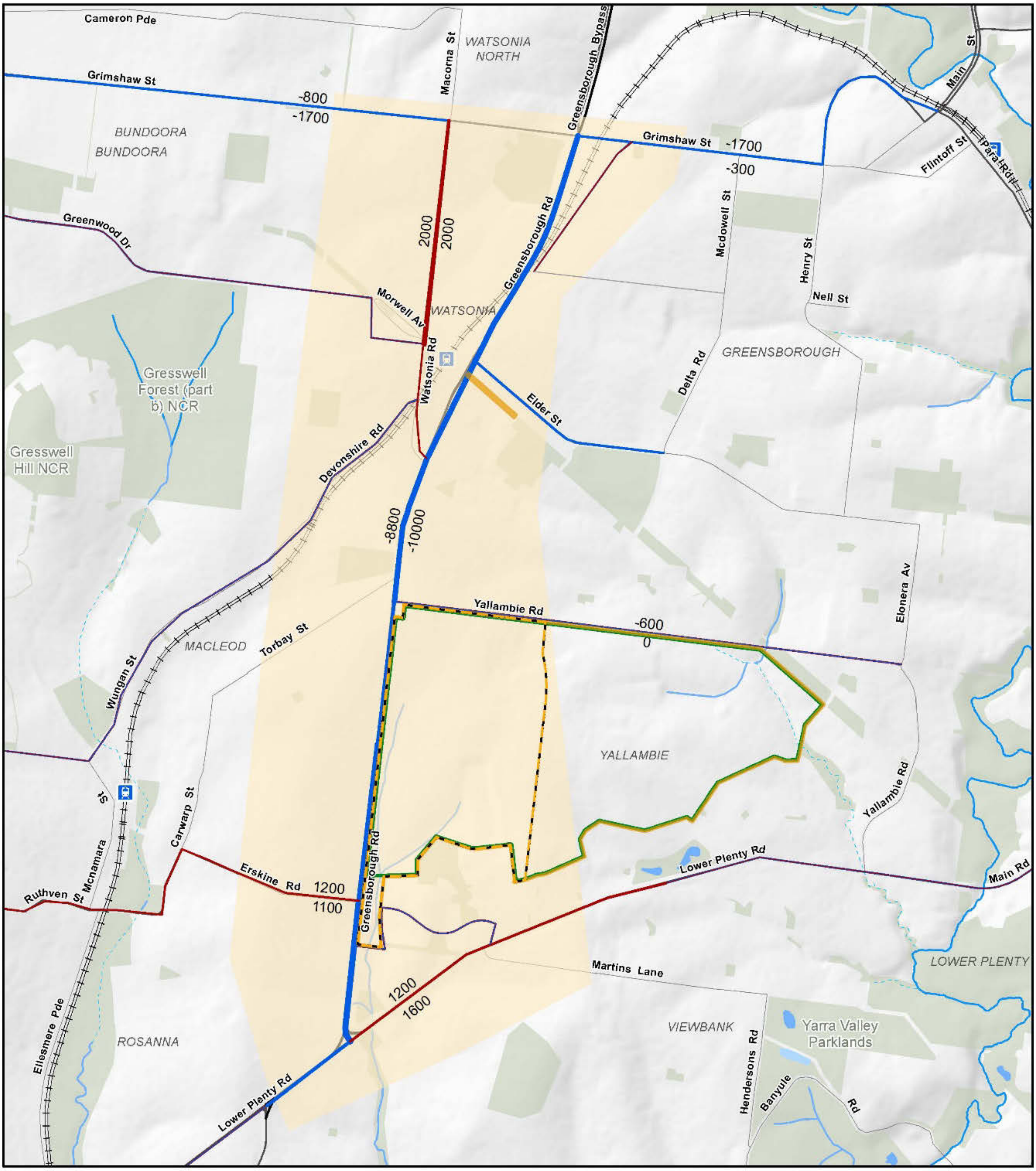
Improved traffic volumes would improve the performance of the road network for general traffic and bus users, improving defence personnel's ability to travel to and from Commonwealth land. Forecast changes to average weekday traffic volumes between the 2036 'no project' and 'with project' scenarios is presented in Figure 11-7.

Proposed avoidance and mitigation measures

As the impacts on changes to traffic volume are considered positive, no avoidance or mitigation measures are proposed.

Residual impact

No significant adverse residual impacts have been identified.



Legend

PER traffic study area	Barracks fenceline	Major road	Train station	**Watercourses**
PER 500m buffer	**Roads**	Local road		River
Commonwealth land	Highway	Railway		Stream

Drain/channel/other	Watercourse	**Total volume changes**	Traffic decrease
Waterbodies	Parks & reserves	Traffic increase	
Lake		Negligible change	

Paper Size A4

0 135 270 540

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Total average weekday traffic volumes (AWDT), 2036 with project vs no project

Figure 11-7

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti

11.4.5 Operational travel times

Impact description

Once operational, it is expected that North East Link would have direct impacts on travel times for people travelling to and from Simpson Barracks. Forecast road-based travel times from Simpson Barracks in the AM and PM peaks are presented for the 2036 'no project' and 'with project' scenarios in Figure 11-8 and Figure 11-9. Travel time improvements are predicted to occur across both peak periods and is most pronounced for destinations to the south-east such as Ringwood and Dandenong. This is due to North East Link providing an additional crossing over the Yarra River, relieving congestion on the existing river crossings such as Manningham Road, Fitzsimons Lane and Chandler Highway. These travel times are likely to provide local travel time improvements for bus services as well as for general traffic.

Travel times are not anticipated to change for walking and cycling trips within the study area, although cycling and walking would benefit from improved connectivity and quality of the new shared use paths. As train services are segregated from the road network, negligible impact is anticipated for rail users.

The overall changes to travel times are anticipated to be positive.

Proposed avoidance and mitigation measures

As the impacts on changes to traffic volume are considered positive, no avoidance or mitigation measures are proposed.

Residual impact

No significant adverse residual impacts have been identified.

2036 ‘no project’ scenario

2036 ‘with project’ scenario

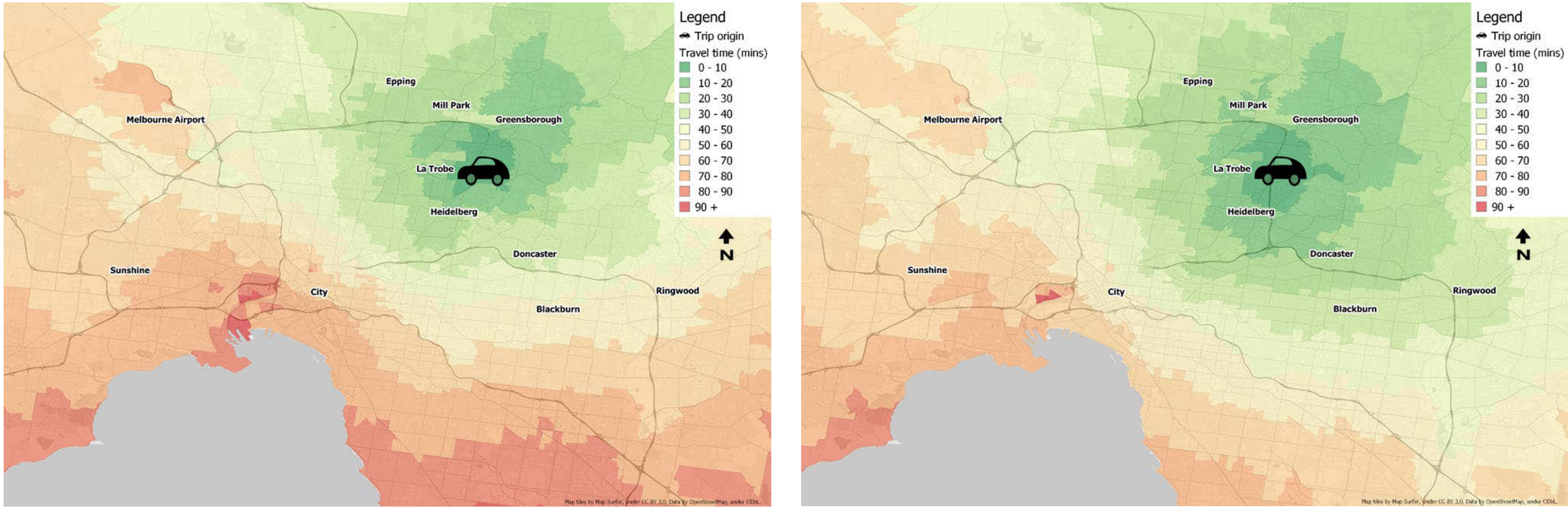
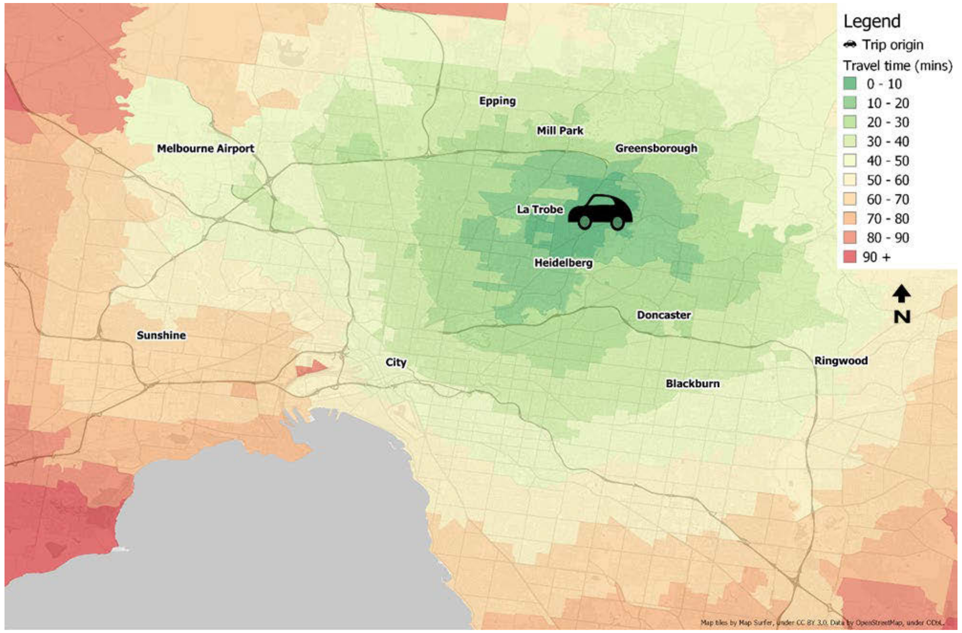


Figure 11-8 Travel times from Simpson Barracks by car, AM peak – 2036 ‘with project’ vs 2036 ‘no project’

2036 'no project' scenario



2036 'with project' scenario

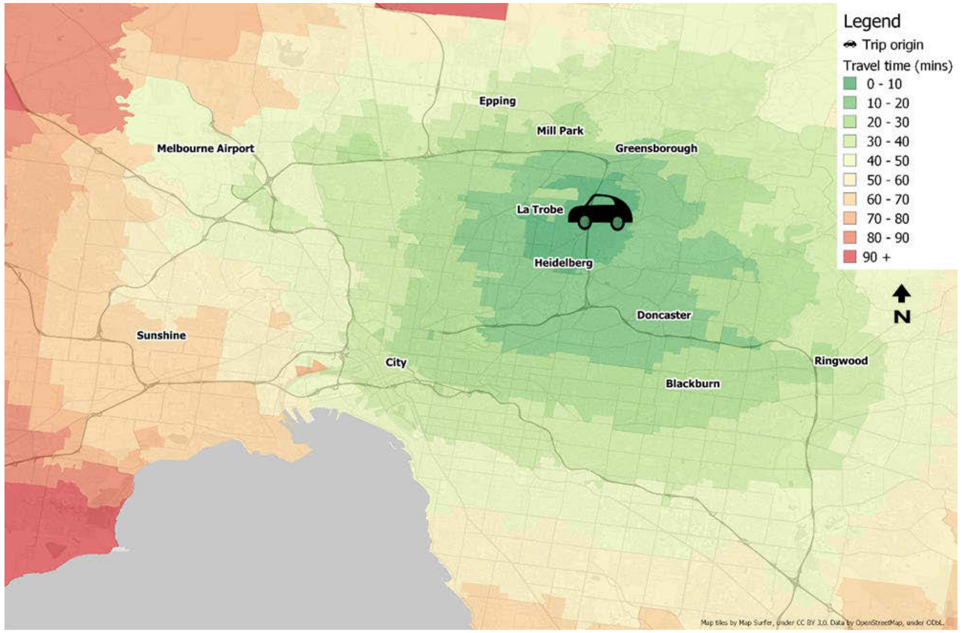


Figure 11-9 Travel times from Simpson Barracks by car, PM peak – 2036 'with project' vs 2036 'no project'

11.4.6 Construction impacts of a northern TBM launch

The alternative northern TBM launch site would generate additional truck movements to and from Commonwealth land. The site access for the northern TBM launch site is planned to be along the trench created by the Kempston Street to northern portal work zone. Truck access between the work zone and Greensborough Road could be between Erskine Road and Strathallan Road.

An assessment of trucks operating for 20 hours a day (travelling through the curfew period) and eight hours a day (not travelling within the curfew period) has been performed. Materials would be delivered across an eight-hour period.

There would be a period when the Kempston Street to northern portal worksite as well as the northern TBM launch site would generate truck movements simultaneously. For the purposes of this combined assessment, it has been assumed that both sites would be operating at their construction peak truck generation rates. However, in reality, the construction peak periods occur at different times. This methodology provides a more conservative assessment of the combined impacts of these two worksites.

As discussed previously, these construction zones are within the curfew area and as such, there may be restrictions on when trucks can haul materials. This assessment considers a 20-hour haulage scenario, assuming that spoil trucks are exempt from the curfews, and an eight-hour haulage scenario, assuming that trucks are not exempt from the curfews.
The forecast daily and hourly volumes are presented in Table 11-7.

Table 11-7 Forecast combined construction truck trips by daily and hourly volumes

Scenario	Daily truck movements	Hourly truck movements (two way)
20-hour spoil haulage	1,920	130
8-hour spoil haulage	1,920	240

In the 20-hour scenario the spoil trucks would operate for 20 hours, but materials delivery would only take place eight hours per day based on the opening hours of suppliers. Table 11-7 presents the higher day volumes for this scenario.

The traffic accessing the site would be across two to three access points: Drysdale Street, Erskine Road and potentially Strathallan Road. However, it is likely the left in/left out arrangement at Erskine Road would be changed to left in/left out and a right turn-out at the Erskine Road traffic signals.

The TBM site works would likely use the Erskine Road exit, while the trenching works would likely be spread across the Drysdale Street and Erskine Road exits. As such, it is possible that, under the 20-hour a day scenario, approximately 90 trucks an hour could be exiting at the Erskine Road exit and approximately 30 trucks an hour using the Drysdale Street exit. Under an eight-hour spoil haul scenario, it is possible that approximately 50 trucks an hour could be exiting at the Erskine Road exit and approximately 15 trucks an hour using the Drysdale Street exit.

Given the low hourly volumes using these exits, it is expected that both would operate without significant impacts to the performance of Greensborough Road. Under both scenarios, Greensborough Road has the spare capacity throughout the day, outside the peak periods, to be able to accommodate the forecast truck demands of up to 240 an hour.

11.5 Residual impacts

Table 11-8 summarises the residual impacts on traffic and transport.

Table 11-8 Summary of residual impacts on traffic and transport

Impact	Mitigation	Significance of residual impact
Construction truck activities such as spoil haulage, materials delivery impacting travel times to and from Commonwealth land, and/or access to Simpson Barracks	A TMP would be developed and implemented to minimise disruption to affected local land uses, traffic, car parking, public transport (rail and bus), pedestrian and bicycle movements and existing public facilities during all stages of construction. The TMP must be authorised by the relevant authorities (such as VicRoads, relevant local councils) before works started and would need to consider the impact of the truck curfew period in minimising the hourly impacts on the network.	Not significant
Construction workforce traffic causes changes to traffic conditions on roads around the Commonwealth land used by the barracks community	As worker start and finish times would not generally occur during the AM or PM peak travel times, and the workforce would be distributed across a large area, no specific mitigation measures are considered necessary.	Not significant
Diversions or closures during construction impacting access to Commonwealth land	A TMP would be developed and implemented to minimise disruption to affected local land uses, traffic, car parking, public transport (rail and bus), pedestrian and bicycle movements and existing public facilities during all stages of construction. The TMP must be authorised by the relevant authorities (such as VicRoads, relevant local councils) before any works started and would need to consider the impact of the truck curfew period in minimising the hourly impacts on the network.	Not significant
Changes to traffic volumes on roads around Commonwealth land due to the operation of North East Link	No mitigation measures are proposed as the impacts on changes to traffic volume are considered positive.	Not significant
Changes to travel times to and from Commonwealth land from the operation of North East Link	No mitigation measures are proposed as the impacts on changes to travel times are considered positive.	Not significant

12. Surface noise

12.1 Introduction

SLR Consulting undertook an assessment of the impacts of surface noise impacts from the action on Commonwealth land. This section summarises the assessment's findings.

12.2 Assessment method

12.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land Table 12-1 summarises the other key policies and guidance relevant to the assessment.

Table 12-1 Key legislation, policy and guidance for noise and vibration

Policy/guidance	Relevance
EPA Victoria – Environment Protection Act 1970 – SEPP (Control of Noise from Commerce, Industry and Trade) No. N-1 (SEPP N-1)	Operation – Fixed facilities
Transport Integration Act 2010	Operational – Traffic noise
VicRoads – Traffic Noise Reduction Policy (VicRoads, 2005)	Operation – Traffic noise
ASHRAE Chapter 48, Sound and Vibration Control15 (ASHRAE, 2015)	Construction – Vibration
AS/NZS 2107:2016 Australian/New Zealand Standard Acoustics-Recommended design sound levels and reverberation times for building interiors1 (Standards Australia, 2016)	Operation – Traffic noise and fixed infrastructure construction – airborne noise
Australian Standard – AS2187.2-2006 Explosives – Storage and Use Part 2: Use of explosives (Standards Australia, 2006)	Construction – overpressure and vibration caused by blasting
Australian Standard AS 2436-2010 (R2016) Guide to noise and vibration control on construction, demolition and maintenance sites (Standards Australia, 2010)	Construction – Airborne noise Construction – Surface vibration
British Standard BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting (British Standards, 2008)	Construction – Surface vibration
British Standard BS 5228-1-2014 Code of practice for noise and vibration control on construction and open sites. Noise (British Standards, 2014)	Construction – Airborne noise
British Standard BS5228-2-2014 Code of practice for noise and vibration control on construction and open sites – Vibration (British Standards, 2008)	Construction – Surface vibration
EPA Victoria – Noise Control Guidelines Publication 1254 (EPA Victoria, 2008)	Construction – Airborne noise
EPA Victoria – Environmental Guidelines For Major Construction Sites, Publication 480 (EPA Victoria, 1996)	Construction – Airborne noise
VicRoads – Noise Guidelines – Construction and Maintenance Works (VicRoads, 2007)	Construction – Airborne noise

Policy/guidance	Relevance
German Standard DIN 4150 – Part 3 – Structural Vibration in Buildings – Effects on Structures (Deutsches Institut Fur Normung, 2016)	Construction – Surface vibration (structural damage)
EPA NSW – Interim Construction Noise Guideline (EPA NSW, 2009)	Construction – Airborne noise
EPA NSW – Assessing Vibration: A Technical Guideline, (EPA NSW, 2006)	Construction – Surface vibration (human amenity)
NSW Roads and Maritime Services (NSW RMS) – Construction Noise and Vibration Guideline (Roads and Maritime Services NSW, 2016)	Construction – Provides approach to mitigation framework
NSW RMS – Environmental Noise Management Manual (Roads and Maritime Services NSW, 2001)	Operation – Determining maximum noise events (practice note 3)
Road Design Note (RDN) 06-01 – Interpretation and application of VicRoads Traffic Noise Reduction Policy 2005 (VicRoads, 2005)	Operation – Traffic noise
VicRoads – Traffic Noise Measurement Requirements for Acoustic Consultants (VicRoads, 2011)	Operation – Traffic noise
World Health Organisation (WHO) – Night Noise Guidelines for Europe (WHO, 2009)	Operation – Traffic noise

12.2.2 Relevant assessment criteria

EPBC criteria

Noise and vibration impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

Construction noise

Guideline targets for construction noise in Simpson Barracks were established using relevant legislation, policy, guidelines and project requirements and are presented in Table 12-2.

Table 12-2 Summary of construction noise guidelines targets

Barracks building type	Internal noise criteria (dBA, Leq, 15min)	External noise criteria (dBA, Leq, 15min)	Highly noise affected criteria (dBA, Leq, 15min)
Administration/general office	-	70	80
Residential	-	70	75
Educational and Miscellaneous	45	60	75
Sports	65	75	85
Industrial/Workshop	-	75	85

Operational noise

Project-specific traffic noise objectives have been developed for North East Link by conservatively applying the VicRoads Traffic Noise Reduction Policy and Road Design Note 06-01, categorising all roads as new (rather than upgraded for the M80 Ring Road and Eastern Freeway).

Operational traffic noise objectives are presented in Table 12-3. The assessment approach for operational traffic noise was based on VicRoads Road Design Note 06-01 (July 2010), excepting that project-specific noise objectives have been adopted for two categories of building:

- Category A – residential dwellings, aged persons home, hospitals, motels, caravan parks and other buildings of a residential nature
- Category B – schools, kindergartens libraries and other noise-sensitive community buildings.

Plant noise is assessed according to SEPP-N1.

Table 12-3 Operational noise objectives

Noise type	Governing reference	Limit
Fixed plant	SEPP-N1	As set within SEPP-N1
Traffic noise from North East Link (façade-corrected traffic noise)	Project specific noise objectives	Category A buildings: $L_{A10(18hour)}$: 63 dBA, measured between 6 am and midnight Category B buildings: $L_{A10(12hour)}$: 63 dBA, measured between 6 am and 6 pm
Traffic noise on non-project roads	Project-specific noise objectives	For Category A and Category B buildings on non-project roads which directly intersect with North East Link roads and where total traffic noise for the design year and 'with project' exceeds the thresholds listed above for traffic noise from North East Link, the combined noise from North East Link project roads and non-project roads for the design year must be no greater than 2 dBA higher than the predicted traffic noise level under the design year 'do nothing' scenario.

12.2.3 Assessment scope

Study area

The assessment looks specifically at noise impacts on receptors on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2). Beyond this distance, the level of impact from surface noise would be negligible.

Noise impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The impacts considered were:

- Noise from construction of North East Link including from works for the cut and cover tunnel and trenching
- Traffic noise from the new roads
- Noise from the tunnel ventilation system.

Vibration and regenerated noise, which relate mainly to trench excavation and tunnelling are discussed in Section 13.

12.2.4 Description of environment

Baseline noise and vibration measurements undertaken along the project boundary formed the basis of the existing conditions assessment. This was used to provide a base line assessment of the current noise and vibration environment.

Classification of sensitive receivers

The areas adjacent to North East Link comprise land use categorised as residential, industrial, Commonwealth land (Simpson Barracks), mixed use commercial, recreational or public open space. Most buildings adjacent to the project boundary are currently exposed to varying levels of traffic noise.

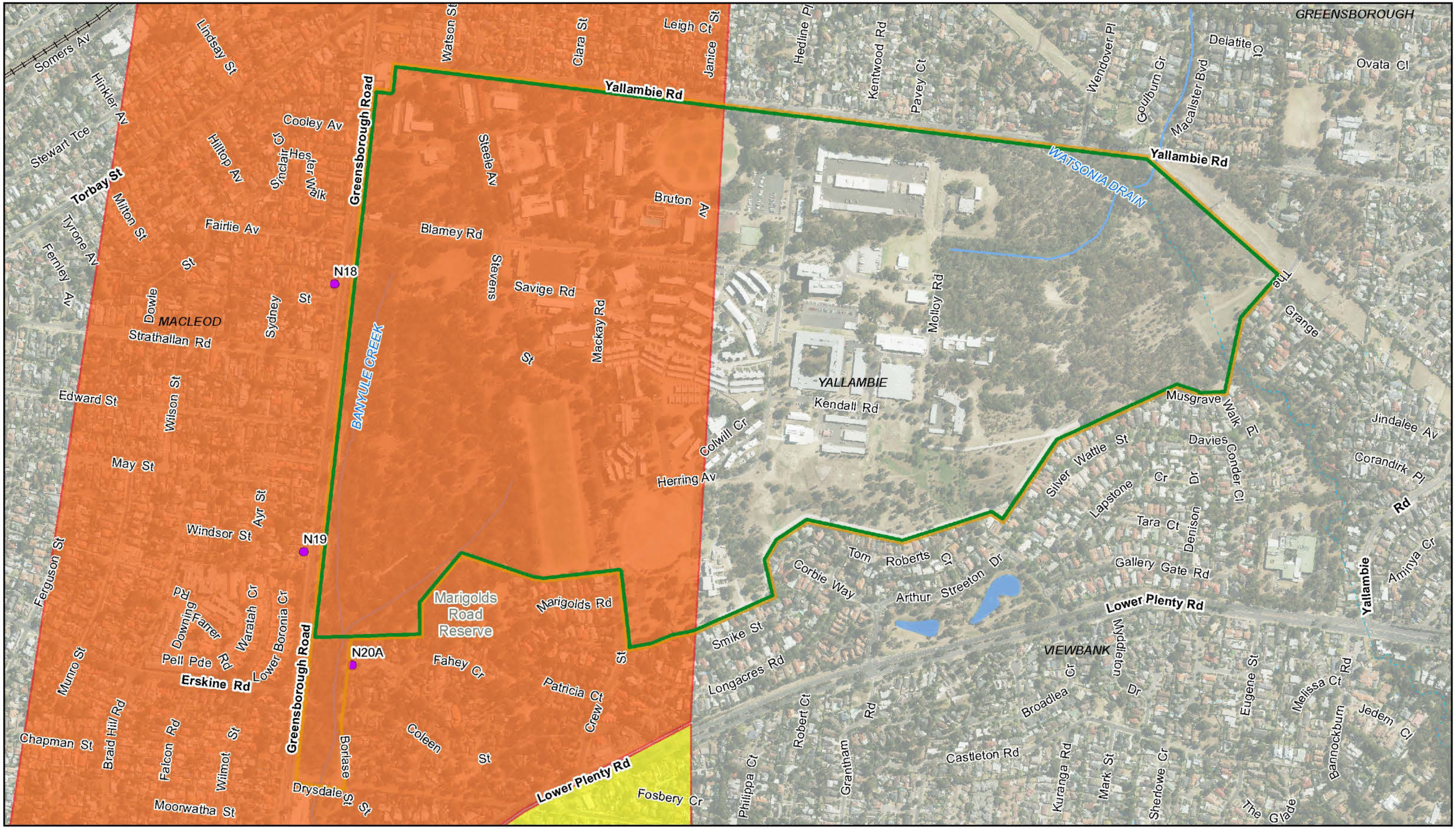
An estimation of the types of receivers which North East Link may impact was undertaken using aerial maps of existing land uses adjacent to the project boundary. This, in conjunction with cadastral information, was used to determine the classification of residential, community, heritage, commercial, industrial, educational, recreational and other land uses.

Site investigations

Site investigations and monitoring were used to develop an understanding of the existing noise conditions at various locations. These included three sites at Simpson Barracks (Commonwealth land) to capture a sample of noise levels at these locations in conjunction with observations of the dominant noise sources within the area, as shown in Figure 12-1.

Existing noise and vibration conditions were monitored and reported with reference to the following descriptors:

- Noise $L_{A10(18hour)}$, L_{A90} (day), L_{A90} (evening), L_{A90} (night)
- Vibration – PPV (peak particle velocity, millimetres per second).



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Legend

- Barracks fenceline
- Commonwealth land
- Baseline Monitoring Locations (unattended monitoring)

Precincts

- Precinct 1: M80 Ring Road to Lower Plenty Road
- Precinct 2: Lower Plenty Road to Manningham Interchange
- Railway
- Stream
- Drain/channel/other
- Lake

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Noise monitoring locations and receptors on Commonwealth land

Figure 12-1

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | SMEDTECH - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: mjshrives

12.2.5 Information sources

Data sources used in the noise and vibration assessment are presented in Table 12-4.

Table 12-4 Data sources for the noise and vibration assessment

Source	Type of data
Monitored data	Baseline and compliance noise monitoring conducted under neutral atmospheric conditions, wind less than 3 m/s and during periods of no rain.
Publicly available aerial photography	Aerial photography used to determine the locations of the residential receptors.
SLR	Noise emissions levels from construction equipment, based on SLR's database and other published sources.

12.2.6 Impact assessment

An existing conditions assessment addressed the location of noise-sensitive buildings and the prevailing airborne noise environment (based on measurements undertaken within or near Simpson Barracks). Sensitive receptors refer to buildings where people rest and reside, staff work, or where normal day-to-day noise-sensitive activities occur. All Simpson Barracks buildings in the study area were classified as sensitive receptors for the study.

Construction and operational noise modelling around Simpson Barracks was undertaken using SoundPLAN noise modelling software which enables the prediction of construction noise and traffic noise. The model uses information on 3-D ground terrain, road design strings (including gradients), building height and locations, traffic volumes, vehicle categories and speed, road surface characteristics and the acoustic shielding provided by existing and proposed noise walls.

The Calculation of Road Traffic Noise (CoRTN) 1988 prediction technique was adopted as the basis for the prediction methodology. CoRTN is widely used and accepted throughout Australia and is the road traffic noise calculation and prediction technique recommended by VicRoads.

Noise model validation was undertaken for the existing conditions noise model (2018) and involved the comparison of the measured and modelled noise levels at the same assessment location to verify the accuracy of the noise model.

A bespoke computer noise model of the proposed tunnel ventilation system was created to predict the potential breakout noise impact at the nearest sensitive receptors, based on:

- Topographical data within the study area
- Design layouts of the facilities
- Assumed sound power level information for the various noise-emitting plant and equipment items proposed to be installed as part of North East Link
- Noise mitigation requirements are based on the predicted noise levels at noise-sensitive receptors and the required noise reductions to meet the noise limits.

12.2.7 Assumptions

The findings of this assessment are subject to the following limitations, uncertainties and assumptions:

- The assessment of surface noise is based on noise criteria that is adopted in Victoria, and other states of Australia. The recommended guidelines, metrics and approach are commonly adopted for major infrastructure projects in Australia.
- Calculations of the resulting noise levels have been undertaken using standard software, widely accepted by government departments throughout Australia.
- Relevant scenarios for construction and operational conditions are modelled and assessed based on information sourced from various disciplines, based on their experience.
- This section is limited to surface noise impacts. Vibration and regenerated noise impacts are discussed in Section 13.
- An assessment of noise impacts on human health has not been included within this assessment. Human health impacts are discussed in Section 15.
- Inputs used to develop the operational noise model are based on the current design. Future changes to the alignment are conceivable, noting that changes to the horizontal or vertical alignment of the road, topography, traffic volumes, road speeds and surfaces would affect predicted noise levels.
- The equipment the successful contractor would use may differ from that assumed. However, the noise emission standards would still need to be met.
- Traffic volumes prepared for the EES have been adopted for the purposes of this assessment. Accordingly, for modelling purposes this section has adopted 2026 as the 'year of opening' and 2036 as the 'design year' consistent with the traffic forecasts developed for the EES. The upper limit of the predicted traffic volume range provided was conservatively selected for the noise impact assessment.

References to traffic, traffic noise or the like is linked to the average annual weekday traffic levels, which are typically higher than on weekends, or public holidays.

12.2.8 Linked sections

Table 12-5 other technical assessments from which information has been drawn for this study.

Table 12-5 Linkages to other assessments

Reference	Topic	Link
Section 11	Traffic	This section uses on modelled operational traffic data.

12.2.9 Stakeholder consultation

No consultation was specifically undertaken by SLR in relation to impacts on Commonwealth land.

12.3 Relevant impacts and mitigation measures

12.3.1 Construction noise impacts

Impact description

Construction activities likely to be required to construct the above-ground aspects of North East Link involve conventional road and tunnel infrastructure construction equipment such as earth moving equipment, piling equipment, paving plant, concreting equipment, and cranes.
Three scenarios were modelled:

- Initial trench excavation works. The top five metres of the ground is relatively soft and can be removed with common excavation equipment (scrapers and the like)
- Mid-depth trench excavation works. From five metres, the ground gradually becomes harder, and it is conservatively assumed that rock and rock breakers would be required
- Surface auger piling, for the creation of the trough walls.

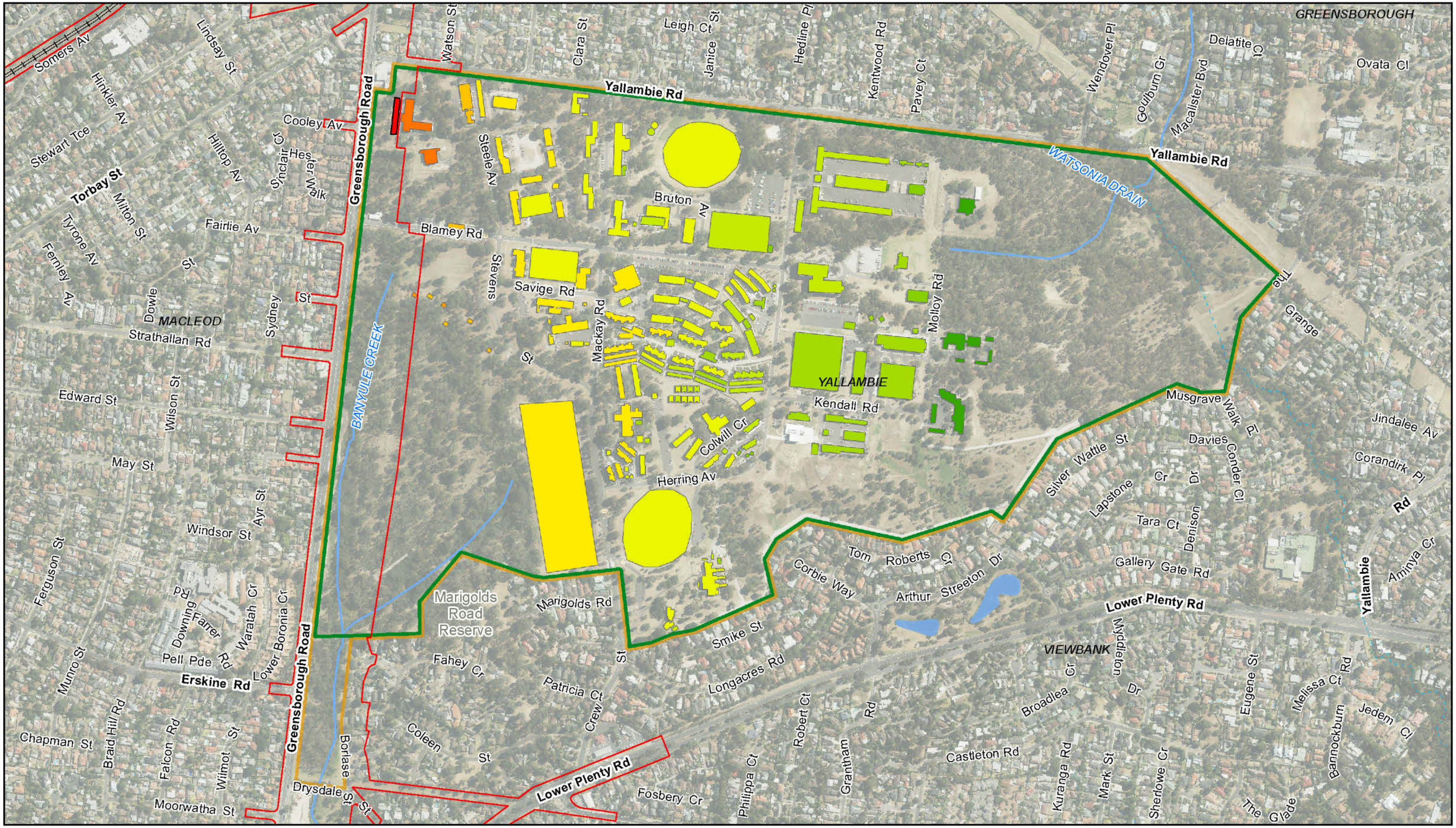
The modelled noise associated with the initial trench excavation is shown in Figure 12-2 and for surface auger piling works in Figure 12-3. Modelling indicates that only the carparking enclosure and vehicle workshop, west of Building 1, is predicted to experience an exceedance of the noise objectives.

During the rock-hammering works for the mid-depth trench excavation works an exceedance of the noise objectives is predicted at three buildings, as shown in Figure 12-4. Excluding the carparking building, the buildings potentially impacted are Building 1 and the residential building (Building 18).

Construction activities and equipment would generally likely move within the construction sites, remaining within the project boundary, so the associated increase in noise levels is expected to be short term.

The large building to the west of the L-shaped building in the north-west corner of Simpson Barracks is understood to be a vehicle shed and workshop. It would act as a noise barrier providing noticeable noise reduction to the office spaces within the adjacent L-shaped building.

It is understood the western end of Building 1 appears to be used as delivery/goods retrieval dock, while the eastern wing of the building appears to be used as office space.



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Legend

- Exceedance of Construction Noise Target
- Barracks fenceline

Project boundary

- Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake

Predicted Noise Level (dBA)

15 - 20, 21 - 25, 26 - 30, 31 - 35, 36 - 40, 41 - 45, 46 - 50, 51 - 55, 56 - 60, 61 - 65, 66 - 70, 71 - 75, 76 - 80, 81 - 85

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Noise impacts from open cut earthworks (surface)

Figure 12-2

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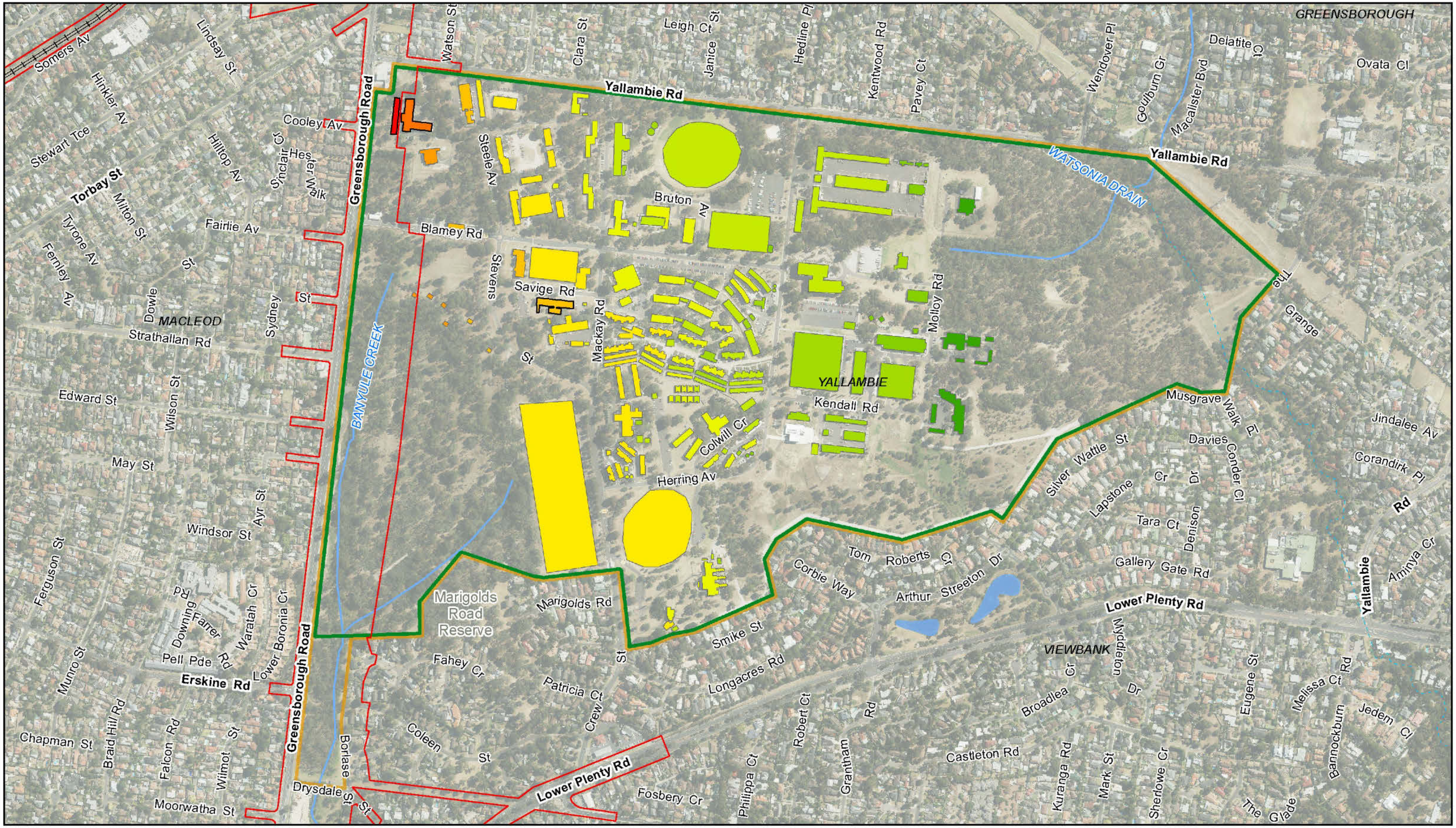
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives



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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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Legend

- Exceedance_of_Construction_Noise_Target
- Barracks fenceline

Project boundary

- Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake

Predicted noise level (dBA)

- 22 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- 61 - 65
- 66 - 70
- 71 - 75
- 86 - 90

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Noise impacts from open cut earthworks (5m)

Figure 12-3

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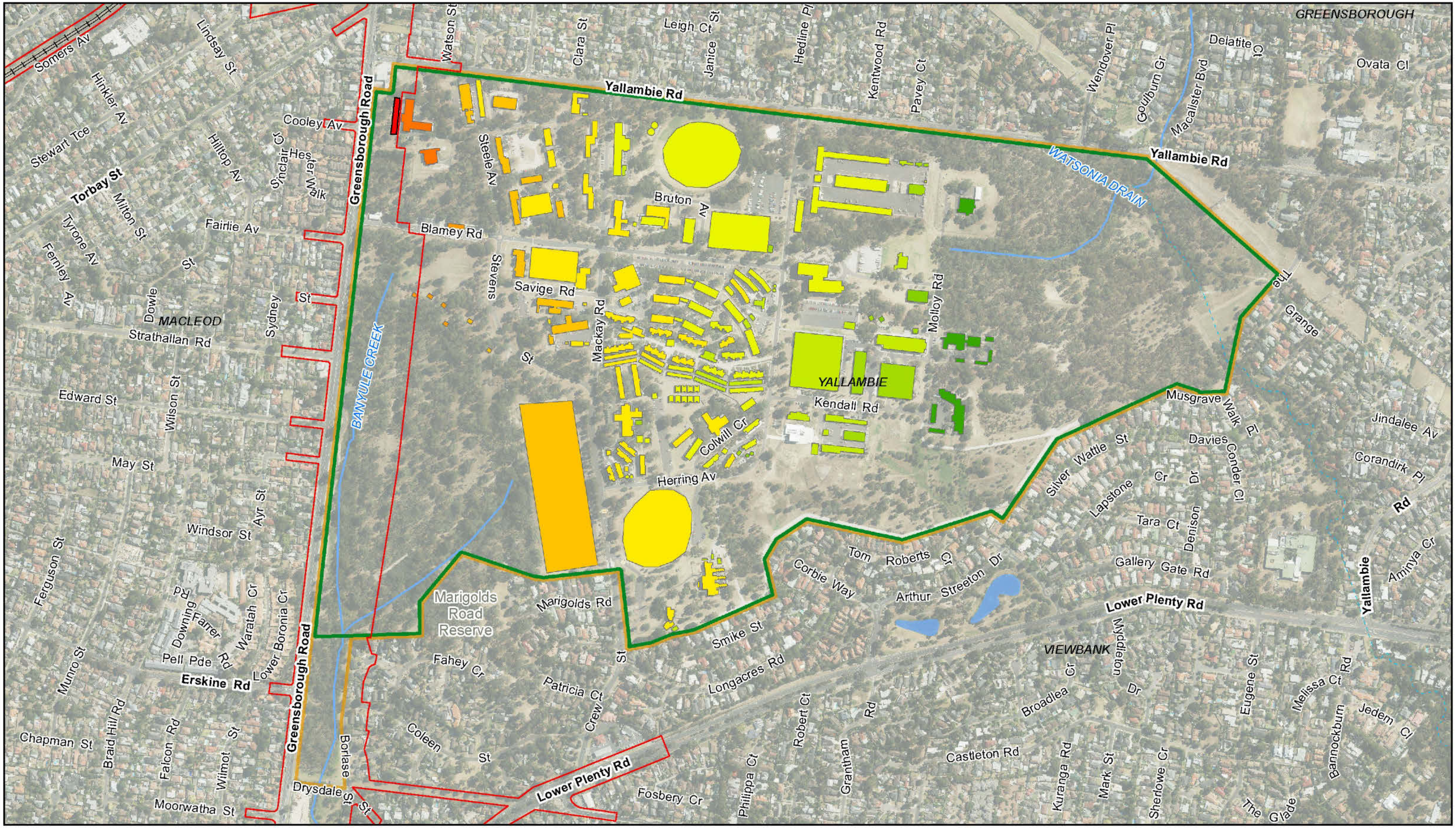
Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Legend

- Barracks fenceline
- Exceedance of Construction Noise Target

Project boundary

- Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake

Predicted noise level (dBA)

- 13 - 15
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- 61 - 65
- 76 - 80

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Noise impacts from piling

Figure 12-4

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Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

Proposed avoidance and mitigation measures

Mitigation measures would be developed and evaluated during the detailed design phase to minimise construction noise management level exceedances at the noise-sensitive Simpson Barracks buildings.

A Construction Noise and Vibration Management Plan (CNVMP) would be developed which would include the proposed construction noise and vibration monitoring, to help reduce the potential for impacts from construction works. The types of mitigation measures that could be implemented as part of this plan to reduce noise impacts from construction works include:

- Scheduling noisy works to not occur concurrently
- Scheduling noisy works which consider the operational use of buildings on Simpson Barracks
- Localised acoustic shielding on the construction site.

Specific details of mitigation and monitoring would be set out in the CNVMP.

In addition a Communications and Community Engagement Plan would be implemented and require stakeholders to be notified in relation to construction activities, potential noise and vibration impacts and relevant mitigation measures.

It is expected that suitable mitigation could be developed to minimise the potential for construction noise impacts, to the noise-sensitive areas of the Simpson Barracks. The adoption of the noise management level system helps guide and identify the appropriate responses and measures.

Residual impacts

Construction noise and vibration would be managed in accordance with a set of construction noise guideline targets with noise mitigation measures implemented through a CNVMP. It is expected there would be no significant impacts on Commonwealth land from construction noise.

12.3.2 Operational traffic noise

Impact description

Operation of North East Link would permanently change road traffic noise levels on Commonwealth land, with potential for direct impacts to those parts of the barracks community exposed to changes in noise levels. Three noise scenarios were modelled to assess operational noise impacts:

- 2018 – existing: noise from existing traffic flows
- 2036 – with project: 10 years after North East Link opens (including proposed noise walls) (see Figure 12-5)
- 2036 – no project: North East Link does not proceed and no additional mitigation (see Figure 12-6).

Modelling was used to assess if the noise objectives applicable to project roads was exceeded. Mitigation has been provided for where the modelled noise level at Category A (residential) receptors are above 63dBA $L_{A10(18h)}$ or Category B (other noise-sensitive receptors) are above 63 dBA $L_{A10(12h)}$ at the lowest habitable level for the design year (2036).

When the 2036 'with project' noise levels are compared with the 2036 'no project' noise levels, the movement of surface traffic into the tunnels would result in minor noise reductions across the northern portion of Simpson Barracks. At the closest building, the 'with project' scenario results in a noise reduction of 3dBA to 4dBA, whereas for the further buildings, noise reductions are smaller at approximately 1dBA.

In the southern portion of the site, the noise from the ramps results in noise increases of up to 2dBA east of North East Link's roads. Increases of this magnitude are generally not considered noticeable to humans.

In 2036, noise from North East Link roads at all buildings on Commonwealth land is predicted to be below 63dBA. At-property noise mitigation is therefore not considered to be required for any building.

Proposed avoidance and mitigation measures

Proposed noise mitigation measures near Simpson Barracks included in the reference project include:

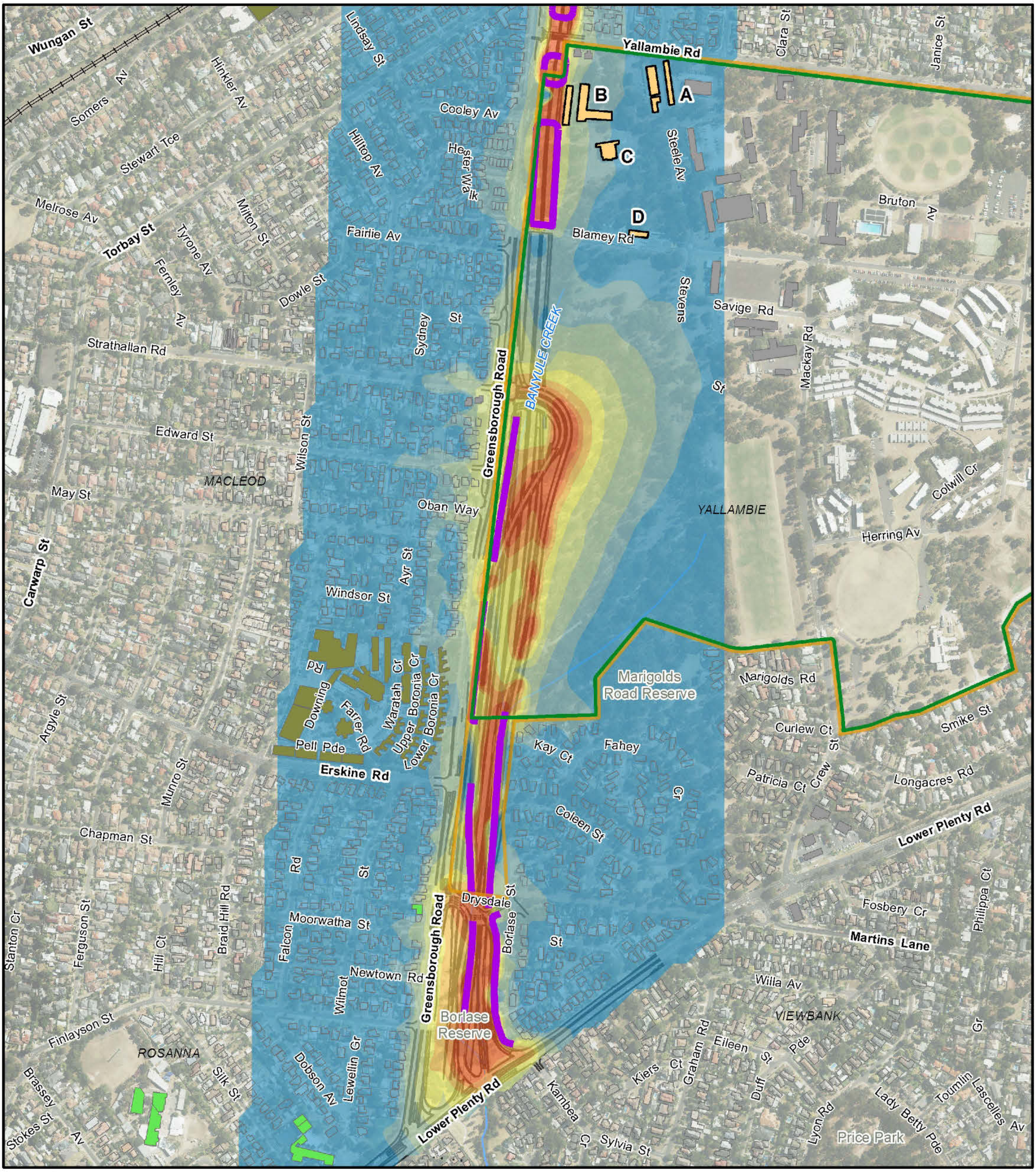
- The use of low-noise, open-graded asphalt on the exposed sections of the main carriageway
- New four-metre high noise walls around the shared use path on the surface above North East Link roads
- Noise walls along the tunnel ramps in the southern portion of the Commonwealth land.

Based on the modelling and the reference project, it is anticipated that no buildings on Commonwealth land would require at-property mitigation as North East Link traffic noise objectives would be met. This would be reviewed and reassessed for the detailed design.

Precise details of the noise wall designs would not be available till the detailed design. However, noise walls would provide noise attenuation equivalent to that assessed in the modelling.

Residual impact

With implementation of the identified mitigation measures, road noise impacts at sensitive receptors at Simpson Barracks would comply with North East Link traffic noise objectives. Changes in traffic noise impacts from North East Link's operation are therefore not considered significant.



Legend

Commonwealth land	Stream	**Noise Contours Project 2036 (dBA)**	48 - 51	57 - 60	66 - 69
Barracks fenceline	Drain/channel/other		51 - 54	60 - 63	
Railway	Noise Walls	<= 48	54 - 57	63 - 66	

Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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2036 Operational traffic Noise Levels (LA10,18hour) for project and local roads (with project)

Figure 12-5

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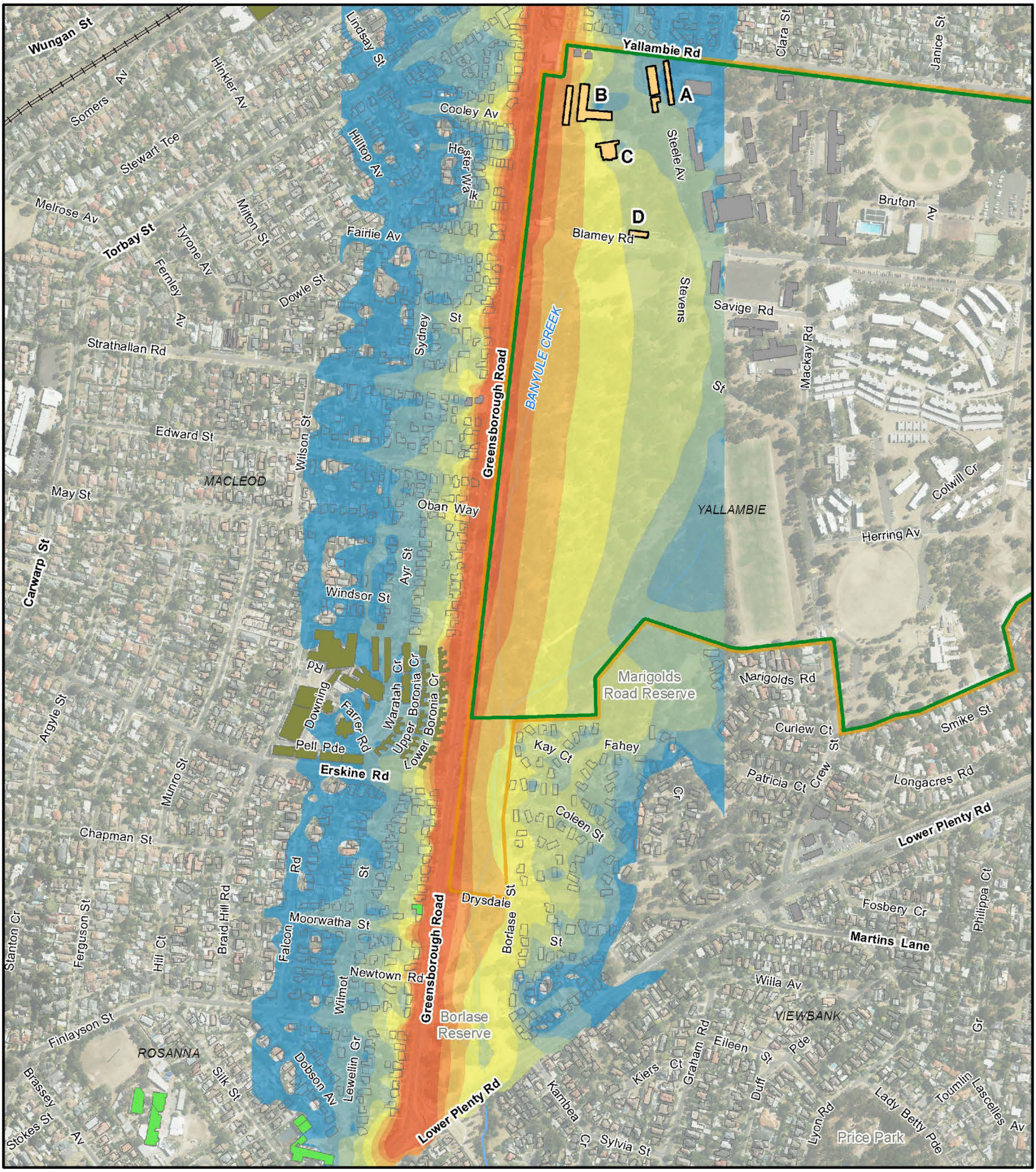
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: mjshrives



Legend

- Modelled building receptors
- Commonwealth land
- Barracks fenceline
- Railway
- Stream
- Drain/channel/other

Building Type

- School / University / Preschool
- Residential Building
- Aged Care
- Non Assessable Buildings

Noise Contours (do nothing scenario)

Noise Contours - Do Nothing Scenario (dBA)

- <= 48
- 48 - 51
- 51 - 54
- 54 - 57
- 57 - 60
- 60 - 63
- 63 - 66
- 66 - 69

Paper Size A4

0 50 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

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Revision	D
Date	28/02/2019

2036 Operational traffic Noise Levels
Do Nothing Scenario

Figure 12-6

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Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: mjshrives

12.3.3 Operational tunnel ventilation structure noise

Impact description

Ventilation structures would be required to move air through the tunnels. The ongoing operation of the ventilation structures would generate noise that may directly affect surrounding noise-sensitive land uses.

In the Melbourne metropolitan area, noise from commerce, industry and trade is subject to the provisions of the *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1* (SEPP N-1). Noise limits are prescribed in the SEPP N-1 for residential premises, based on the land-use zoning of the area and on measured background noise.

Noise impacts to Simpson Barracks are not required to be assessed under SEPP N-1 as the barracks is not a ‘residential premise’ and is not zoned under the relevant planning scheme, (although it is acknowledged that people do reside at the facility). However a qualitative assessment indicates that ventilation structure noise levels at Simpson Barracks would be equivalent to or lower than the levels required to comply with SEPP N-1, and are therefore at acceptable levels when considering building usage and prevailing ambient noise sources in the area.

Proposed avoidance and mitigation measures

The proposed ventilation structure includes noise attenuation equipment to reduce noise emissions to below the established ventilation noise criteria based on SEPP N-1.
During detailed design, silencers would be selected to provide an overall insertion loss taking into account flow noise due to the movement of air through splitters of the silencers, on the intake and discharge side of each of the fans. These silencers would need be re-assessed during detailed design, having consideration of the design of the building and the frequency-dependent noise spectra of the selected fans.

Residual impact

The residual noise impacts on Simpson Barracks from operational ventilation structures are not considered significant.

12.3.4 Construction impacts of a northern TBM launch

North East Link includes an alternative northern TBM launch site option at Lower Plenty Road, extending north to Blamey Road.

The alternative northern TBM launch site option would include primary workshops and storage facilities for the works with access to the northern TBM launch site through Blamey Road to the north and Erskine Road to the south. An acoustic shed would be placed at the adjacent to Moorwatha Street, with the nearest residential receivers along Greensborough Road and Borlase Street approximately 30 to 50 metres from the TBM launch site facilities.

The primary differences between the two TBM launch options are the available area to contain all the facilities, the significant difference in set-back distance to the nearest residential receivers, as well as the origin point from which significant spoil haul traffic would be generated.

The spoil haul route for the southern TBM launch site option is to the west along Banksia Street and Bell Street and north along Rosanna Road/Greensborough Road and three alternative routes of Sydney Road, High Street and Plenty Road. This results in small increases in noise level and noise events on these routes during the night period. The northern TBM launch site option is contained in a truck curfew zone and therefore potentially unable to operate spoil haulage during the night-time period and so under this scenario there are no increases in night-time noise levels or noise events on the haul route of Greensborough Road.

12.4 Residual impacts

Table 12-6 summarises the residual surface noise and vibration impacts.

Table 12-6 Summary of residual surface noise and vibration impacts

Impact	Mitigation	Significance of residual impact
Noise from construction of the action impacts the barracks community	A CNVMP would be developed and implemented to minimise construction noise and vibration impacts. This would include construction noise and vibration monitoring. Specific noise mitigation measures implemented as part of the plan may include: • Scheduling noisy works to not occur concurrently • Scheduling noisy works to consider the operational use of buildings on Simpson Barracks • Localised acoustic shielding on the construction site. In addition a Communications and Community Engagement Plan would be implemented.	Not significant
Operational traffic noise changes, are audible within the barracks community	Noise mitigation measures included in the reference project close to Simpson Barracks include: • The use of low-noise, open-graded asphalt on the exposed sections of the main carriageway • New four-metre high noise walls around the shared use path on the surface above the road • Noise walls along the tunnel ramps in the southern portion of the Commonwealth land. It is anticipated based on the reference project that no buildings on Commonwealth land would require at-property mitigation.	Not significant
Noise from the operation of the tunnel ventilation system impacts the barracks community	Noise attenuation equipment would be included as part of the ventilation structure design to meet SEPP N-1 noise criteria.	Not significant

13. Vibration

13.1 Introduction

Heilig and Partners undertook an assessment of the vibration from the tunnelling as well as surface construction works, and an assessment of the impacts on Commonwealth land. This section summarises the assessment's findings.

13.2 Assessment method

13.2.1 Relevant assessment criteria

Tunnel vibration impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

13.2.2 Assessment scope

Study area

The assessment looked specifically at vibration impacts on receptors on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2). However, the assessment was confined to a distance of 200 metres from the excavations, as there would be no likely vibration and regenerated noise impacts beyond this distance.

Vibration impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The assessment looks specifically at ground borne vibration and regenerated noise impacts of construction of North East Link on people, properties, services and other infrastructure on Commonwealth land. The analyses presented in this section address the possible impact of the planned cut and cover tunnel and trenching activities on personal amenity and infrastructure integrity.

The impacts considered were:

- Amenity impacts on people working within Simpson Barracks from vibration and regenerated noise created by the earthworks necessary to support and develop the cut and cover tunnels and trench
- Integrity of building infrastructure from vibration created by the earthworks necessary to support and develop the cut and cover tunnels and trench.

The impacts of airborne/surface noise are addressed in Section 12.

Traffic-generated vibration from North East Link's paved roadways once operating would be imperceptible at locations within Simpson Barracks. Assuming well-maintained pavements and appropriate separation distances between the buildings and the road alignment, vibration impacts are expected to be indistinguishable from the currently existing environment.

13.2.3 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land Table 13-1 summarises the other key policies and guidance relevant to the assessment.

Table 13-1 Key legislation, policy and guidance for vibration

Policy/guidance	Relevance
Australian Standard AS2436-2010 (Standards Australia, 2010)	Overarching standard to guide noise and vibration control on construction, demolition and maintenance sites. Standard provides links and references to other standards or guidelines that should be followed.
Australian Standard AS2187.2-2006 (Standards Australia, 2006)	Addresses vibration from impulsive activities like blasting and provides reference to vibration levels for personal amenity and building damage.
British Standard BS5528-2:2009 (British Standards, 2008)	Standard referenced with respect to vibration guidelines applicable for construction projects for both amenity and building damage. Referenced document in AS2436.
British Standard BS6472-1:2008 (British Standards, 2008)	Most widely referenced standard for assessing amenity with respect to vibration. Standard used as a guide to evaluation of human exposure to vibration in buildings for vibration sources other than blasting.
British Standard BS7385-2: 1993 (British Standards, 1993)	British Standard for the evaluation and measurement for vibration in buildings with respect to guide to building damage levels from ground borne vibration. Standard referenced in AS2436 and AS2187.
Department of Environment and Conservation for New South Wales (NSW) DEC – Assessing vibration: A technical guideline (Department of Environment and Conservation NSW, 2006)	A Department of Environment and Conservation for New South Wales (NSW) document which references dosage for assessing vibration amenity. Refers to the BS6472-1 standard.
German Standard DIN4150-3:2016 (Deutsches Institut Fur Normung, 2016)	In combination with the British Standard BS7385, the German Standard is also very widely used for the protection of infrastructure from vibration damage.
Noise Control Guidelines, Publication 1254 (EPA Victoria, 2008)	While applicable to commercial, industrial and some large-scale residential construction projects, the Noise Control Guidelines provide a basis for determining construction noise targets to reduce noise impacts.
NSW Interim Construction Noise Guidelines (EPA NSW, 2009)	The Construction Noise Guidelines are specifically aimed at managing noise from construction works and can be used to assist in setting statutory conditions in licences or other regulatory instruments.
Australian Standard AS2436-2010 (Standards Australia, 2010)	Overarching standard for guide to noise and vibration control on construction, demolition and maintenance sites. Standard provides links and references to other standards or guidelines that should be followed.

13.2.4 Description of environment

The assessment examines modelled impacts on receptors identified in consultation with the DoD's management of Simpson Barracks.

13.2.5 Impact assessment

Impact assessment is based on modelling of vibration based on the proposed tunnelling and excavation of the reference project.

The expected level of vibration and regenerated noise from a range of excavation scenarios has been modelled using a project-specific vibration and regenerated noise package tailored to North East Link.

The model is based upon engineering principles supported in the international literature with the results verified from other large-scale tunnelling and construction sites. The scenarios address the possible equipment that could deliver the mainline tunnels, the cut and cover tunnels and trench structures at the northern portal.

Construction methodology is an important component of determining likely impacts.
The northern cut and cover tunnels and trench have some higher strength rock conditions which could require large plant excavators fitted with hydraulic hammers or other equipment capable of excavating high strength materials. The weaker ground condition areas would be developed with varying size excavators.

Sensitive receptors refer to buildings where people rest and reside, staff work, or where normal day-to-day activities occur. All buildings and assets in the study area were classified as sensitive receptors for the study.

The amenity-based vibration criteria are presented in the international standards. In these standards, vibration can either be presented in the velocity domain and displaying values in millimetres per second, or by using a more complicated dosage regime and returning values in ms-1.75. Vibration dosage is a useful method of assessing human comfort in that it follows the commonly observed view that lower levels of vibration can be tolerated for longer periods, or elevated levels of vibration for shorter durations.

The assessment of building related damage is done using the velocity domain (mm/s) which is consistent with the standards and all commonly employed methods in Australia.

13.2.6 Assumptions

The impacts of construction equipment that could be used to deliver North East Link have been assessed based on sourced information. Equipment other than that assessed could also be used. Drilling and blasting could remain an option for excavating the harder more competent rock mass that could be encountered.

The modelling results specifically relate to the proposed areas of excavation (that is, tunnel, portal/tunnel dive structures or cross passages).

The limitations or confidence in the predictions centre around the accuracy of the parameters that are estimated during the assessment phase. One of the key limitations remains the variability in the geology and its interaction with the vibration transmission through the rock mass. The assessments presented in this section are based upon best available information for the Melbourne rock masses.

The impacts of the action are completed through an assessment of the expected level of vibration and regenerated noise that involves best available engineering methods and practices. Nevertheless, the approach assumes a set of criteria that can only ever be fully specified once the activities have started and some measurement undertaken.

While the above assessments have been shown for other tunnelling projects to be within accepted levels, it would remain important that measurements of vibration and regenerated noise occur during the initial stages of North East Link and a comparison with the expected results undertaken.

13.2.7 Linked sections

Table 13-2 lists other technical assessments from which information has been drawn for this study.

Table 13-2 Linkages to other assessments

Reference	Topic	Link
PER Technical Appendix B – Groundwater technical report	Groundwater	Provides detail of the geology of the Commonwealth land at Simpson Barracks.

13.2.8 Stakeholder consultation

No consultation was specifically undertaken with persons within the study area.

13.3 Description of the environment

Geology

Geology influences the type of equipment that could be used for the excavation of the cut and cover tunnels and trench structures. For the cut and cover tunnels and trench structures along Greensborough Highway, the geology varies from residual soil to weathered siltstone to fresh siltstone. Further detail of the geology of the Commonwealth land at Simpson Barracks is provided in PER Technical Appendix B – Groundwater technical report.

The size of the excavating equipment (and hence the energy required for excavation) would vary with the degree of weathering. While an excavator could reasonably dig through the residual soil, a hydraulic hammer would likely be required as the degree of weathering for the rock mass reduces.

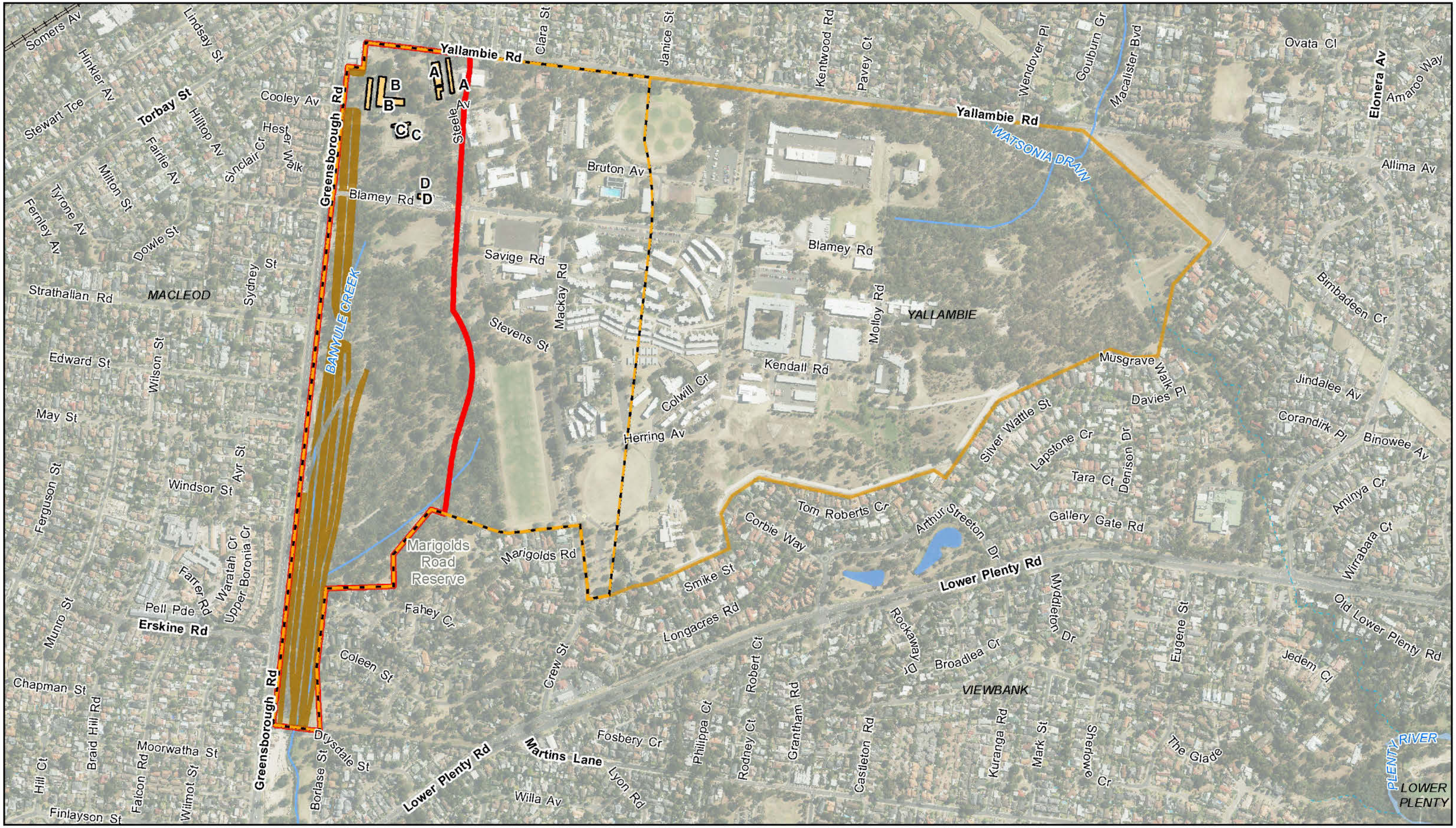
Simpson Barracks

Simpson Barracks occupies an approximately 129-hectare parcel of land immediately to the north-east of the northern extent of the portal dive structure along Greensborough Highway. Construction of North East Link would occur within Commonwealth land of the barracks along its western boundary parallel to Greensborough Highway. The closest barracks building is approximately seven metres from edge of the bored pile works and is understood to be a workshop facility for vehicles.

The next closest buildings range between 60 and 120 metres from the eastern edge of the trench (see Figure 13-1). These are a contractor office, an operational building and the barracks' gatehouse on Blamey Road.

Existing vibration environment

Background vibration in the study area has been assessed with data collected at four locations around Greensborough Road and Lower Plenty Road. Existing vibration conditions around are typical of a residential area with minimal sources of elevated vibration. Any perceptible vibration would likely result only from a combination of heavy vehicle movements coupled with uneven road pavement surfaces. Even this vibration would be limited to areas immediately around the road and not measurable at the properties adjacent to the road.



Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Legend

- Tunnel vibration study area
- PER 500m buffer
- Commonwealth land
- Modelled building receptors
- Reference design within commonwealth land
- Railway
- Stream
- Drain/channel/other
- Watercourse
- Lake

NORTH EAST LINK PROJECT

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Revision | C
Date | 16/01/2019

Potential receptors of tunnel vibration and regenerated noise assessment

Figure 13-1

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Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | Noise data - SLR - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2020 Created by: mjshrives

13.4 Relevant impacts and mitigation measures

13.4.1 Vibration or regenerated noise affecting amenity

Impact description

The impact assessment has considered the potential for the construction activities to induce elevated levels of vibration that could affect the amenity of persons within the study area. Where the construction activities are near to occupied properties near to the buildings within Simpson Barracks, there may be unavoidable elevated levels of vibration and/or regenerated noise.

All construction impacts relating to amenity are short-term, that is, only occurring during the period when the construction equipment is operating. These impacts are reversible.

The vibration and regenerated noise modelling results for each of the significant phases of construction equipment have been modelled.

The impacts of the activities on people within Simpson Barracks from the various construction phases are:

- Bored piling activities are planned on what is currently Commonwealth land. The closest building to the trench within Simpson Barracks is the workshop facility for vehicles, which is located a sufficient distance from the edges of the trench so impacts of the bored piling would be imperceptible and inaudible for most of the building. However, the western section of the building is closer to the trench and could receive very low levels of vibration and regenerated noise when the works are immediately adjacent.
- Vibration and regenerated noise from the trench excavation with a (typically used) 40-tonne excavator would also be insignificant and have no effect on amenity or the integrity of buildings within Simpson Barracks. Of these buildings, the western wing of the workshop facility would be the closest and is predicted to receive only momentary instances of vibration around 0.5 mm/s. Given the short duration of vibration, these levels are considered imperceptible.
- A hydraulic hammer may be used near the western wing of the workshop facility and vibration levels up to two millimetres per second could be experienced at this building. Vibration levels are modelled to attenuate to less than one millimetre per second at the main section of the workshop. The elevated levels of vibration would be perceptible and may require mitigation to provide an acceptable level of amenity for people in some sections of this building. The regenerated noise levels in the workshop would also be elevated because of the hammering, and may require mitigation.

Figure 13-2 to Figure 13-5 show contour plots showing the potential levels of vibration and regenerated noise for a trench excavation and hydraulic hammer.

Proposed avoidance and mitigation measures

During construction, contractors would be required to implement management actions if guideline target levels for continuous vibration from construction activity to protect human comfort of occupied buildings (including heritage buildings) are not achieved. These levels are calculated from the BS6472-1:2008 (British Standards, 2008).

In locations where guideline values cannot be met and use of alternative construction equipment is not feasible, other measures should be considered as detailed within a Construction Noise and Vibration Management Plan (CNVMP), such as:

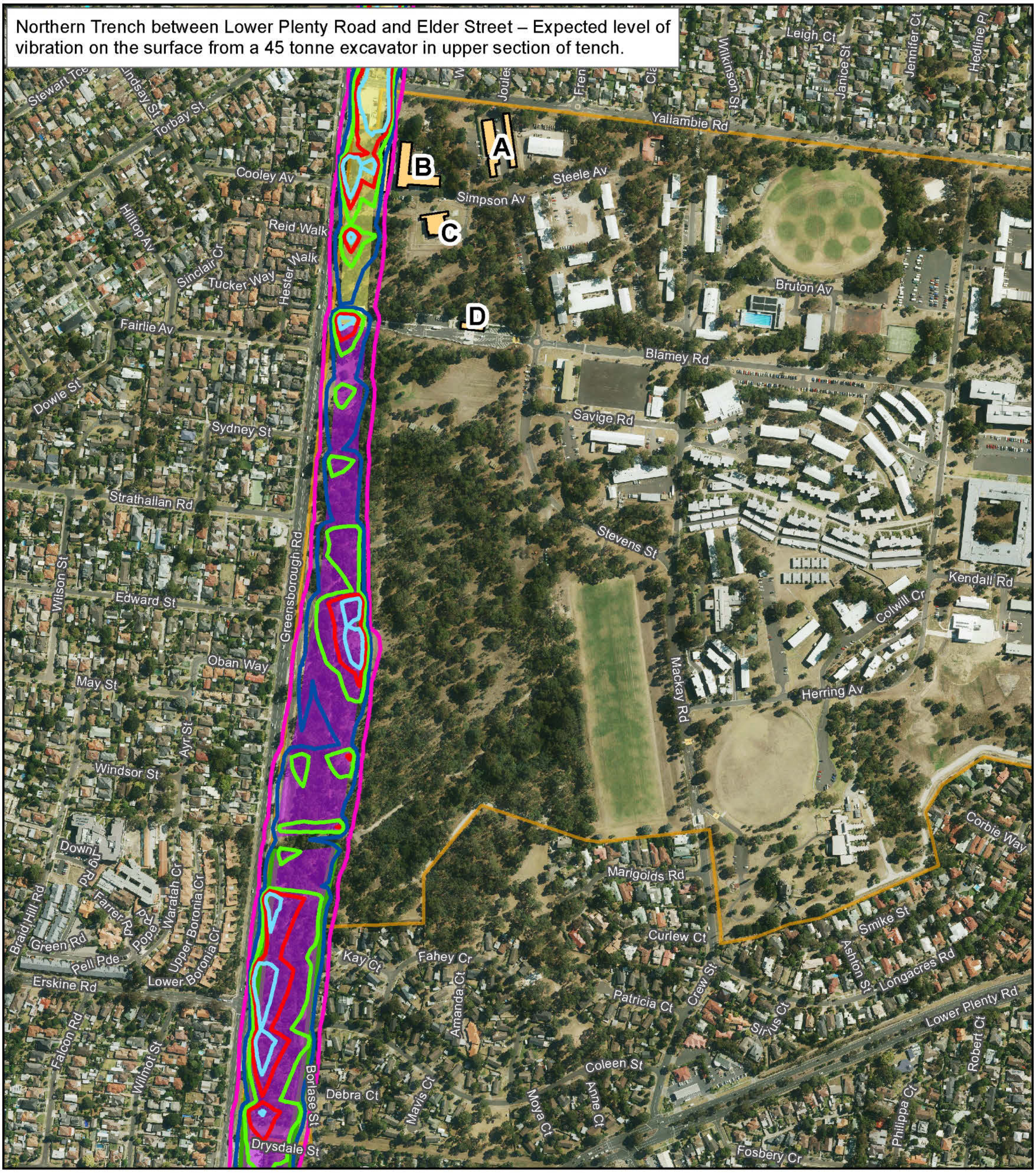
- Adjusting the scale of the construction equipment to control the level of vibration and regenerated noise at properties close to the works
- Real time monitoring of the level of vibration and regenerated noise to assess whether the activity complies with the criteria
- Revised scheduling of works
- Consultation with Simpson Barracks.

If the above mitigation measures are inappropriate or cannot reduce vibration levels to acceptable values, measures such as temporary relocation may be required. Similar mitigation measures have been successfully applied for other large-scale tunnelling projects in Australia.

Residual impact

Some people in the vehicle workshop in Simpson Barracks may perceive vibration and regenerated noise above that presently experienced. However, the impacts from vibration and regenerated noise would be temporary and minor and are not expected to have any significant amenity impact on people on Commonwealth land.

Northern Trench between Lower Plenty Road and Elder Street – Expected level of vibration on the surface from a 45 tonne excavator in upper section of tench.



Legend

Surface Vibration Levels

- 0.5 mm/s Vibration Contour
- 1.0 mm/s Vibration Contour
- 1.5 mm/s Vibration Contour
- 2 mm/s Vibration Contour
- 2.5 mm/s Vibration Contour
- Trench
- Cut and cover tunnel
- Diaphragm Wall
- Commonwealth land
- Modelled building receptors

Paper Size A4

0 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Vibration contours based on a 45 tonne excavator in upper section of trench

Figure 13-2

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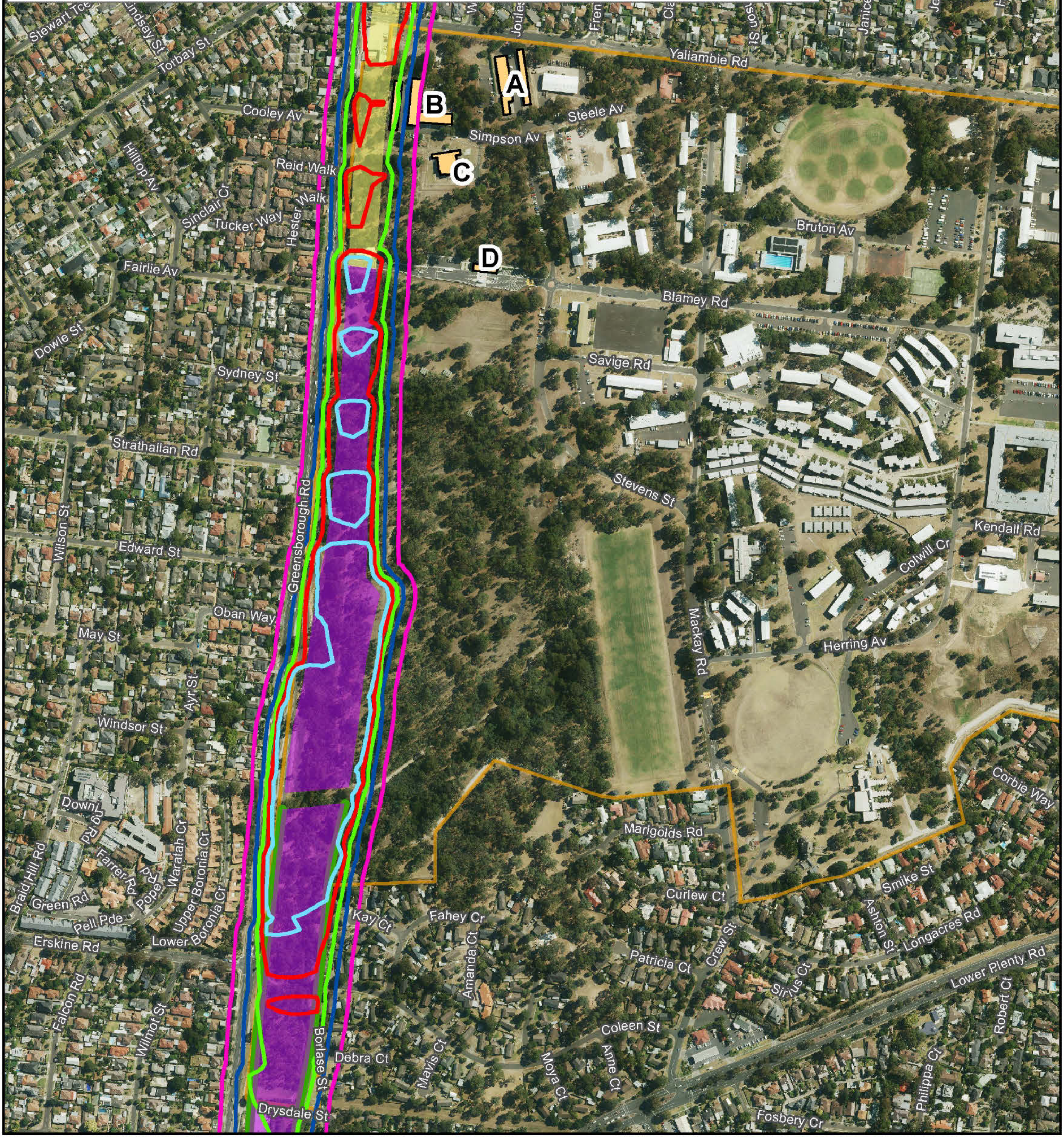
T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com
180 Lonsdale Street Melbourne VIC 3000 Australia

Data source: Data Set Name - Custodian - Version/Date. Created by:bkaemmerling

Northern Trench between Lower Plenty Road and Elder Street – Level of vibration on the surface from a 45 tonne excavator with a 3300kg hydraulic hammer at road level (Cat H160 or similar).



Legend

Surface Vibration Levels

- 0.5 mm/s Vibration Contour
- 1.0 mm/s Vibration Contour
- 1.5 mm/s Vibration Contour
- 2 mm/s Vibration Contour
- 2.5 mm/s Vibration Contour
- Trench
- Cut and cover tunnel
- Diaphragm Wall
- Commonwealth land
- Modelled building receptors

Paper Size A4

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Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Vibration contours based on a 45 tonne excavator with 3300kg hydraulic hammer at road level

Figure 13-3

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Data source: Data Set Name - Custodian - Version/Date. Created by:bkaemmerling

Northern Trench between Lower Plenty Road and Elder Street – Expected level of regenerated noise on the surface from a 45 tonne excavator in upper section of tench.

Legend

Regenerated Noise Levels

- Expected 35dBA Regenerated Noise Contour
- Expected 40dBA Regenerated Noise Contour
- Expected 45dBA Regenerated Noise Contour
- Expected 50dBA Regenerated Noise Contour
- Expected 55dBA Regenerated Noise Contour
- Trench
- Cut and cover tunnel
- Diaphragm Wall
- Commonwealth land
- Modelled building receptors

Paper Size A4

0 40 80 120 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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NORTH EAST LINK PROJECT

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Revision C
Date 03 Apr 2019

Regenerated noise contours based on a 45 tonne excavator in upper section of trench

Figure 13-4

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180 Lonsdale Street Melbourne VIC 3000 Australia

Data source: Data Set Name - Custodian - Version/Date. Created by:bkaemmerling

Northern Trench between Lower Plenty Road and Elder Street – Level of regenerated noise on the surface excavator with a 3300kg hydraulic hammer at road level (Cat H160 or similar).

Legend

Regenerated Noise Levels

- Expected 35dBA Regenerated Noise Contour
- Expected 40dBA Regenerated Noise Contour
- Expected 45dBA Regenerated Noise Contour
- Expected 50dBA Regenerated Noise Contour
- Expected 55dBA Regenerated Noise Contour
- Trench
- Cut and cover tunnel
- Diaphragm Wall
- Commonwealth land
- Modelled building receptors

Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Regenerated noise contours based on a 45 tonne excavator with 3300kg hydraulic hammer at road level

Figure 13-5

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13.4.2 Vibration damage to buildings and services

Impact description

The assessment has considered the potential for construction activities to induce elevated levels of vibration to adjacent buildings. High levels of vibration (that typically exceed that which can be generated by mechanical equipment) can cause superficial damage, flaking of paint, cracking of plaster and paint edge separation. Relatively extreme levels of vibration can cause structural damage to buildings.

The expected maximum level of vibration from the activities is calculated as less than 1.5 millimetres per second. While this level of vibration may be perceptible to some people along the alignment, it is below the values presented in the international literature and standards as potentially representing the onset of superficial damage to buildings.

The potential impacts of vibration on buildings in Simpson Barracks from each phase of construction are:

- Bored piling activities for the cut and cover trench are close to the vehicle workshop facility in Simpson Barracks, which would receive slightly elevated levels of vibration when compared with the existing background environment. The vibration from the piling activities would remain well below any values that could cause damage to the building or affect the building's content, other than possibly extremely sensitive scientific measurement apparatus.
- Vibration from trench excavation with a 45-tonne excavator would also be insignificant and have no effect on the integrity of the buildings. The western wing of the workshop is predicted to receive only momentary instances of vibration around 0.5 millimetres per second. Given the short duration of this vibration, there would be no impact upon the integrity of the building.
- The western wing of the workshop would be the closest to excavation works where a hydraulic hammer may be used. The separation distance is small and vibration levels up to two millimetres per second could be experienced at this building. The vibration would have no impact upon the building integrity.

All other buildings in Simpson Barracks are not affected by vibration from the planned equipment usage for developing the northern cut and cover tunnels and trench.

Telecommunications, water, sewerage, power and gas services exist may experience increased groundborne vibration from the action. Assessment of the available GIS, DBYD or asset supplied data bases has not identified any sensitive exchanges or reservoirs within 100 metres of the alignment.

The proximity of other residential properties and the mitigation and avoidance measures proposed (see below) are expected to maintain the integrity of these services. The modelling results indicate that levels of vibration at the identified services would not exceed two millimetres per second.

Proposed avoidance and mitigation measures

In locations where guideline vibrations values cannot be met and use of alternative construction equipment is not feasible, other measurements should be considered as detailed within a Construction Noise and Vibration Management Plan (CNVMP), such as:

- Adjusting the scale of the construction equipment to control the level of vibration
- Real time monitoring of the level of vibration and regenerated noise to assess whether the activity complies with recommendations in AS2436:2010 (Standards Australia, 2010)
- Vibration isolation devices for specific equipment or isolated areas within Simpson Barracks
- Rectification or strengthening of existing infrastructure to permit an elevated level of vibration or the use of alternative construction methods
- Consult Simpson Barracks in relation to vibration-sensitive equipment or activities.

Residual impact

The proposed construction activities may generate elevated levels of vibration. However, the level would be less than those values identified as representing the onset of superficial or structural damage to adjacent building infrastructure on Commonwealth land. There are not expected to be any significant vibration impacts on the buildings on Commonwealth land.

13.4.3 Construction impacts of a northern TBM launch

Vibration and regenerated noise modelling has identified the areas where impact could occur. The modelling techniques have considered the equipment types and their associated energies that could be used to construct the cut and cover sections of the trench.

In undertaking this assessment, the sequencing of the works has minimal effect on the measured levels of vibration and regenerated noise. An alternative project schedule associated with a launch direction for the TBM from the north would have no effect on the measured levels of vibration and regenerated noise.

13.5 Residual impacts

Table 13-3 summarises the residual vibration impacts.

Table 13-3 Summary of residual vibration impacts

Impact	Mitigation	Significance of residual impact
Construction vibration and regenerated noise has amenity impacts on personnel on Commonwealth land	Prepare and implement a CNVMP which sets out measures to minimise and monitor the impact of construction noise and vibration.	Not significant
Construction vibration damages buildings on Commonwealth land	Prepare and implement a CNVMP which sets out measures to minimise and monitor the impact of construction noise and vibration.	Not significant

14. Air quality

14.1 Introduction

Golder Associates undertook an assessment of the air quality impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

Air quality impacts relate to the people and communities criteria (see Table 16-1) as these are the primary receptors of the impacts. This section also relates to the conclusions presented in Table 30-1 relating to the potential impacts of North East Link related to pollutants, chemicals, and toxic substances.

14.2 Assessment method

14.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 14-1 summarises the other key policies and guidance relevant to the assessment.

Table 14-1 Key legislation, policy and guidance for air quality

Policy/guidance	Relevance
National Environment Protection (Ambient Air Quality) Measure (Air NEPM) (February 2016) National Environment Protection (Air Toxics) Measure (Air Toxics NEPM) (December 2004	The Air NEPM contains standards and goals for key pollutants that are required to be achieved nationwide, with due regard to population exposure The standards are not applied as modelling criteria for assessing air emissions from individual sources, specific industries or roadside locations.
State Environment Protection Policy (Ambient Air Quality) (SEPP(AAQ)) (February 2016)	SEPP(AAQ) objectives were used for comparison with air quality modelling predictions for North East Link's combined impacts.
State Environment Protection Policy (Air Quality Management) (SEPP(AQM)) (December 2001)	SEPP (AQM) objectives were used in the assessment of the impacts of North East Link's tunnel ventilation system emissions.
EPA Victoria Environmental Guidelines for Major Construction Sites (EPA Victoria, 1996)	Recommends measures for managing air quality issues for construction activities.

14.2.2 Relevant assessment criteria

EPBC criteria

Air quality impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

Air quality criteria

Pollutant impacts from the North East Link tunnel ventilation system were assessed against SEPP(AQM) Schedule A design criteria, as presented in Table 14-2.

Table 14-2 SEPP(AQM) design criteria

Pollutant	Criterion (mg/m^3) [1, 2]	Averaging period
PM_{10}	0.08	1 hour
$PM_{2.5}$	0.05	1 hour
NO_2	0.19	1 hour
CO	29	1 hour
Benzene	0.053	3 minute
Toluene	0.65 (odour)	3 minute
Ethylbenzene	14.5	3 minute
Xylene isomers	0.35 (odour)	3 minute
Formaldehyde	0.04	3 minute
1,3 Butadiene	0.073	3 minute
PAH [as B(a)P toxic equivalent]	0.00073	3 minute

Notes: 1. Design criteria to be used in assessing the design of new or expanded sources of emissions such as industrial premises.2. Assessment criteria based on modelled 99.9th percentile in accordance with Schedule C of SEPP(AQM)

Comparisons are also made with the SEPP(AAQ) objectives for relevant pollutants (see Table 14-3), although it should be emphasised they have no regulatory status. They have been used for comparative rather than compliance purposes for the combined impacts assessment (surface road vehicle and tunnel ventilation structure emissions and background air quality) which evaluates the potential impact of North East Link on the receiving environment.

Table 14-3 SEPP(AAQ) objectives

Pollutant	Units	Objective 1	Averaging period
PM_{10}	$\mu g/m^3$	50 20	24 hour Annual
$PM_{2.5}$ (2025)	$\mu g/m^3$	20 7	24 hour Annual
NO_2	ppm	0.12 0.03	1 hour Annual

Note: Assessment criteria based on the 100th percentile for all averaging periods.

14.2.3 Assessment scope

Study area

The assessment looked specifically at air quality impacts on receptors on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, both within the project boundary and within Commonwealth land (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2).

Air quality impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

The assessment specifically assessed air quality impacts on human receptors on Commonwealth land, including:

- Impacts of fugitive dust emissions during construction
- Odour emissions from disturbance of contaminated soil during construction
- Combustion emissions from Heavy Commercial Vehicles (HCV) and mobile plants during construction
- Combustion emissions from operational sources, specifically the ventilation structure and surface road vehicles.

Human health impacts from any changes in air quality are assessed in Section 15.

Air pollutants of relevance to the construction and operation of North East Link are:

- Particulate matter
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Benzene, toluene, ethylbenzene and xylene isomers (BTEX), formaldehyde and 1,3-butadiene
- Polycyclic aromatic hydrocarbons (PAH) as benzo(a)pyrene equivalents.

14.2.4 Description of environment

A description of the receiving environment includes the type and location of sensitive receptors, topography, meteorology and existing air quality. The receiving environment was characterised by:

- Identifying sensitive receptor groups within the study area
- Identifying relevant sources of existing information (such as the Bureau of Meteorology (BoM) and EPA Victoria monitoring station locations)
- Extracting data relevant to the study area and presenting it over a representative time period
- Collating relevant data into a form to support the impact assessment (such as in dispersion modelling).

14.2.5 Information sources

Data sources used in the air quality assessment are presented in Table 14-4.

Table 14-4 Data sources for the air quality assessment

Type of data	Source	Details
Topographical data	Department of Environment, Land, Water and Planning	• 2015 Vicmap elevation data (metro 1 to 5-m contours)
Meteorological data	Viewbank (BoM) Essendon Airport Melbourne Airport	• Wind speed, wind direction, temperature and sigma theta (2013 to 2017) (Viewbank met station) • Cloud cover (2013 to 2017) (Melbourne and Essendon Airports) • Twice daily sonde data (2013 to 2017) Meteorological input files were developed in accordance with guidelines provided in EPA Victoria Publication No. 1550 (EPA Victoria, 2013), for meteorological pre-processing using United States Environmental Protection Agency (USEPA) formulae. Meteorological data sources were used in conjunction with AERMET to generate five 12-month meteorological data files for 2013 to 2017. These years were considered representative of meteorology for the local area and correspond to the period selected for background air quality data. The meteorological stations were chosen such that each of the required parameters for meteorological pre-processing were sourced from stations nearest to the project boundary. Cloud cover and sonde data are not measured at the nearest meteorological station, Viewbank, and therefore these were sourced from Essendon Airport and Melbourne Airport respectively.
Background pollutant concentrations	Alphington (EPA Victoria) Various sites (EPA Victoria)	• PM_{10}, $PM_{2.5}$, CO and NO_2 (2013 to 2017; $PM_{2.5}$ 2014 to 2017 only) • PAH [benzo(a)pyrene], benzene, toluene, ethyl benzene, xylene isomers, formaldehyde and 1,3 butadiene
Traffic data	Veitch Lister Consulting (VLC) and Smedtech (VLC, 2018)	• Predicted traffic volumes and fleet mixes (passenger cars (PC), light commercial vehicles (LCV)) • LCV and HCV for the years 2026 and 2036.
Vehicle emissions (based on traffic data above)	NPI Australian Motor Vehicle Emissions Inventory (MVEI) COPERT Australia Brisbane City Council World Road Association (PIARC)	These standards and databases were used to develop the emissions factors on which the modelling of air emissions was based. These are discussed in Section 14.2.6.

14.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to air quality impacts during construction and operation are listed in Table 14-5.

Victoria's established framework for assessing air quality impacts formed the basis of the assessment. The receiving environment for North East Link was characterised as described in Section 14.2.4.

Table 14-5 Air quality assessment method

Phase	Approach
Construction	Construction emissions for large road and tunnel projects are complex due to the range, type and number of activities and associated sources of emissions, uncertainty associated with quantification of emissions, the geographical extent over which these activities occur and the intensity and duration. Air quality impacts associated with construction activities have therefore been addressed qualitatively. Where information was available, the nature of the proposed works and potential emission sources are described.
Operation	The assessment of potential air quality impacts resulting from North East Link's operation involved: • Use of air dispersion modelling techniques to assess the impacts of air emissions from tunnel ventilation structures. • Use of air dispersion modelling techniques to assess the base (without project) and North East Link impacts of vehicle emissions on sensitive receptors adjacent to major surface roads, where the action is expected to cause significant changes in traffic volumes or fleet mix. • Evaluating the combined impact of emissions from the tunnel ventilation structures and surface roads at identified locations in the receiving environment.
Modelling	The dispersal of pollutant emissions to air from the North East Link tunnel ventilation structure and from new or significantly impacted surface roads were modelled using AERMOD, the Victorian regulatory model under the SEPP(AQM). This included modelling emissions from the northern ventilation structure at a height of 40 m above ground level.

Emissions factors

2020 vehicle emission factors were developed from the COPERT Australia road transport air pollutant emission inventory model, a version of the model developed by the European Environment Agency, adapted to Australian vehicle types. This was used in preference to the widely used World Road Association (PIARC) data as COPERT permits a more accurate representation of the fleet mix. PIARC does not provide visibility ($PM_{2.5}$) emission factors for PC-P (Passenger cars – Petrol), nor PM_{10}, NO_2, VOCs or PAH emission factors for any vehicle class.

It is noted that COPERT Australia emission factors are not gradient dependent and the PAH emission factors are not speed dependent. In the absence of gradient dependencies, adjustments informed by the gradient dependencies described by PIARC were made for PM_{10}, $PM_{2.5}$, CO and NO_2 as provided in Appendix A. No adjustments were made for VOCs or PAH.

Passenger car traffic for North East Link has been assumed to be 15 per cent diesel and 85 per cent petrol-fuelled cars.

Composite vehicle emission factors for Brisbane for the years 2010 and 2025 (Brisbane City Council) were employed using COPERT Australia to estimate future year factors with which to adjust the PM_{10}, $PM_{2.5}$ and NO_2 assessment emission factors to 2025.

COPERT Australia requires a greater level of detail for the classes of vehicles to be modelled. In the absence of this level of detail, the North East Link model was configured on a state-based level, including vehicle fleet mix and mean fleet mileage statistics for Victoria in 2010. This information was developed as part of the NPI Australian Motor Vehicle Emissions Inventory (MVEI) and compiled in a COPERT Australia input file.

A (partial) validation study (Smit et. al., 2015) of COPERT Australia with in-ventilation system monitoring data from Brisbane's Clem Jones Tunnel (CLEM7) suggests that COPERT Australia is generally accurate at fleet level for PM_{10}, $PM_{2.5}$, CO and NO_X.

However, COPERT was found to under-estimate emissions by between 7 per cent and 37 per cent for the particular characteristics of CLEM7 and the fleet mix observed within.

The results indicated that overall underestimation for particulate matter emissions are small, but more significant for HCVs, with the study (Smit et. al., 2015) concluding that given the range of factors that complicate validation for particulate matter, the results show a remarkably good performance for COPERT Australia. For the purposes of this assessment, the conservative assumptions included in the estimation of the emission rates are considered to compensate for potential underestimation by COPERT Australia.

Assessment scenarios

The road tunnel and surface roads impact assessments were undertaken for two normal operation scenarios each for 2026 (A1 and A2) and 2036 (B1 and B2). Vehicle emission factors used in Scenarios A1 and B1 were conservatively assumed to remain at levels predicted for 2020. In order to conduct a sensitivity analysis which provides more realistic outcomes, vehicle emission factors used in Scenarios A2 and B2 were assumed to remain at levels predicted for 2025.

Traffic modelling was undertaken by VLC and Smedtech to predict traffic volumes and fleet mixes (Passenger Cars (PCs), Light Commercial Vehicles (LCVs) and Heavy Commercial Vehicles (HCVs)) for the years 2026 and 2036 for the purposes of the assessment. These years are understood to be generally representative of the '*expected year of opening'* and '*ten years following project opening*'. This traffic data formed the basis for the air quality impact assessment. The upper limit of the predicted traffic volume range provided was conservatively selected.

Modelling approach and inputs

The overall modelling approach for the surface impact assessment is described in Section 14.2.6.

Traffic models use line sources to represent mobile source emissions from vehicles on roads. In AERMOD, mobile sources can be represented by a series of volume sources. Volume sources require the following input parameters:

- Source coordinates
- Base elevation
- Release height
- Initial lateral dimension
- Initial vertical dimension
- Pollutant emission rate.

The pollutant emission rate is calculated from the vehicle volumes along each road link and the pollutant emission factor expressed as mass of pollutant per unit length for each vehicle category.

Volume sources require an estimate of the initial vertical and lateral dimensions of the plume. For mobile sources the initial lateral dimension (plume width) is the modelled road width plus three metres on either side of the road. AERMOD does not calculate concentrations within a defined area around the volume source called the volume source exclusion zone and receptors cannot be placed within the zone. The exclusion zone is defined as 2.15 times sigma Y plus one metre, where sigma Y is the initial lateral dimension, equivalent to the road width plus six metres. Figure 14-1 shows an example of a line source showing individual volume sources and the exclusion zone represented by a dashed circle. Receptors indicated by orange dots are placed along the edge of the exclusion zone.

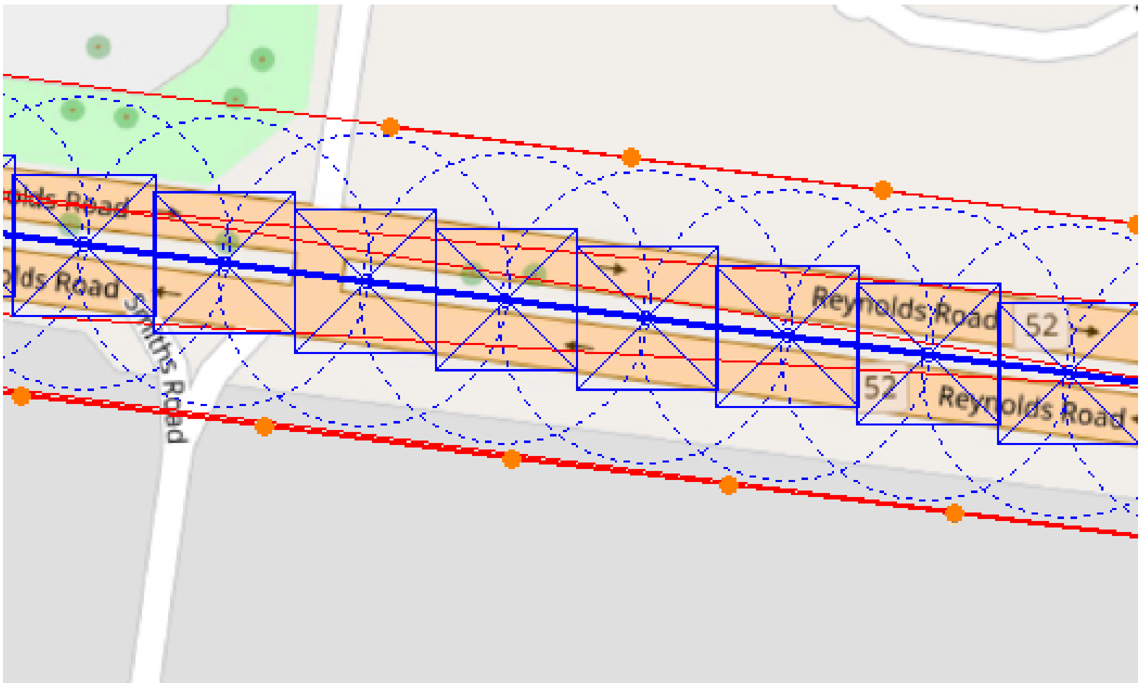

Figure 14-1 Volume source with exclusion zone

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14.2.7 Assumptions

The detailed construction methodology and associated level of understanding of impacts are uncertain and would depend on the working method of the contractor. However, the assessment has assumed that activities would be subject to a Construction Environmental Management Plan (CEMP), in accordance with the EPA Victoria Environmental Guidelines for Major Construction Sites (EPA Victoria, 1996), prepared to the satisfaction of an independent environmental auditor and accepted by NELP.

Where uncertainties in the assessment approach exist, Golder has used conservative assumptions to reduce the likelihood of underestimating impacts. Conservative assumptions have included the following:

- Five years of meteorological data were assessed so that the years corresponding to the greatest predicted impact from the tunnel ventilation structure and surface roads were selected for the air quality impact assessment.
- Background pollutant concentrations for the modelled years of 2026 and 2036 were assumed to remain at levels recorded for 2013 to 2017. EPA Victoria predicts a significant reduction in CO and NO_2 concentrations over the next 20 years through cleaner exhaust emissions from petrol, diesel and LPG engines and improvements in national motor vehicle emission standards. Similarly, a significant reduction in particle emissions ($PM_{2.5}$) from diesel vehicle engines is expected by 2030. Concentrations of these pollutants in 2026 and, in particular, 2036, would therefore be lower than those used as background levels in the air quality impact assessment.
- The upper limit of the predicted traffic volume range provided for all roads was selected.
- The adopted background concentrations for PM_{10}, $PM_{2.5}$, CO and NO_2 include exceptional events (as defined in the SEPP(AAQ)) such as bushfires, controlled burns and dust storms. During these periods, concentrations of particulate matter (PM_{10} and $PM_{2.5}$) can reach extremely high levels. Inclusion of data during these periods as representative background concentrations for the action can be highly conservative, contributing a significant proportion of the overall impact (background plus predicted).
- Vehicle emission factors used in Scenarios A1 and B1, representing 2026 and 2036 traffic, were assumed to remain at levels predicted for 2020. Vehicle emission factors used in Scenarios A2 and B2 were assumed to remain at levels predicted for 2025. Emission factors used for this assessment are considered conservatively high because there is a general trend towards lower emission vehicles (older technology vehicles being replaced over time with newer, improved technology vehicles) and expected improvements in vehicle technology beyond 2020 and 2025, which are not accounted for in the air quality impact assessment.
- Hybrid and electric vehicles were not considered in the fleet mix. The percentages of lower emission and zero emission vehicles in the Victorian vehicle fleet are expected to increase in future years.
- Acoustic barriers were not considered to have any effect on pollutant concentrations downwind. There is a significant body of evidence to suggest that acoustic barriers reduce pollutant concentrations immediately downwind of roadways at the most impacted sensitive receptors.
- All days in the model year were assumed to be weekdays for the purpose of assessing annual averages.
- Surface roads were modelled at grade.
- Motor vehicle emissions included both tailpipe emissions and brake and tyre wear.
- Roads and ramps were correctly located relative to each other, so the combined impacts are appropriately assessed (road geometry was estimated from aerial photographs and design drawings).
- Ramp speeds were assumed to be half the road speed limit.

14.2.8 Linked sections

Table 14-6 lists other technical assessments from which information has been drawn for this study.

Table 14-6 Linkages to other assessments

Reference	Topic	Link
Section 10	Social	Outputs from the air quality impact assessment were used in this section.
Section 11	Transport	The traffic volumes and fleet mix projections for North East Link were used in the estimation of emissions from surface roads and ventilation structures.
Section 15	Human health	Outputs from the air quality impact assessment were used in this section.

14.2.9 Stakeholder consultation

Specific consultation on air quality comprised a series of meetings with the EPA Victoria between November 2017 and July 2018 to agree approaches to air quality monitoring, modelling and impact assessment, the outcomes of which have fed into this assessment. There was no PER-specific consultation.

14.3 Description of environment

14.3.1 Sensitive receptors

Schedule C, Part B, 5I of SEPP(AQM) describes a sensitive location as 'hospitals, schools or residences'.

EPA Victoria Publication No. 1518 – Recommended Separation Distances for Industrial Residual Air Emissions (EPA Victoria, 2013) defines a sensitive land use as *'any land uses which require a particular focus on protecting the beneficial uses of the air environment relating to human health and wellbeing, local amenity and aesthetic enjoyment, for example residential premises, childcare centres, pre-schools, primary schools, education centres or informal outdoor recreation sites'*.

Sensitive receptors to which this assessment applies are people and communities on Commonwealth land. Defence personnel are recognised as a distinct community separate to the civilian population surrounding the site. There is short and long-term residential accommodation at the barracks, as shown in Figure 8-1.

14.3.2 Topography

Topography affects the dispersal and transport of pollutants. The land on which Simpson Barracks rests is undulating and approximately 80 metres above sea level. It gently slopes towards the Yarra valley where the elevation can be as low as 10 metres.

14.3.3 Meteorology

Wind speed and wind direction also affect the dispersal and transport of pollutants. Meteorological data was obtained for the closest BoM meteorological monitoring station to the North East Link tunnel and ventilation structures (at Banyule Flats Reserve at Viewbank, near Banyule Road) for 2013 to 2017. A comparison with the larger historical record showed it to be consistent.

Figure 14-2 shows wind rose data from the BoM AWS at Viewbank, indicating that the wind most commonly blows from either the south-south-west or north-north-east quadrants, with the summer months particularly dominated by winds from the south-south-west.

Autumn had the highest frequency of calm conditions, defined as wind speed less than 0.5 metres per second. Overall, the 2013 to 2017 wind observation dataset can be summarised as follows:

- The most frequent wind class is two to four metres per second
- Less than six per cent of winds exceed six metres per second
- The average wind speed is 3.1 metres per second
- Low wind speeds (less than two metres per second) occurred most frequently in autumn and winter
- South-south-west winds predominate in summer and are uncommon in winter
- North and north-north-east winds predominate in winter and are uncommon in summer
- Spring and autumn conditions are similar to the annual average.

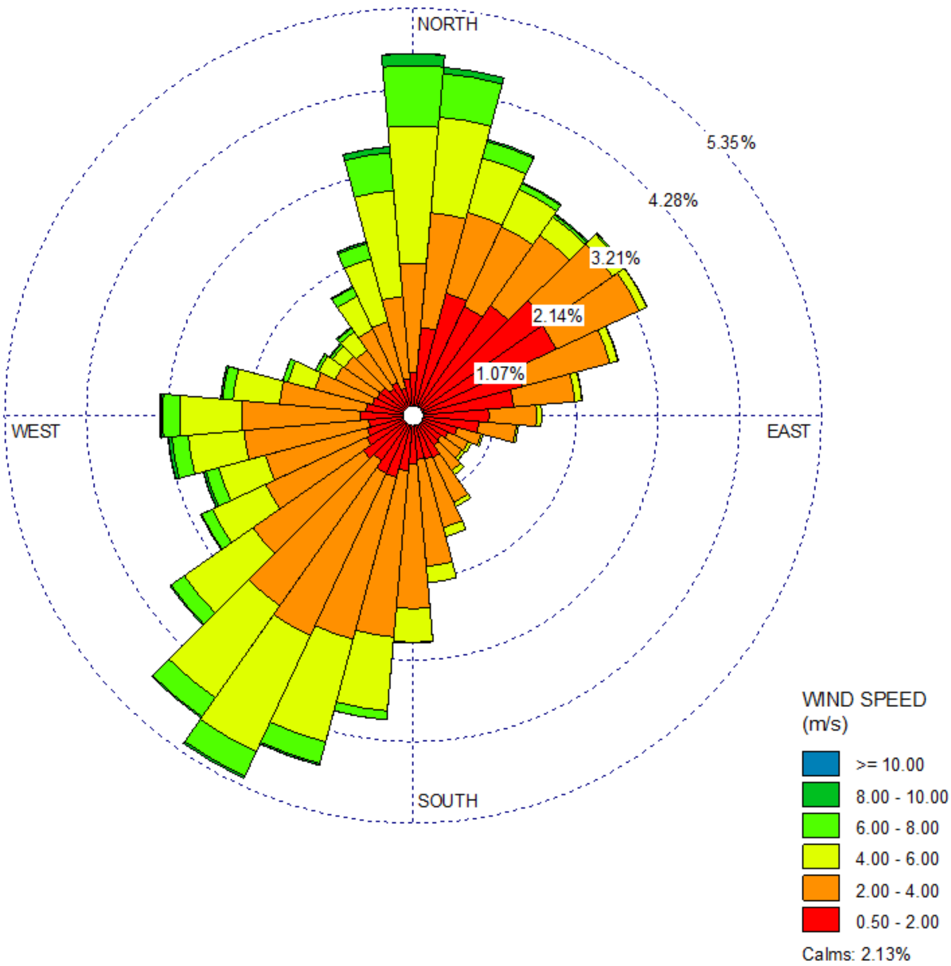

Figure 14-2 Viewbank AWS wind rose (2013 – 2017)

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The temperature trends show the monthly averages ranging between 22 degrees Celsius in January to nine degrees Celsius in June/July/August dependent on the year. The highest maximum was 43 degrees Celsius in January 2014 while the lowest minimum was -2 degrees Celsius in July 2015.

14.3.4 Air emission sources

The main industrial and non-industrial air emission sources contributing to the local airshed include:

- Traffic using the road network, including Greensborough and Lower Plenty Road
- Domestic fuel burning (gas, liquid and solid)
- Residential activities (such as lawn mowers and barbecues)
- Industrial activity.

14.3.5 Ambient air quality

EPA Victoria conducts long-term ambient air quality monitoring at performance monitoring stations. The closest EPA Victoria performance monitoring station to North East Link is the Alphington AAQMS, located approximately 6.5 kilometres south-east of Simpson Barracks and is considered a good indicator of existing air quality in the local airshed. Data from this station was used to determine background air quality for CO, NO_2, PM_{10} and $PM_{2.5}$. Details on these parameters are presented in Table 14-7.

Table 14-7 Background air quality for CO, NO_2, PM_{10} and $PM_{2.5}$

Pollutant	Averaging period	Background concentration	Units	Period
CO	1 hour	Time-varying. The hourly background concentrations for the scenarios assessed are provided in Section 14.4.	mg/m^3	2013–2017
NO_2	1 hour and annual		$µg/m^3$	2013–2017
PM_{10}	1 hour, 24-hour and annual		$µg/m^3$	2013–2017
$PM_{2.5}$	1 hour		$µg/m^3$	2014–2017

Note: 24-hour and annual average PM_{10} and $PM_{2.5}$ concentrations and annual average NO_2 concentrations only apply to the surface roads and combined impacts assessments

EPA Victoria provided background air quality values for polycyclic aromatic hydrocarbons (PAHs) and Volatile organic compounds (VOCs) which are presented in Table 14-8. The values are considered conservative for most pollutants.

Table 14-8 Background air quality for PAH and VOCs

Pollutant	Average concentration		Units	Source
	Maximum 24 h	Annual		
PAH (Benzo(a)pyrene)	0.55	0.14	ng/m^3	Yarraville, Francis Street, May 2012 to May 2013 (EPA Victoria, 2013)
Benzene	2.3	0.8	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Toluene	11.5	6	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Ethylbenzene	1.1	0.5	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
m&p Xylenes	3.5	1.1	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
o-Xylene	1.2	0.5	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Formaldehyde	4	2.2	ppb	Carlton 2006 (EPA Victoria, 2014)
1,3-Butadiene	0.2	0.1	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)

14.4 Relevant impacts and mitigation measures

14.4.1 Construction air quality impacts

Impact description

The impact assessment has considered the potential for construction activities to impact air quality.

The main air quality impacts resulting from construction are associated with airborne particulate matter of various size fractions [deposited dust, total suspended particulate matter (TSP), PM_{10} and $PM_{2.5}$].

The generation of airborne dust could affect local ambient air quality. Particulate matter generated from exposed surfaces, unsealed roads and stockpiles is termed fugitive dust. Fugitive dust emissions are caused by surface materials being pulverised and abraded by application of mechanical force through the use of implements such as wheels and blades, followed by entrainment of particles by the action of turbulent air currents.

The combustion of diesel fuel and petrol in HCVs and mobile plant would result in emissions of CO, SO_2, particulate matter fractions, VOCs, semi-volatile organic compounds and trace levels of heavy metals. The deposition of dust can cause nuisance and aesthetic impacts on the receiving environment. Finer particles (PM_{10} and $PM_{2.5}$) remain entrained much longer and are therefore dispersed at greater distances from the source. The fine nature of these particles also has the potential for human health impacts if not adequately controlled.

Ancillary services such as pre-cast manufacturing and concrete batching plants with the potential to generate dust emissions would be required for the construction of hardstand areas, footpaths, bridge and tunnel segments and other concrete surfaces.

Odorous emissions may also be generated during construction of North East Link, depending on the materials handled including Potential Acid Sulfate Soils (PASS).

Proposed avoidance and mitigation measures

A Dust and Air Quality Management and Monitoring Plan (DAQMMP) outlining best practice measures would be implemented during construction of North East Link to address the impacts outlined above. This would include measures to minimise potential emissions to air (particulate matter, odour and products of combustion). The construction schedule, site activities and management measures required would be incorporated into the DAQMMP. Table 14-9, Table 14-10 and Table 14-11 outline examples of the types of relevant engineering, planning and operational controls that would be contained within the DAQMMP.

Table 14-9 Example engineering controls

Aspect	Mitigation measure
Underground tunnel ventilation structures (temporary)	Extraction and filtration system to remove particulate matter during extraction of spoil to the surface during underground excavations.
HCVs	Diesel-fuelled equipment would be fitted with particulate filters and serviced in accordance with manufacturer's instructions.

Table 14-10 Example planning controls

Aspect	Mitigation measure
Underground tunnel ventilation structures (temporary)	Tunnel ventilation structures to be sited, where possible, at locations away from sensitive receptors.
Pre-construction works	Dust minimisation measures would be developed and implemented before construction started based on the key air quality risks identified for the action, prepared as part of the EES risk assessment process.
Site entry/exits	Site exits would be fitted with hardstand material, rumble grids or other appropriate measures to limit the tracking of material off-site.
Site barriers	Physical barriers would be erected at work/site compounds, where appropriate, using screens or wind breaks.
During and prior to daily commencement of construction works	Methods for the management of emissions, particularly particulate matter and odour, would be incorporated into North East Link inductions, training and tool-box talks.
Location of dust generating activities	Where possible, dust generating activities would be located as far as practicable from sensitive receptors.
Adverse meteorological conditions	Dust generating activities would be curtailed under adverse meteorological conditions (for example, high winds associated with extended dry periods).
Land clearing	The size of land clearing areas and the duration the land remains cleared would be minimised.
Vehicle movements	All vehicle movements would be strictly limited to designated entries and exits, haulage routes and parking areas.
Stockpiles	Stockpiles would be minimised and located away from sensitive receptors, where practicable.
Exposed surfaces	Exposed soil surfaces would be revegetated, as soon as practicable.
Fuels/chemicals	All chemicals and fuels would be stored in sealed containers as per relevant regulations and guidelines.

Table 14-11 Construction management controls

Aspect	Mitigation measure
Vehicle speed limits	Speed limits would be imposed on all construction vehicles while on site.
Vehicle loads	All trucks containing entrained material entering/leaving the construction sites would be covered.
Truck tailgates	Tailgates of road transport trucks would be securely fixed before loading and immediately after unloading.
Road washers/sweepers	Road washers or street sweepers would be used when mud and dirt has been tracked onto sealed road surfaces.
Watering	Water would be applied to unsealed roads and work areas using a water cart. Application rates would be related to atmospheric conditions and the intensity and duration of construction operations.

Aspect	Mitigation measure
Water sprays/dust suppression	Water sprays or dust suppressants would be applied to stockpiles, as appropriate. Alternatively, stockpiles may be covered with tarpaulins or high density polyethylene sheeting or hydro mulched if left standing for extended periods.
Vehicle maintenance	All vehicles and plant machinery would be maintained in good working order.
Truck idling	Idling engines would be either switched off or throttled down to a minimum when not in use for more than 15 minutes.
Truck emissions	Emissions from trucks would be regulated in accordance with the requirements of the Diesel Vehicle Emissions NEPM.
Temporary concrete batching plant	Particulate matter emissions from the concrete batching plant would be minimised by: • Wetting of feed material (aggregate) • Enclosure of conveyors • Installation of filtration apparatus on cement storage silos to control emissions during filling • Installation of filtration apparatus to control emissions from the weigh hopper and truck loading. All emission sources would be controlled and managed in accordance with the requirements of EPA Environmental Guidelines for the Concrete Batching Industry (EPA Victoria, 2008).
Temporary asphalt plant	Air quality emissions (particulate matter and odour) from the mobile asphalt plant would be minimised by: • Wetting feed material • Ensuring the baghouse (and/or other appropriate control technology) is operating efficiently.
Ambient air quality monitoring	An ambient air quality monitoring program would be implemented as part of the DAQMMP, consisting of dust deposit gauges, directional dust gauges and real time PM_{10} and $PM_{2.5}$ instruments to determine the effectiveness of management measures.
Daily odour/dust inspections	Daily inspections would be conducted to assess the effectiveness of odour and dust control measures with the outcomes reported. Further inspections may be required in response to community complaints.
Reactive air quality management system	A reactive air quality management system would be implemented to modify (reduce, suspend or cease) dust generating activities under forecast adverse meteorological conditions (such as high winds and prolonged dry periods).
Trigger Response Levels	Trigger response levels (1 hour and rolling 24 hour average PM_{10} and $PM_{2.5}$ concentrations) would be established for construction works. Trigger response levels would be a key tool in assessing impact potential and establishing an early warning system, thereby reducing complaint potential and non-compliances with ambient air quality criteria. The real-time ambient air quality monitoring program would be linked to the trigger response levels and associated control measures and documented in the DAQMMP.
Complaints procedures	A mechanism for dealing with complaints would be established for the duration of construction.
Continuous improvement	A continuous improvement program for the management of particulate matter emissions would be incorporated into the DAQMMP.

Residual impacts

Potential air quality impacts during surface works would be localised and occur over a defined period. The implementation of appropriate management practices would minimise impacts on nearby sensitive receptors and the receiving environment.

A number of construction compounds would be required to enable works to be conducted in a safe, efficient and environmentally responsible manner. Activities in these compounds would be subject to the CEMP and DAQMMP.

14.4.2 Operational impacts from tunnel ventilation structure emissions

Impact description

Emissions from vehicles travelling through the tunnels would be discharged through ventilation structures before being dispersed into the atmosphere.

Tunnel ventilation systems are designed to provide adequate air quality during normal operation in addition to supporting self-evacuation and rescue efforts during emergency incidents. The capacity of the ventilation system for normal operation is defined by the air demand required to maintain acceptable in-tunnel visibility and air quality. Table 14-12 presents key parameters of the ventilation structure.

Table 14-12 Ventilation structure parameters

Parameter	Value
Location (UTM coordinates; m): Primary Secondary	 330961 E, 5823137 S 330962 E, 5823147 S
Release height above ground level (m)	40
Base elevation (m)	71
Exhaust temperature (°C)	Ambient
Structure diameter (m) Primary Secondary	 7.1 5.0

The required volume of fresh air for a given tunnel traffic condition depends on the number of vehicles in the tunnel, the average pollutant emission per vehicle, the allowable pollutant in-tunnel concentration and the ambient concentration for the pollutant under consideration.

Fresh air entering the tunnel through the entry portal is drawn through the tunnel due to the movement of vehicles (piston effect) and the action of jet fans installed along the length of the tunnel. Before the tunnel exit portal air is withdrawn from the tunnel into ventilation structures and discharged to the atmosphere. Additional jet fans are installed immediately before the exit portal to reverse the air flow and prevent emissions of pollutants from the portal.

The North East Link air quality impact assessment has assumed there are no emissions from the tunnel portals and that all vehicle emissions occurring within the tunnels are discharged via the ventilation structures.

Dispersion modelling has been used to predict pollutant ground level concentrations (GLCs), which are subsequently added to background levels and assessed against applicable air quality criteria (see Section 14.2.6).

Based on the modelling results, the impact of road tunnel ventilation emissions on Simpson Barracks are discussed.

Model inputs, domain and receptors

In addition to the environmental inputs discussed in the section above, AERMOD requires modelling domain receptors and source emission characteristics particular to the assessment required. These inputs are discussed in the following sections.

A model domain encompassing the study area was included, with two uniform Cartesian receptor grids representing Simpson Barracks, each with a 25-metre resolution. Additional receptors were included along the boundaries of these areas with a 25-metre spacing. All receptor points were input at ground level. Figure 14-3 presents the receptor grids of the model domain.

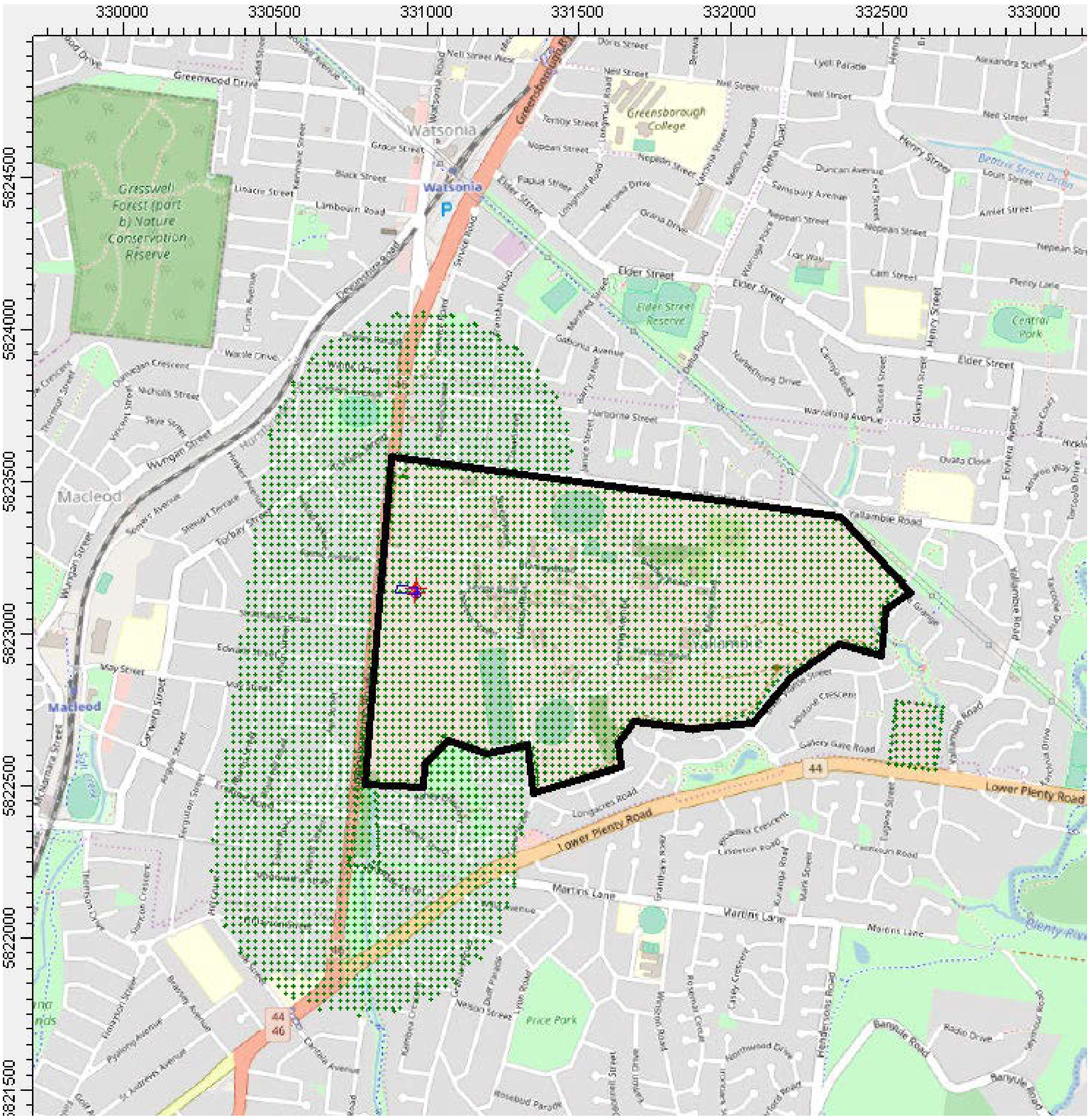


Figure 14-3 Model domain project area receptors

Golder Associates 2019

Emission sources

The North East link design includes duty fans serving the tunnel ventilation structure, the speed of which is controlled so that polluted air flowing through the tunnel in the direction of traffic, plus incoming air from the downstream portal, is captured and dispersed. Due to the increase in elevation to the north, traffic emissions from the northbound tunnel are predicted to be greater than those from the southbound. The northern ventilation structure is designed to account for this with a larger diameter ventilation structure permitting greater ventilation rates.

Based on the tunnel ventilation system design, the northbound ventilation structure is represented in the model as two point sources, as it consists of a primary and secondary vent.

Using the primary and secondary vents in combination enables the exhaust air velocity to be maintained between approximately 18 and 22 metres per second, with combined ventilation rates of approximately 740 to 1,290 cubic meters per second. The primary vent would operate at all times, with use of the secondary vent dependent on the time of day, vehicle volumes, in-tunnel air quality and maintenance schedules.

For the purposes of modelling, the primary and secondary vent configurations have been represented by two discharge points. The northern ventilation structure diameters are 7.1 and 5.0 metres (corresponding to cross sectional areas of 40 and 20 square metres) respectively.

In the absence of other information, ventilation structure exhaust temperatures have been assumed to be equal to ambient temperatures (as determined from the modelling meteorological file). In reality, the exhaust temperature would be greater than the ambient temperature under most circumstances, due to the heat generated from vehicles inside the tunnel.

The tunnel structure itself, having a large thermal mass, remains at a relatively constant temperature (closely linked to the surrounding ground temperature) and either heats or cools the ventilation air depending on the relative temperatures.

The heat input from vehicles is significant and in a form (exhaust and radiator rejected heat) that is readily mixed with tunnel ventilation air. The result would be a degree of heating positively related to traffic load and negatively to ventilation rate. The net effect would be to raise the ventilation structure exhaust temperature above ambient levels.

A ventilation structure temperature greater than ambient results in a more buoyant plume, thereby increasing dispersal. Consequently, by modelling the exhaust temperature equal to ambient, model predictions are considered conservatively high.

Other pollutant sources within the model domain were not assessed. However, background concentrations representative of the local area have been included.

The magnitude of pollutant rates emitted from the ventilation structures depends on the type and volume of vehicles using the tunnels. The predicted vehicular traffic through the tunnels in conjunction with vehicle specific emission factors (Section 14.2.6) and tunnel gradients were used to generate hourly ventilation structure emission inventories.

Traffic data

Predicted traffic volumes and fleet mixes for 2026 and 2036 were used as the basis for the air quality impact assessment:

- Scenarios A1 (2020 emission factors) and A2 (2025 emission factors) – projected traffic volume and fleet mix for 2026 under normal operating conditions
- Scenarios B1 (2020 emission factors) and B2 (2025 emission factors) – projected traffic volume and fleet mix for 2036 under normal operating conditions.

Traffic modelling provided the hourly volumes of passenger cars (PC), light commercial vehicles (LCV) and heavy commercial vehicles (HCV) for the northbound tunnel for 2026 and 2036 between Blamey Road and Manningham Road (herein the ‘north section’) and between Manningham Road and Bulleen Oval (herein the ‘south section’).

Hourly traffic fleet mix developed from the traffic data for petrol fuelled passenger cars (PCP), diesel fuelled passenger cars (PCD), LCV and HCV for Scenarios A1 and A2 and Scenarios B1 and B2 are presented in Figure 14-4 to Figure 14-7. Hourly traffic fleet composition data are provided in Appendix A.

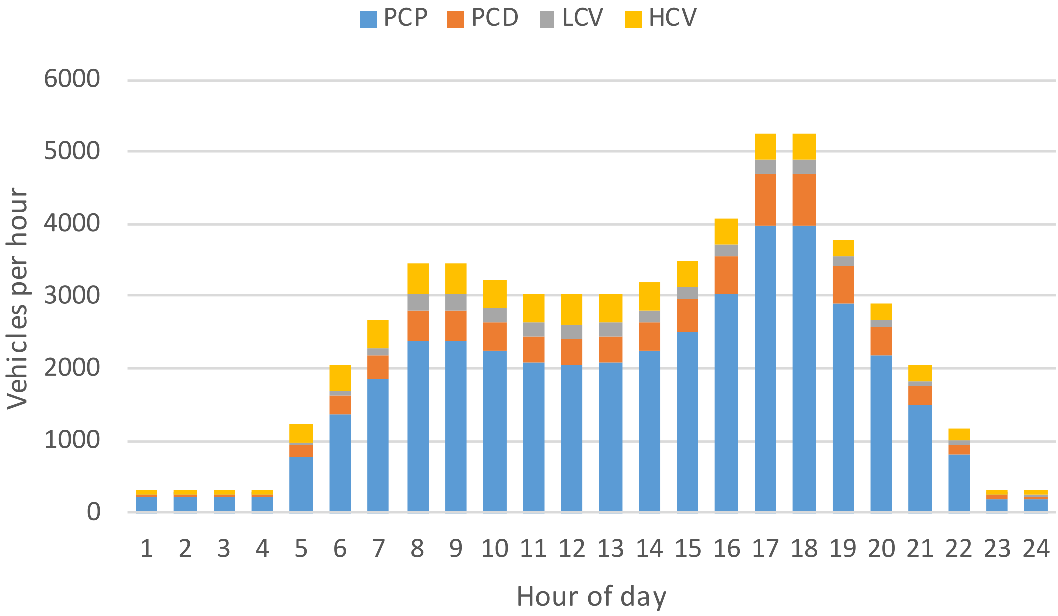


Figure 14-4 Scenario A1 and A2 northbound traffic – north section

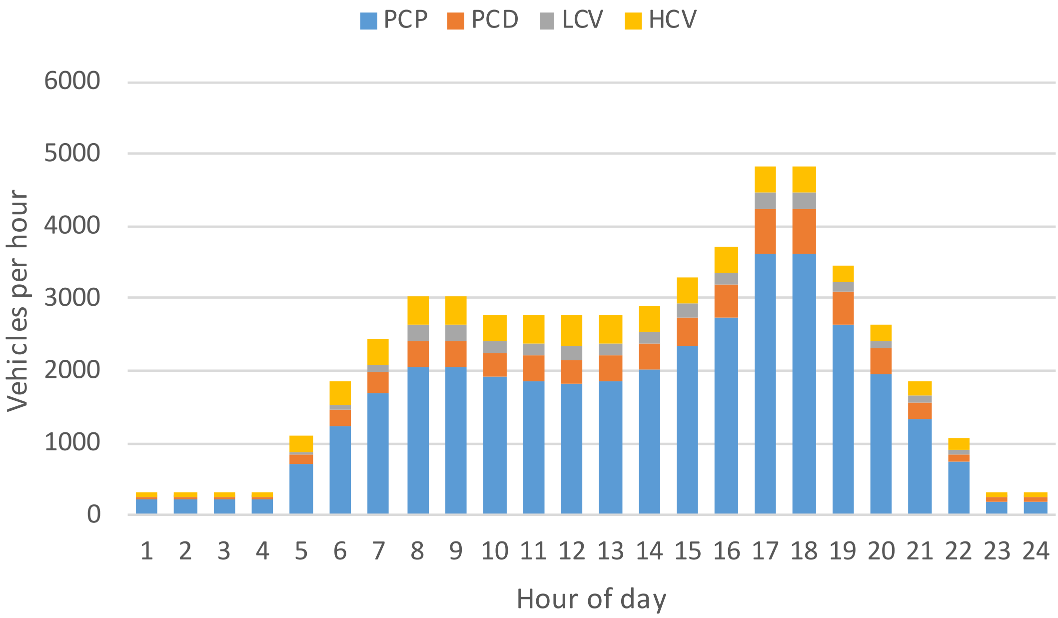


Figure 14-5 Scenario A1 and A2 northbound traffic – south section

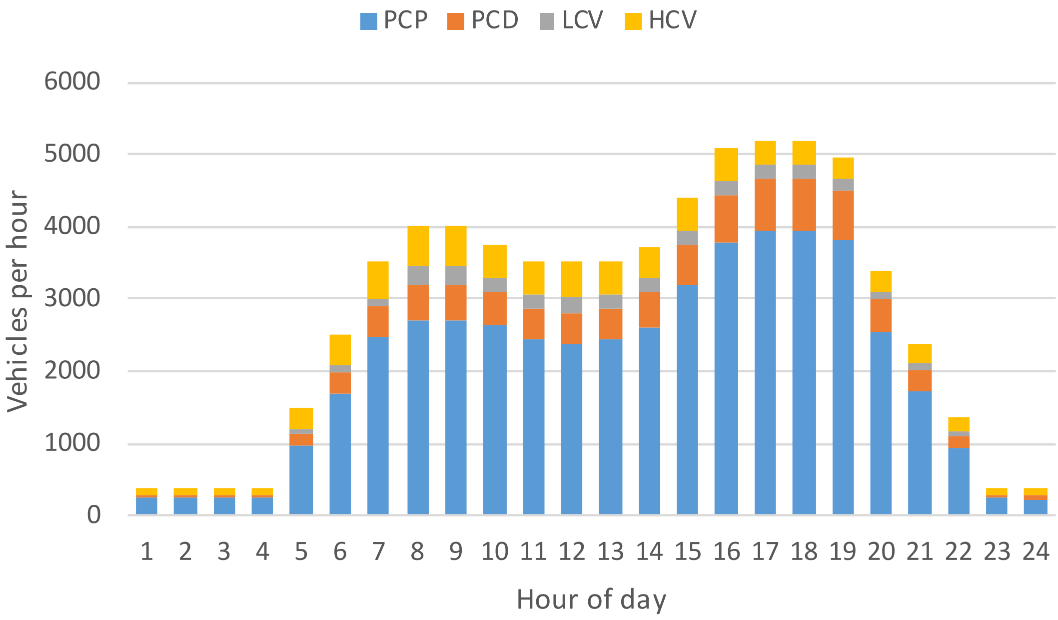


Figure 14-6 Scenario B1 and B2 northbound traffic – north section

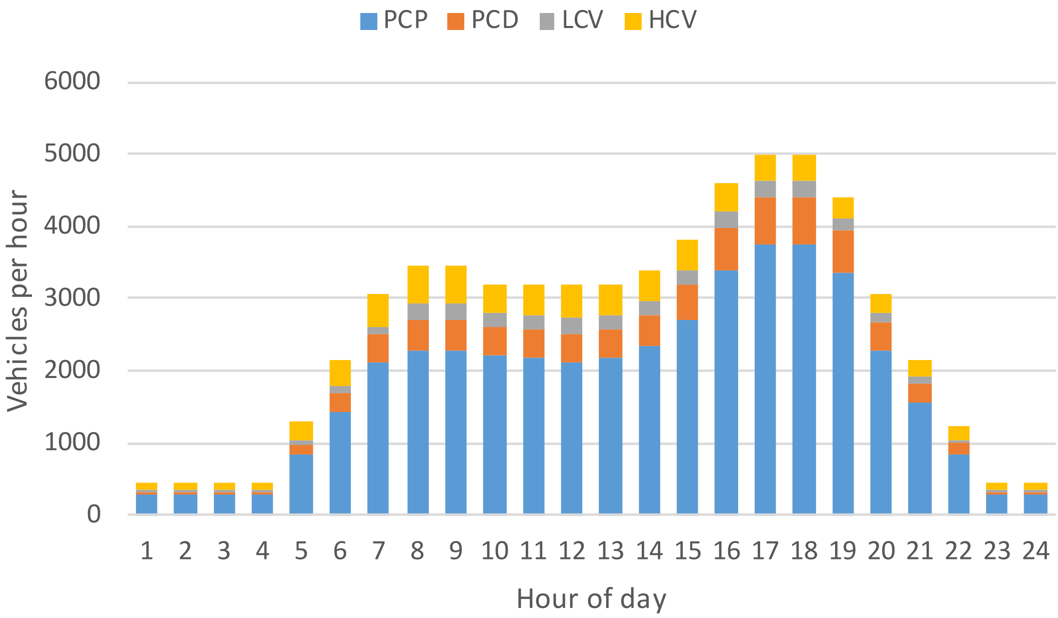


Figure 14-7 Scenario B1 and B2 northbound traffic – south section

Tunnel gradient

For the purposes of calculating emission factors, the North East Link tunnel gradients were conservatively approximated, as presented in Table 14-13.

Table 14-13 Tunnel gradients and lengths

Tunnel	Section length at gradient (km)							Total length (km)
	-6°	-4°	-2°	0°	+2°	+4°	+6°	
Northbound	0	0.84	1.0	0.23	2.5	1.5	0	6.1

The pollutant emission inventories developed from the predicted Scenarios A1 and B1 traffic fleet mixes and emission factors discussed above are summarised in Figure 14-10 and Figure 14-11. Scenarios A2 and B2 (2025 emission factors) emissions inventories (PM_{10}, $PM_{2.5}$ and NO_2) are summarised and compared with the corresponding Scenario A1 and B1 inventories in Figure 14-8 and Figure 14-9.

The emission inventory data is provided in Appendix B.

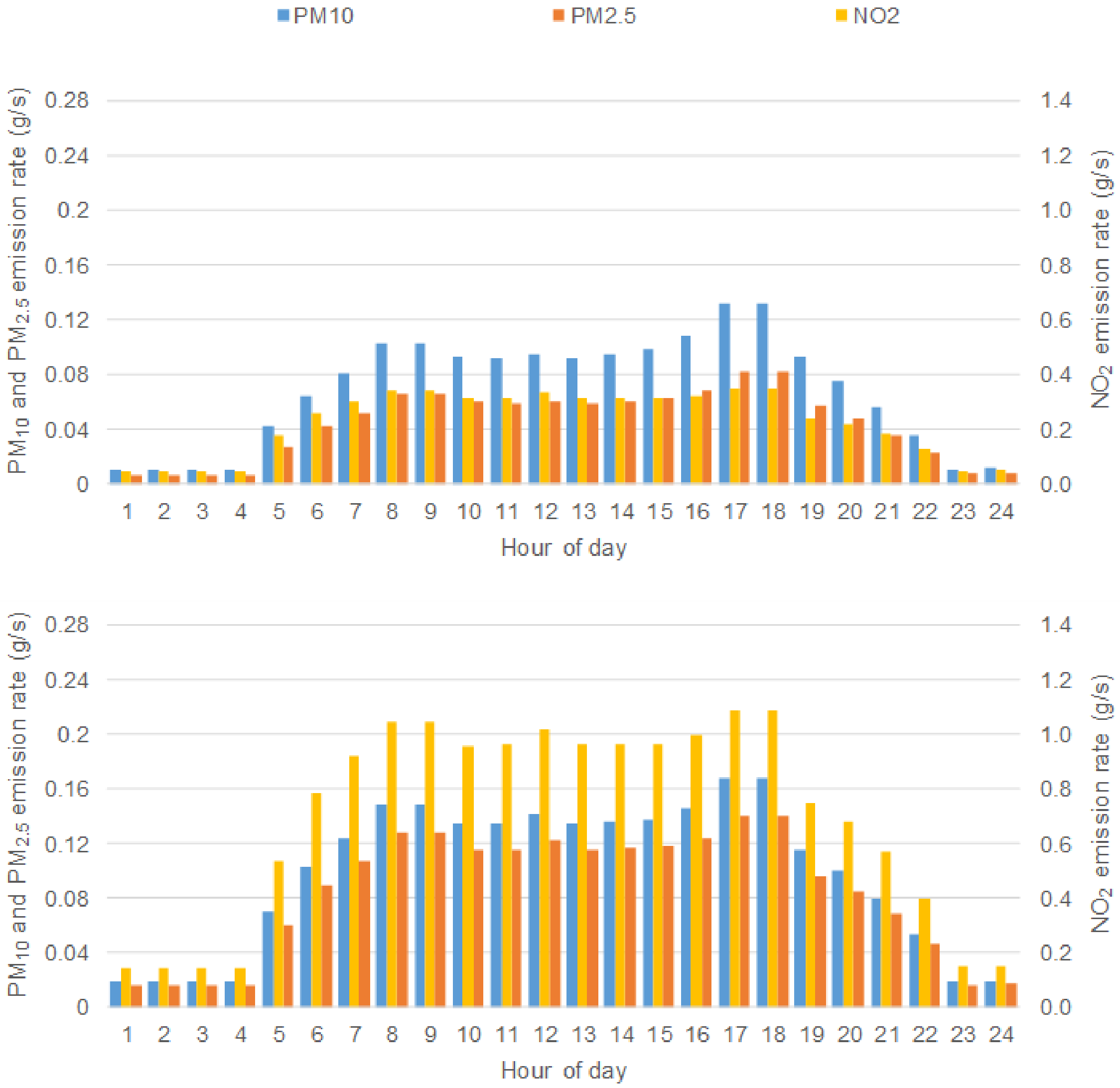
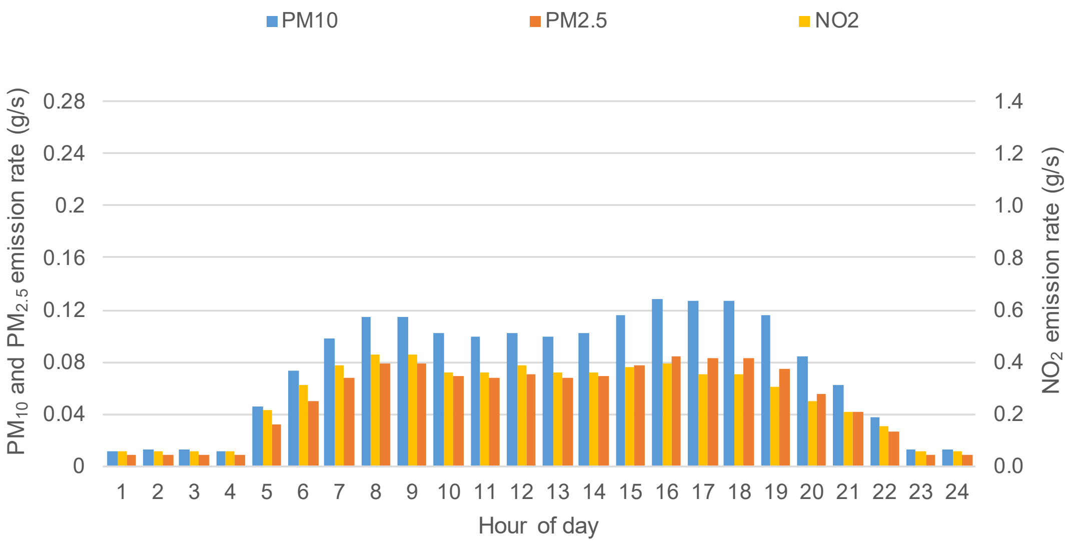


Figure 14-8 Scenario A2 northbound emissions (top) and Scenario A1 northbound emissions (bottom)



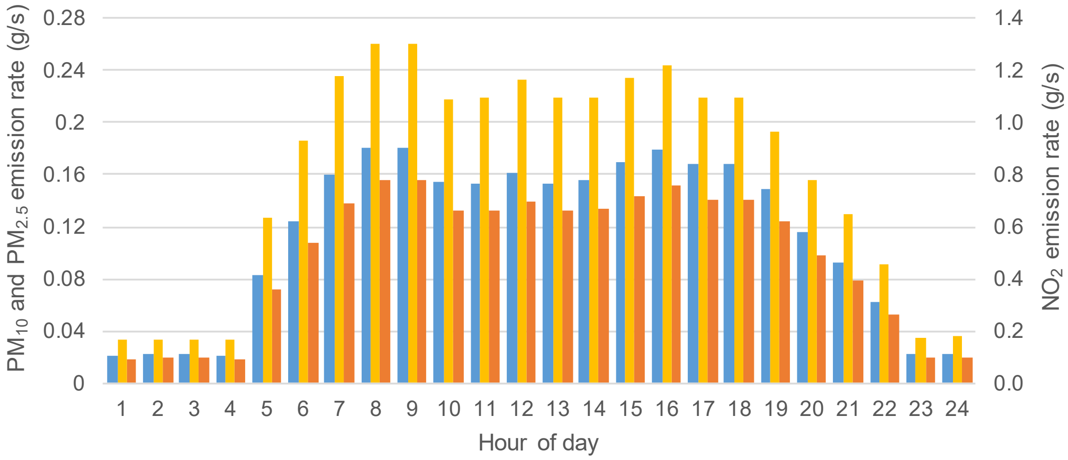


Figure 14-9 Scenario B2 northbound emissions (top) and Scenario B1 northbound emissions (bottom)

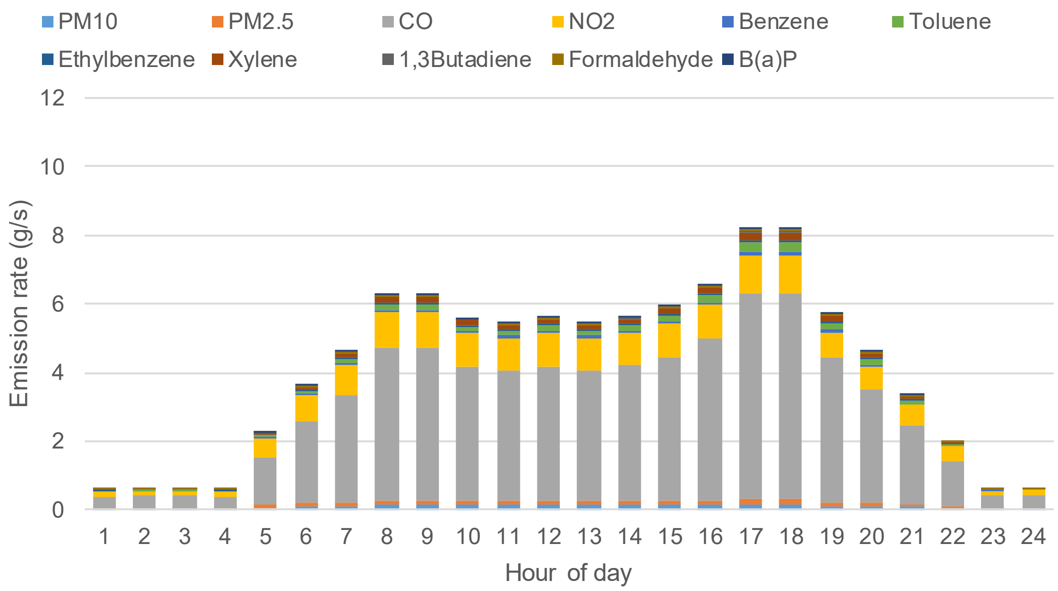


Figure 14-10 Scenario A1 northbound traffic emission rates

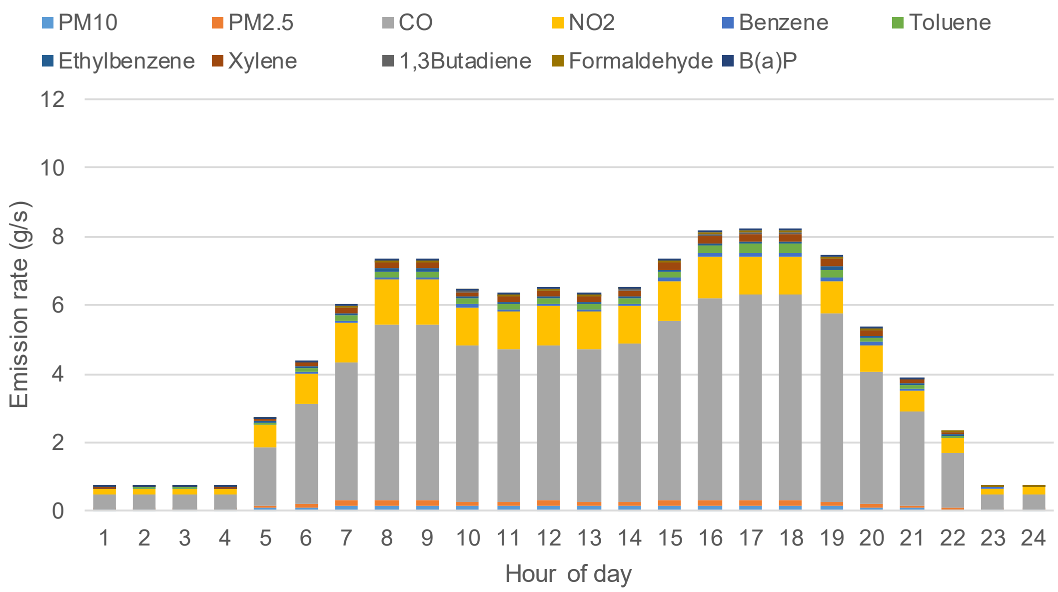


Figure 14-11 Scenario B1 northbound traffic emission rates

Ventilation structure flow rates

Hourly ventilation structure flow rates for scenarios A1 and A2 and scenarios B1 and B2 are presented in Figure 14-12.

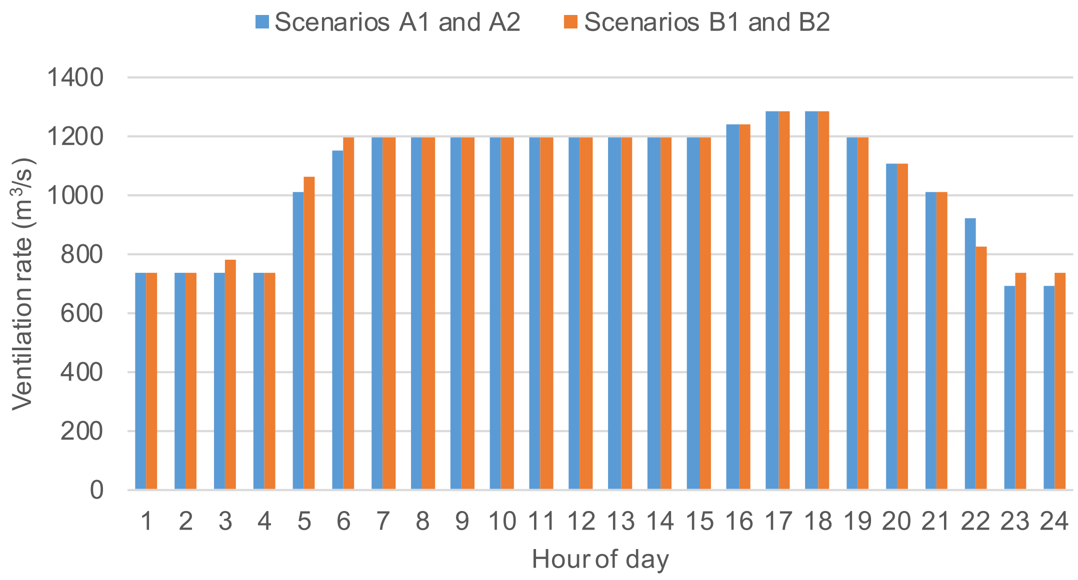


Figure 14-12 Ventilation structure flow rates

Stack-tip and building downwash

Stack-tip downwash was included in the modelling of the North East Link ventilation structures. Stack-tip downwash occurs when airflow passing by a stack is rapidly mixed to the ground as frictional forces and pressure gradients cause stagnations and eddies to develop in the wake of the stack. This effect is greatest when the stack exit velocity is small compared with the wind speed.

Building downwash is the same phenomenon, but caused by structures near to pollutant emission sources, influencing atmospheric turbulence. Building downwash is a major consideration in the design of stacks and their positioning in relation to buildings. United States Environmental Protection Agency (USEPA) established a 'Good Engineering Practice' stack height defined as the 'height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutants in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles'3. The definition of GEP stack height is the stack height plus 1.5 times the lesser of the building height or projected building width.

A stack is considered to be wake affected when the stack and building are located less than five times the lesser of the building height or project building width apart.

The dimensions of the buildings from which the ventilation structures extend were approximated from design drawings. Based on aerial photography, no existing buildings are likely to wake affect the proposed ventilation structures, consideration of building downwash was therefore restricted to the ventilation structure buildings.

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[3] United States Environmental Protection Agency, 'Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations)', June 1985 (USEPA June 1985)

Three-minute average GLCs

SEPP(AQM) design criteria (see Appendix A)) for air toxics are based on three-minute average GLCs. AERMOD outputs for averaging periods less than one hour require post-processing of hourly average predictions. In accordance with EPA Victoria publication 1550 (EPA Victoria, 2013) the following formula for converting one-hour average concentrations to other averaging times was used:

$c(t) = c(t_0) \times (t_0/t)^{0.2}$

where it is the averaging time of interest (three minutes in this case), and t0 is the modelling output averaging time (60 minutes).

Model outputs

An assessment of modelling results against SEPP(AQM) design criteria requires a comparison with the maximum predicted impact (GLC) within the study area over the model period for each pollutant. This comparison has been undertaken within Simpson Barracks, to represent the Defence personnel.

To assess the overall impact of ventilation structure emissions on the study area, isopleth plots have been modelled and are presented in Appendix A.

The SEPP (AQM) defines the maximum predicted concentration as the 99.9th percentile concentration (for averaging periods of one hour or less) at any receptor, including background. However, when the background concentration file contains exceedances of the design criterion, contour plots of the cumulative predictions have limited value. Therefore, in order to provide a more transparent representation of the predicted impacts associated with North East Link, the concentration isopleth plots presented in Appendix A are for the 100th percentile predicted concentrations excluding background.

Design assessment – Simpson Barracks

For the 2013 to 2017 meteorological data files, the 99.9th percentile corresponds to the 8th highest one-hour average concentration prediction for each year. Model predictions for the hours corresponding to the top seven predictions without background were consequently removed from the data set. A single pollutant and scenario ($PM_{2.5}$; Scenario A1) was used to determine which of the five modelled years predicted the highest one hour average 99.9th percentile GLC, with results presented in Figure 14-5.

Table 14-14 Project only results by meteorological year

Meteorological year	Pollutant	Units	Averaging period	Maximum predicted project contribution GLC[41]
2013	$PM_{2.5}$	µg/m^3	1 hour	3.3
2014	$PM_{2.5}$	µg/m^3	1 hour	3.1
2015	$PM_{2.5}$	µg/m^3	1 hour	3.4
2016	$PM_{2.5}$	µg/m^3	1 hour	3.4
2017	$PM_{2.5}$	µg/m^3	1 hour	3.6

4 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criterion

Results from each year were within approximately 10 per cent of each other, with the meteorological year 2017 giving the highest result. All subsequent modelling was conducted using the 2017 meteorological and background concentration datasets.

The results of the plume dispersion modelling assessments for Simpson Barracks are presented in Table 14-15 to Table 14-18. Where time-varying background concentrations have been included in the assessments (PM_{10}, $PM_{2.5}$, CO and NO_2) the background concentration can have a strong influence on the assessment outcomes and in particular the hour at which the assessed maximum (99.9th percentile) occurs.

Table 14-19 – Table 14-22 present the maximum (99.9th percentile) results for PM_{10}, $PM_{2.5}$, CO and NO_2 for Scenarios A1 and A2 and Scenarios B1 and B2 without consideration of the background concentration (project only).

Table 14-15 Results: Scenario A1 – Simpson Barracks

Pollutant	Units	Averaging period	Assessment background type[1]	Maximum predicted GLC[2]	Design criterion[3]	Location of predicted maximum	Contribution to maximum predicted GLC		Project contribution relative to design criterion (%)	Compliance
							Project	Background		
PM_{10}	µg/m³	1 hour	Time-varying	200	80	331562, 5823317	0.17	200	0.22	No[4]
$PM_{2.5}$	µg/m³	1 hour	Time-varying	74	50	331187, 5823492	0.021	74	0.041	No[4]
CO	mg/m³	1 hour	Time-varying	2.5	29	33987, 5822992	0.032	2.5	0.11	Yes
NO_2	µg/m³	1 hour	Time-varying	120	190	330787, 5822610	1.1	120	0.57	Yes
Benzene	µg/m³	3 minute	Constant	12	53	330987, 5822992	5.1	7.3	9.6	Yes
Toluene	µg/m³	3 minute	Constant	54	650	330987, 5822992	10	43	1.5	Yes
Ethylbenzene	µg/m³	3 minute	Constant	8.6	14,500	330987, 5822992	3.8	4.8	0.026	Yes
Xylene isomers	µg/m³	3 minute	Constant	31	350	330987, 5822992	10	20	2.9	Yes
1,3-Butadiene	µg/m³	3 minute	Constant	1.5	73	330987, 5822992	1.1	0.44	1.5	Yes
Formaldehyde	µg/m³	3 minute	Constant	7.0	40	330987, 5822992	2.0	4.9	5.0	Yes
PAHs [as B(a)P TEQ]	µg/m³	3 minute	Constant	0.0010	0.73	330987, 5822992	0.00049	0.00055	0.067	Yes

Notes: Concentrations rounded to two significant figures.

1 Hourly time varying or constant background concentration. Hourly time varying concentrations change from hour to hour over a 24-hour period. A constant background concentration refers to one concentration used to represent background conditions (without the project).
2 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criteria.
3 SEPP (AQM) design criterion.
4 See Section 14.4.2 'Discussion'.

Table 14-16 Results: Scenario A2 – Simpson Barracks

Pollutant	Units	Averaging period	Assessment background type[1]	Maximum predicted GLC[2]	Design criterion[3]	Location of predicted maximum	Contribution to maximum predicted GLC		Project contribution relative to design criterion (%)	Compliance
							Project	Background		
PM_{10}	µg/m³	1 hour	Time-varying	200	80	331562, 5823317	0.13	200	0.16	No[4]
$PM_{2.5}$	µg/m³	1 hour	Time-varying	74	50	331187, 5823492	0.009	74	0.018	No[4]
NO_2	µg/m³	1 hour	Time-varying	120	190	330787, 5822610	0.35	120	0.18	Yes

Notes: Concentrations rounded to two significant figures.

1 Hourly time varying or constant background concentration. Hourly time varying concentrations change from hour to hour over a 24-hour period. A constant background concentration refers to one concentration used to represent background conditions (without the project).
2 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criteria.
3 SEPP (AQM) design criterion.
4 See Section 14.4.2 'Discussion'.

Table 14-17 Results: Scenario B1 – Simpson Barracks

Pollutant	Units	Averaging period	Assessment background type[1]	Maximum predicted GLC[2]	Design criterion[3]	Location of predicted maximum	Contribution to maximum predicted GLC		Project contribution relative to design criterion (%)	Compliance
							Project	Background		
PM_{10}	μg/m³	1 hour	Time-varying	200	80	331562, 5823317	0.21	200	0.27	No[4]
$PM_{2.5}$	μg/m³	1 hour	Time-varying	74	50	331187, 5823492	0.024	74	0.49	No[4]
CO	mg/m³	1 hour	Time-varying	2.5	29	330987, 5822992	0.037	2.5	0.13	Yes
NO_2	μg/m³	1 hour	Time-varying	120	190	330787, 5822610	1.1	120	0.57	Yes
Benzene	μg/m³	3 minute	Constant	13	53	331012, 5823017	5.3	8.0	10	Yes
Toluene	μg/m³	3 minute	Constant	58	650	331012, 5823017	11	43	1.7	Yes
Ethylbenzene	μg/m³	3 minute	Constant	9.2	14,500	331012, 5823017	4.0	4.8	0.028	Yes
Xylene isomers	μg/m³	3 minute	Constant	33	350	331012, 5823017	10	20	02.9	Yes
1,3-Butadiene	μg/m³	3 minute	Constant	1.6	73	330987, 5823017	1.1	0.44	1.5	Yes
Formaldehyde	μg/m³	3 minute	Constant	8.6	40	330987, 5822992	2.1	4.9	5.3	Yes
PAHs [as B(a)P TEQ]	μg/m³	3 minute	Constant	0.0011	0.73	330987, 5823017	0.00051	0.00055	0.07	Yes

Notes: Concentrations rounded to two significant figures.

1 Hourly time varying or constant background concentration. Hourly time varying concentrations change from hour to hour over a 24-hour period. A constant background concentration refers to one concentration used to represent background conditions (without the project).
2 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criteria.
3 SEPP (AQM) design criterion.
4 See Section 14.4.2 'Discussion'.

Table 14-18 Results: Scenario B2 – Simpson Barracks

Pollutant	Units	Averaging period	Assessment background type[1]	Maximum predicted GLC[2]	Design criterion[3]	Location of predicted maximum	Contribution to maximum predicted GLC		Project contribution relative to design criterion (%)	Compliance
							Project	Background		
PM_{10}	µg/m^3	1 hour	Time-varying	200	80	331562, 5823317	0.16	200	0.20	No[4]
$PM_{2.5}$	µg/m^3	1 hour	Time-varying	74	50	331187, 5823492	0.011	74	0.022	No[4]
NO_2	µg/m^3	1 hour	Time-varying	120	190	330787, 5822610	0.35	120	0.19	Yes

Notes: Concentrations rounded to two significant figures.

1 Hourly time varying or constant background concentration. Hourly time varying concentrations change from hour to hour over a 24-hour period. A constant background concentration refers to one concentration used to represent background conditions (without the project).
2 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criteria.
3 SEPP (AQM) design criterion.
4 See Section 14.4.2 'Discussion'.

Table 14-19 Results: Scenario A1 – Simpson Barracks; project only

Pollutant	Units	Averaging period	Maximum predicted project contribution GLC[1]	Design criterion[2]	Location of predicted maximum	Project contribution relative to design criterion (%)
PM_{10}	µg/m^3	1 hour	4.1	80	330987, 5822992	5.1
$PM_{2.5}$	µg/m^3	1 hour	3.5	50	330987, 5823017	7.0
CO	mg/m^3	1 hour	0.14	29	330987, 5822992	0.48
NO_2	µg/m^3	1 hour	28	190	330987, 5823017	15

Notes: Concentrations rounded to two significant figures.

1 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criterion.
2 SEPP (AQM) design criterion.

Table 14-20 Results: Scenario A2 – Simpson Barracks; project only

Pollutant	Units	Averaging period	Maximum predicted project contribution GLC[1]	Design criterion[2]	Location of predicted maximum	Project contribution relative to design criterion (%)
PM_{10}	µg/m^3	1 hour	3.2	80	330987, 5822992	4.0
$PM_{2.5}$	µg/m^3	1 hour	2.0	50	330987, 5822992	4.0
NO_2	µg/m^3	1 hour	9.2	190	330987, 5823017	4.8

Notes: Concentrations rounded to two significant figures.

1 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criterion.
2 SEPP (AQM) design criterion.

Table 14-21 Results: Scenario B1 – Simpson Barracks; project only

Pollutant	Units	Averaging period	Maximum predicted project contribution GLC[1]	Design criterion[2]	Location of predicted maximum	Project contribution relative to design criterion (%)
PM_{10}	µg/m³	1 hour	4.7	80	330987, 5823017	5.9
$PM_{2.5}$	µg/m³	1 hour	4.0	50	330987, 5823017	8.0
CO	mg/m³	1 hour	0.15	29	330987, 5822992	0.52
NO_2	µg/m³	1 hour	34	190	330987, 5823017	18

Notes: Concentrations rounded to two significant figures.

1 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criterion.
2 SEPP (AQM) design criterion.

Table 14-22 Results: Scenario B2 – Simpson Barracks; project only

Pollutant	Units	Averaging period	Maximum predicted project contribution GLC[1]	Design criterion[2]	Location of predicted maximum	Project contribution relative to design criterion (%)
PM_{10}	µg/m³	1 hour	3.4	80	330987, 5822992	4.2
$PM_{2.5}$	µg/m³	1 hour	2.1	50	330987, 5822992	4.4
NO_2	µg/m³	1 hour	11	190	330987, 5823017	5.8

Notes: Concentrations rounded to two significant figures.

1 99.9th percentile (8th highest value) as required for assessment against SEPP (AQM) design criterion.
2 SEPP (AQM) design criterion.

Emissions from the North East Link tunnel ventilation structure were calculated for projected diurnal weekday traffic conditions in 2026 and 2036 using 2010 emission factors, adjusted to 2020 and 2025 to account for anticipated reductions in vehicle fleet emissions. In accordance with the requirements of SEPP(AQM), modelling was conducted to predict the potential impacts of pollutant emissions from the proposed tunnel ventilation structures on ground level concentrations, with the 99.9th percentile maximum predicted concentrations assessed against SEPP(AQM) design criteria. EPA Victoria guidance (EPA Victoria, 2013) states that modelling be conducted using five years of meteorological data (2013 to 2017), reporting the worst case year results. The year 2017 was found to predict the highest one-hour average 99.9th percentile GLC for a single pollutant ($PM_{2.5}$) and was therefore selected for all subsequent modelling.

When available, SEPP(AQM) requires model predictions to incorporate time varying background concentration data. Time varying hourly average background concentration data were used for PM_{10}, $PM_{2.5}$, CO and NO_2. When appropriate time varying background concentration data are unavailable, SEPP(AQM) indicates that the 70th percentile of observed concentrations, as a constant value, should be incorporated. Constant background concentrations provided by EPA Victoria were used for air toxics.

Hourly PM_{10} and $PM_{2.5}$ background concentrations at the Alphington AAQMS exceed the one-hour average design criteria on multiple occasions in 2017. This effectively imposes exceedances before the additional impact of the tunnel ventilation structures is considered.

Analysis of the hourly PM_{10} concentrations showed that exceedances of the 80 micrograms per cubic metre design criterion occurred on eight occasions during 2017 without any contribution from North East Link. Ventilation structure emissions from North East Link would result in no additional exceedances (Figure 14-13).

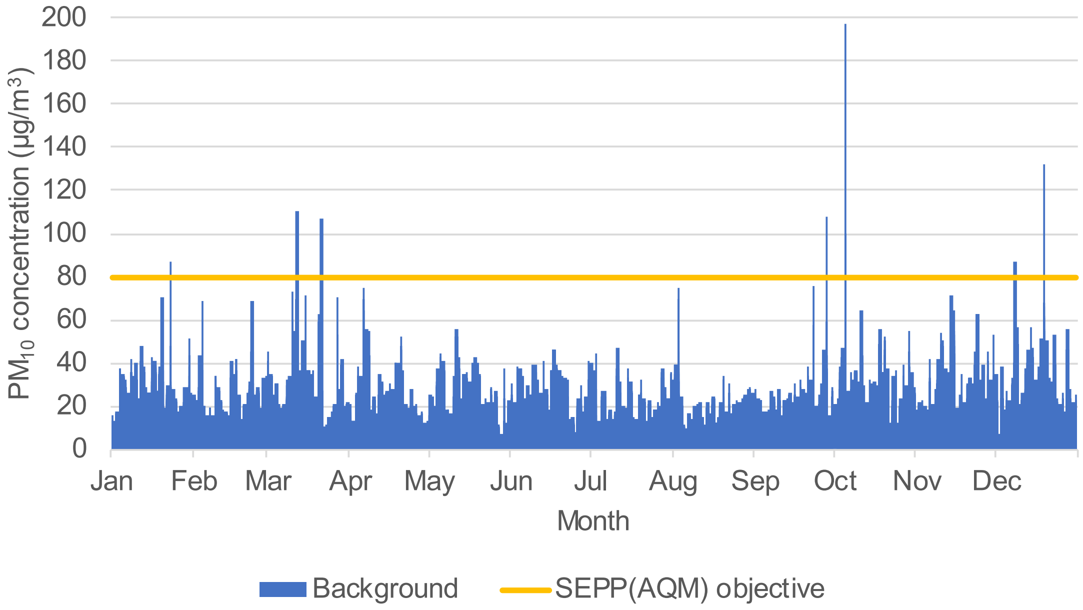

Figure 14-13 2017 hourly background PM_{10} concentration

The hourly background concentrations for $PM_{2.5}$ at the Alphington AAQMS exceed the one-hour average 50 micrograms per cubic metre design criterion on 20 occasions for 2017, as shown in Figure 14-14.

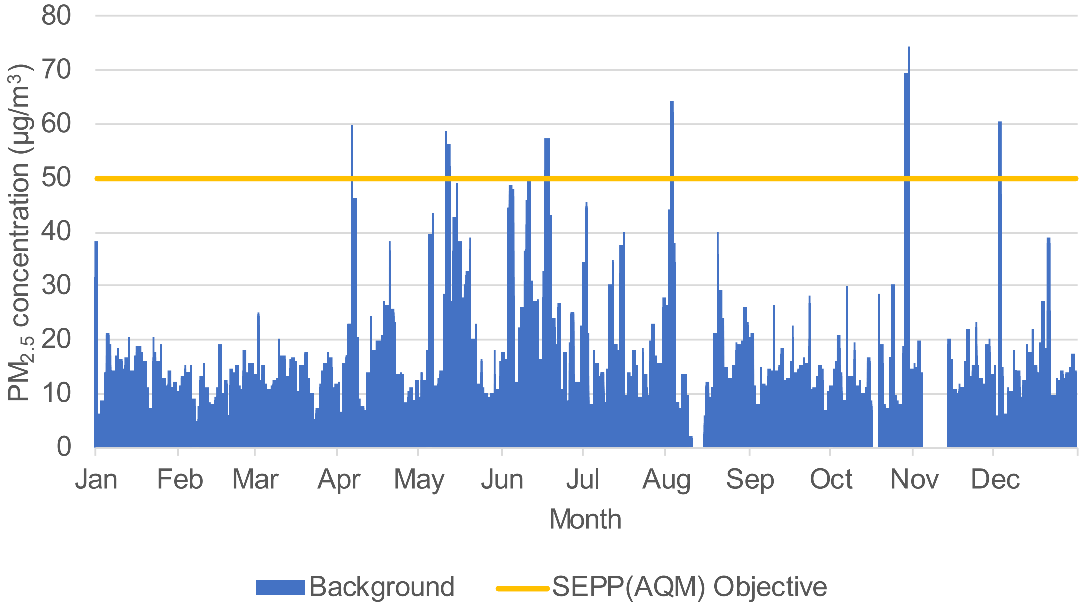

Figure 14-14 2017 hourly background $PM_{2.5}$ concentration

Scenario A1 (2026 traffic, 2020 emissions factors)

Tunnel ventilation structure emissions result in no additional PM_{10} exceedances of the design criterion to those already imposed by the background contribution.

The air quality impact assessment indicated that while the one-hour average design criterion was exceeded in 2026, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile PM_{10} GLC, which is equivalent to less than 1 per cent of the design criterion, in Simpson Barracks. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted contribution to the PM_{10} GLC (no background) from North East Link is 4.1 micrograms per cubic metre, or 5.1 per cent of the design criterion, within Simpson Barracks.

North East Link tunnel ventilation structure emissions result in one additional $PM_{2.5}$ exceedance with a project contribution of less than 0.5 micrograms per cubic metre and a corresponding background concentration of 49.8 micrograms per cubic metre for both receptor groups.

The assessment indicated that while the one-hour average design criterion would be exceeded in 2026, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile $PM_{2.5}$ GLC, which is equivalent to less than 1 per cent of the design criterion, in Simpson Barracks. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted contribution to the $PM_{2.5}$ GLC (no background) from North East Link is 3.5 micrograms per cubic metre, or 7 per cent of the design criterion, within Simpson Barracks.

The maximum predicted contributions of PM_{10} and $PM_{2.5}$ from North East Link each represent the eighth worst hour of the year (rank 8 of 8,784) at the most impacted receptor. It is noted that during all other hours, all receptors are less impacted than this. For example, Figure 14-5 presents the next 1,000 highest PM_{10} and $PM_{2.5}$ results for Simpson Barracks, each representing the concentrations predicted at the most impacted receptor for that hour. Figure 14-5 illustrates that for most of the time the predicted PM_{10} and $PM_{2.5}$ impacts are significantly below the maximum results.

Predicted CO, NO_2, BTEX, 1,3-butadiene, formaldehyde and PAH [as B(a)P TEQ] concentrations comply with the applicable design criteria in 2026 for Simpson Barracks.

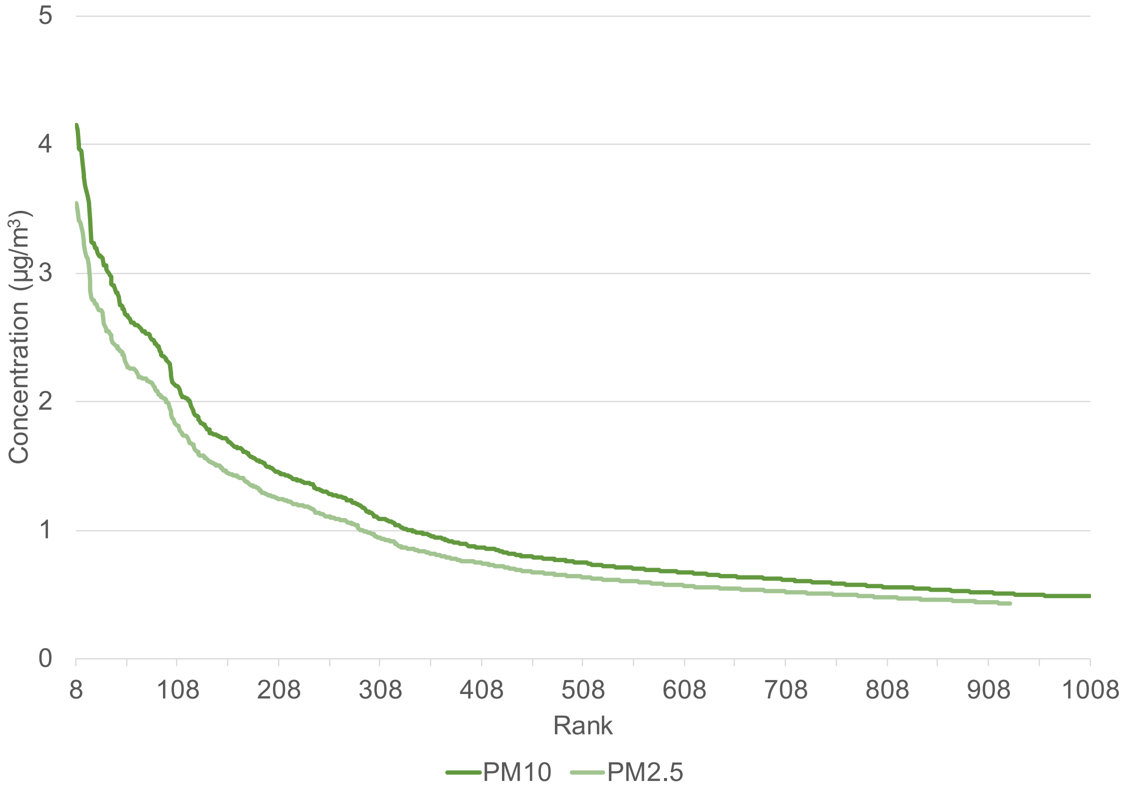

Figure 14-15 Scenario A1 – Simpson Barracks PM_{10} and $PM_{2.5}$ 1,000 highest results

Scenario A2 (2026 traffic; 2025 emission factors)

Tunnel ventilation structure emissions result in no additional PM_{10} exceedances of the design criterion to those already imposed by the background contribution.

The air quality impact assessment indicated that while the one-hour average design criterion was exceeded in 2026, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile PM_{10} GLC in Simpson Barracks, which is equivalent to less than 1 per cent of the design criterion. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted contribution to the PM_{10} GLC (no background) from North East Link is 3.2 micrograms per cubic metre, or 4 per cent of the design criterion, within Simpson Barracks.

North East Link tunnel ventilation structure emissions result in one additional $PM_{2.5}$ exceedance with a project contribution of less than 0.3 micrograms per cubic metre and a corresponding background concentration of 49.8 micrograms per cubic metre for both receptor groups.

The assessment indicated that while the one-hour average design criterion was exceeded in 2026, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile $PM_{2.5}$ GLC in Simpson Barracks, which is equivalent to less than 1 per cent of the design criterion. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted project contribution to the $PM_{2.5}$ GLC (no background) is 2 micrograms per cubic metre, or 4 per cent of the design criterion, within Simpson Barracks.

The maximum predicted project contributions of PM_{10} and $PM_{2.5}$ each represent the eighth worst hour of the year (rank 8 of 8,784) at the most impacted receptor. It is noted that during all other hours, all receptors are less impacted than this. For example, Figure 14-16 presents the next 1,000 highest PM_{10} and $PM_{2.5}$ results for Simpson Barracks, each representing the concentrations predicted at the most impacted receptor for that hour. Figure 14-16 illustrates that for most of the time the predicted PM_{10} and $PM_{2.5}$ impacts are significantly below the maximum results.

Predicted CO, NO_2, BTEX, 1,3-butadiene, formaldehyde and PAH [as B(a)P TEQ] concentrations comply with the applicable design criteria in 2026 for Simpson Barracks.

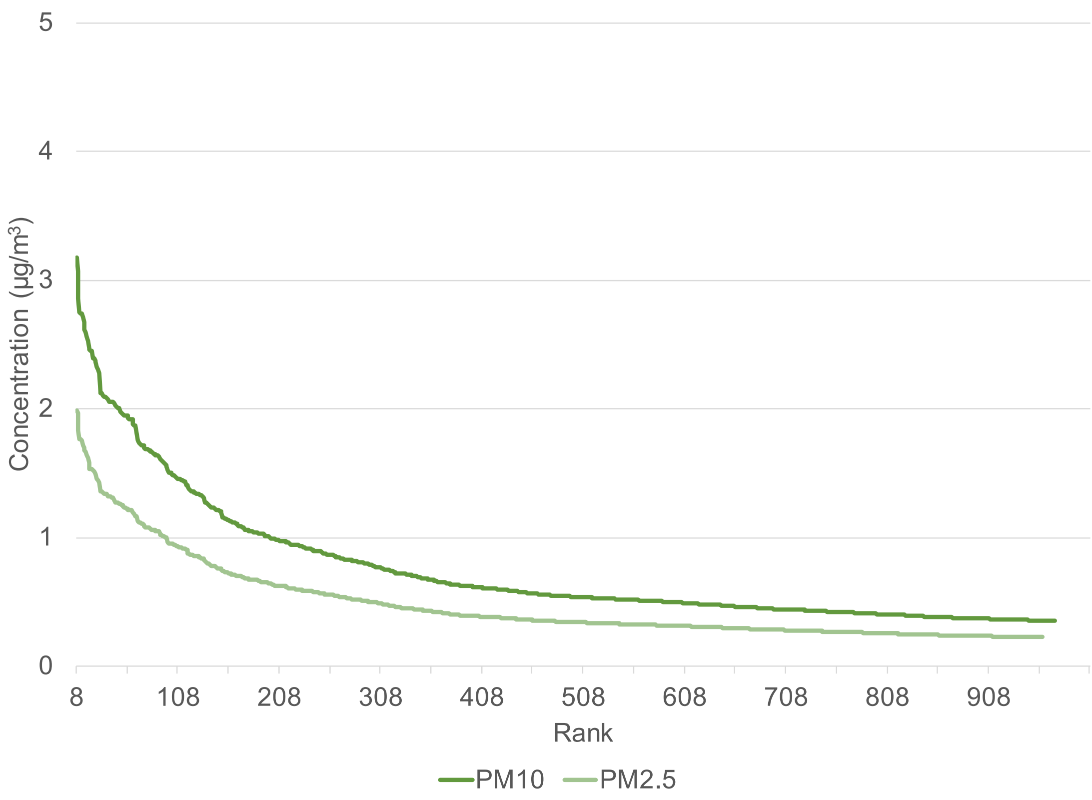

Figure 14-16 Scenario A2 – Simpson Barracks PM_{10} and $PM_{2.5}$ 1,000 highest results

Scenario B1 (2036 traffic; 2020 emission factors)

Tunnel ventilation structure emissions result in no additional PM_{10} exceedances of the design criterion to those already imposed by the background contribution.

The air quality impact assessment indicated that while the one-hour average design criterion was exceeded in 2036, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile PM_{10} GLC, which is equivalent to less than 1 per cent of the design criterion, in Simpson Barracks. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted project contribution to the PM_{10} GLC (no background) is 4.7 micrograms per cubic metre, or 5.9 per cent of the design criterion within Simpson Barracks.

Ventilation structure emissions from North East Link result in one additional $PM_{2.5}$ exceedance with a contribution of less than 0.6 micrograms per cubic metre and a corresponding background concentration of 49.8 micrograms per cubic metre for both receptor groups.

The assessment indicated that while the one-hour average design criterion was exceeded in 2036, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile $PM_{2.5}$ GLC, which is equivalent to less than 1 per cent of the design criterion, in Simpson Barracks. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted project contribution to the $PM_{2.5}$ GLC (no background) is 4 micrograms per cubic metre, or 8 per cent of the design criterion, within Simpson Barracks.

The maximum predicted project contributions of PM_{10} and $PM_{2.5}$ each represent the eighth worst hour of the year (rank 8 of 8,784) at the most impacted receptor. It is noted that during all other hours, all receptors are less impacted than this. For example, Figure 14-17 presents the next 1,000 highest PM_{10} and $PM_{2.5}$ results for Simpson Barracks, each representing the concentrations predicted at the most impacted receptor for that hour. Figure 14-17 illustrates that for most of the time the predicted PM_{10} and $PM_{2.5}$ impacts are significantly below the maximum results.

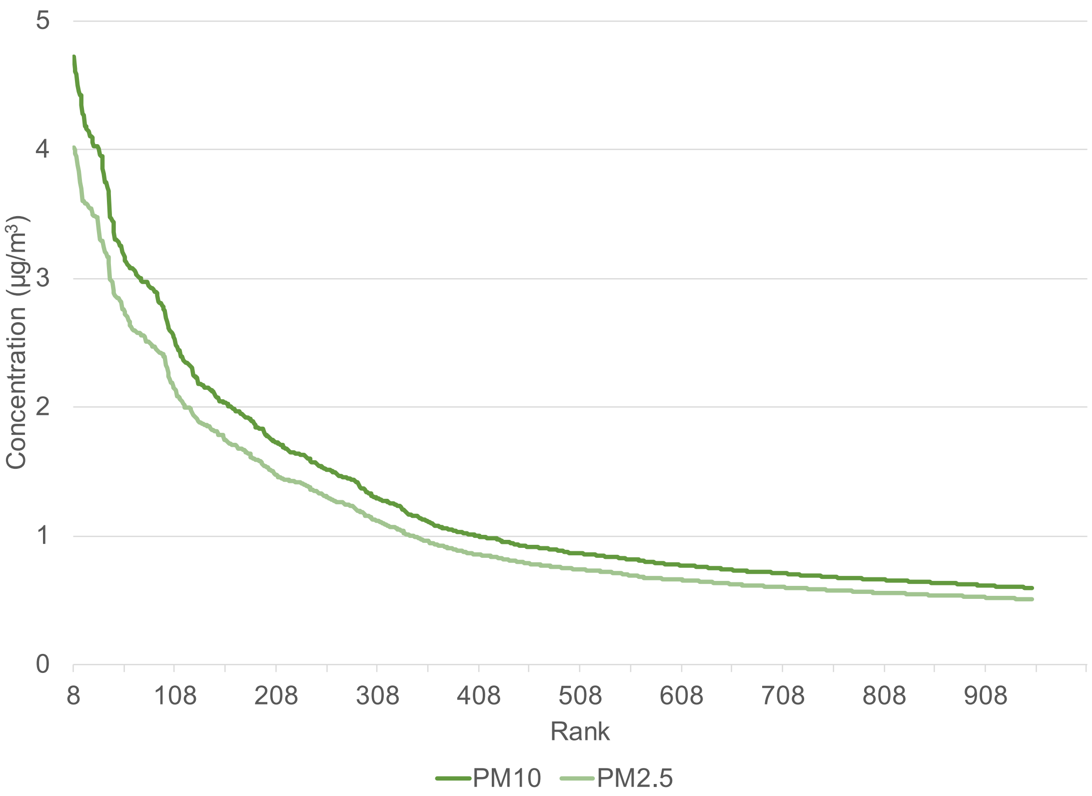

Figure 14-17 Scenario B1 – Simpson Barracks PM_{10} and $PM_{2.5}$ 1,000 highest results

Predicted CO, NO_2, BTEX, 1,3-butadiene, formaldehyde and PAH [as B(a)P TEQ] concentrations comply with the applicable design criteria in 2036 for Simpson Barracks.

Scenario B2 (2036 traffic; 2025 emission factors)

Tunnel ventilation system emissions result in no additional PM_{10} exceedances of the design criterion to those already imposed by the background contribution.

The air quality impact assessment indicated that while the one hour average design criterion was exceeded in 2036, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile PM_{10} GLC in Simpson Barracks, which is equivalent to less than 1 per cent of the design criterion. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted project contribution to the PM_{10} GLC (no background) is 3.4 micrograms per cubic metre, or 4.2 per cent of the design criterion, within Simpson Barracks.

Tunnel ventilation structure emissions result in one additional $PM_{2.5}$ exceedance with a project contribution of less than 0.3 micrograms per cubic metre and a corresponding background concentration of 49.8 micrograms per cubic metre for both receptor groups.

The assessment indicated that while the one-hour average design criterion was exceeded in 2036, the tunnel ventilation structure emissions contributed less than 1 per cent of the predicted 99.9th percentile $PM_{2.5}$ GLC, in Simpson Barracks, which is equivalent to less than 1 per cent of the design criterion. This exceedance applies to all receptors assessed due to the elevated background concentration.

The maximum predicted project contribution to the $PM_{2.5}$ GLC (no background) is 2.1 micrograms per cubic metre, or 4.2 per cent of the design criterion, within Simpson Barracks.

The maximum predicted project contributions of PM_{10} and $PM_{2.5}$ each represent the eighth worst hour of the year (rank 8 of 8,784) at the most impacted receptor. It is noted that during all other hours, all receptors are less impacted than this. For example, presents the next 1,000 highest PM_{10} and $PM_{2.5}$ results for Simpson Barracks, each representing the concentrations predicted at the most impacted receptor for that hour. Figure 14-17 illustrates that for most of the time the predicted PM_{10} and $PM_{2.5}$ impacts are significantly below the maximum results.

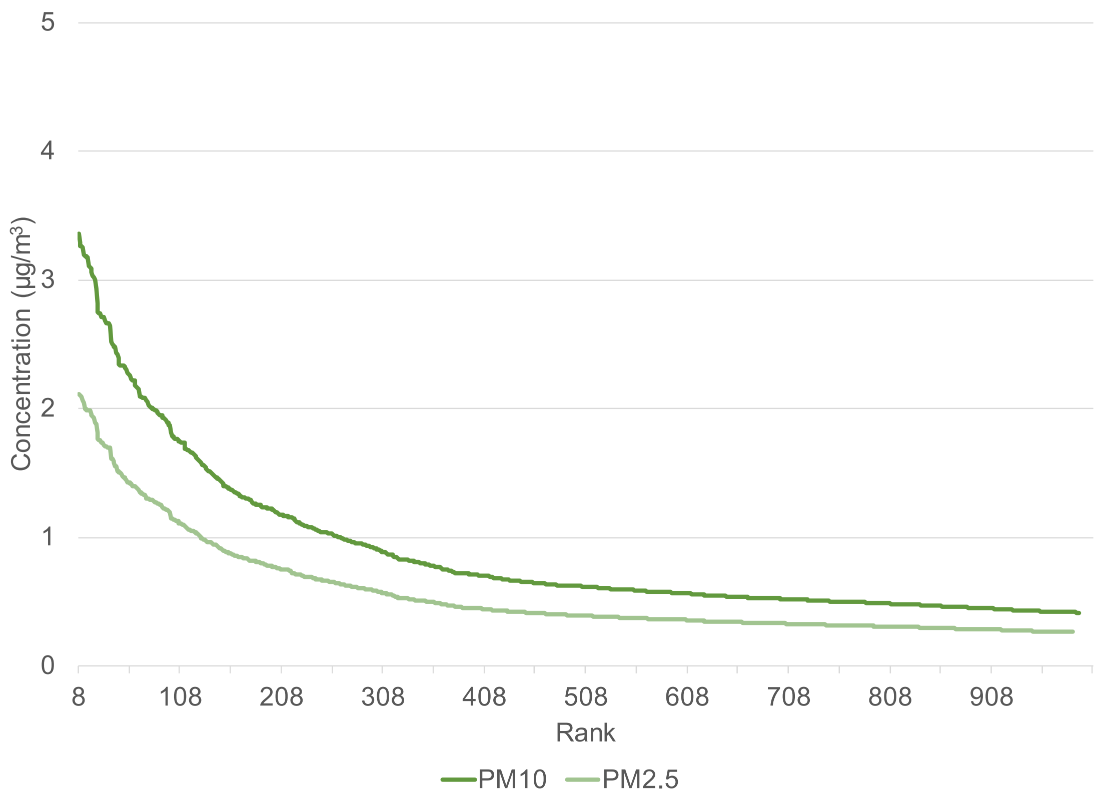

Figure 14-18 Scenario B1 – Simpson Barracks PM_{10} and $PM_{2.5}$ 1,000 highest results

Predicted CO, NO_2, BTEX, 1,3-butadiene, formaldehyde and PAH [as B(a)P TEQ] concentrations comply with the applicable design criteria in 2036 for Simpson Barracks.

With the exception of PM_{10} and $PM_{2.5}$, compliance with all applicable SEPP(AQM) design criteria was demonstrated for the proposed North East Link tunnel ventilation structure under normal operating conditions. The PM_{10} and $PM_{2.5}$ exceedances were due to the high background concentrations.

In their assessment report for the West Gate Tunnel project, EPA Victoria (EPA Victoria, 2017) noted that *"the proposed ventilation stacks meet the criteria for all air pollutants under the Policy, except for PM_{10} emissions, where the prevailing hourly PM_{10} background levels (the design criterion) are exceeded by the predicted cumulative PM_{10} levels". The 'exceedance is not considered to conflict with the intent of the Policy',* primarily due to the small contribution that emissions from the tunnel ventilation structures made to the predicted concentrations. Consistent with the West Gate Tunnel ventilation structure air quality impact assessment, the primary contributors to the exceedances associated with the North East Link ventilation structures are the PM_{10} and $PM_{2.5}$ background concentrations. The exceedances of PM_{10} and $PM_{2.5}$ criteria are consequently not considered to conflict with the intent of the SEPP(AQM).

The sensitivity analysis provided in Scenarios A2 and B2 (2025 emission rates) provides some context as to the conservatism of the 2020 emission rates used in Scenarios A1 and B1.

North East Link contributions to the Scenario A2 99.9th percentile PM_{10}, $PM_{2.5}$ and NO_2 GLCs were found to decrease by approximately 26 per cent, 55 per cent and 68 per cent respectively, compared with the Scenario A1 predictions. Overall, this resulted in a decrease to the resultant maximum predicted (99.9th percentile) PM_{10}, $PM_{2.5}$ and NO_2 GLCs of approximately 0.044, 0.011 and 0.74 micrograms per cubic metre, or 0.022 per cent, 0.015 per cent and 0.63 per cent. That is, due to the background contribution, the reduction in the maximum predicted (99.9th percentile) GLCs is minimal. The corresponding decreases in the maximum predicted project contribution GLCs (no background) are 1, 1.6 and 19 micrograms per cubic metre for PM_{10}, $PM_{2.5}$ and NO_2 respectively.

North East Link contributions to the Scenario B2 99.9th percentile PM_{10}, $PM_{2.5}$ and NO_2 GLCs were found to decrease by approximately 25 per cent, 55 per cent and 68 per cent respectively, compared with the Scenario B1 predictions. Overall this resulted in a decrease to the resultant maximum predicted (99.9th percentile) PM_{10}, $PM_{2.5}$ and NO_2 GLCs of approximately 0.054, 0.013 and 0.75 micrograms per cubic metre, or 0.027 per cent, 0.018 per cent and 0.63 per cent. As with the Scenario A1 and A2 comparison, due to the background contribution, the reduction in the maximum predicted (99.9th percentile) GLCs is minimal. The corresponding decreases in the maximum predicted project contribution GLCs (no background) are 1.4, 1.9 and 23 micrograms per cubic metre for PM_{10}, $PM_{2.5}$ and NO_2 respectively.

Proposed avoidance and mitigation measures

Proposed avoidance and mitigation measures for impacts from tunnel ventilation as well as surface traffic emissions are discussed in Section 14.4.4.

Residual impacts

The residual impacts for tunnel ventilation and surface traffic emissions are discussed in Section 14.4.4.

14.4.3 Operational impacts from surface road emissions

Exhaust emissions are associated with vehicles travelling on North East Link and changes to traffic volumes and types of traffic on surrounding surface roads.

Plume dispersion modelling was used to predict pollutant ground level concentrations resulting from vehicle emissions on surface roads constructed for North East Link.

To provide a comparison with existing conditions, a base case was modelled using traffic data from key surface roads in the vicinity of Simpson Barracks (such as Greensborough Road). Traffic on Greensborough Road is expected to experience a significant change in vehicle volumes following operation of North East Link, and these changes have been included in modelling for Scenario A1 and A2 (2026) and Scenario B1 and B2 (2036).

Based on the modelling results, the impact of vehicle emissions from surface roads on Simpson Barracks are discussed.

Meteorology

The meteorology of the area is described in Section 14.2.6, based on measured data collected at the Bureau of Meteorology AWS at Viewbank for 2013 to 2017.

Golder conducted preliminary modelling with AERMOD based on meteorological data from the Viewbank site for 2013 to 2017, to determine the most appropriate year for assessing impacts from surface roads. An idealised set of road links was used, forming an intersection of roads oriented north-south and east-west in flat terrain. The roads were one kilometre long and 14 metres wide (approximately the width of a four-lane highway).

Receptors were placed at 28 metres and 85 metres from the intersection in the north-east, north-west, south-east and south-west directions, to represent highly-impacted residential locations close to the road and cycle paths and walking paths at further distances. The model was run for each year separately, with constant unit emissions from the roadways. For both receptor distances, the upper hourly and 24-hour average concentrations were generally highest using the 2016 meteorological data. Consequently, to obtain conservatively high model results, AERMOD was run for surface road impacts using meteorological data from 2016.

Model configuration and scenarios

Traffic data was used for surface roads associated with North East Link and key surface roads (such as Greensborough Road). Hourly traffic fleet composition data are provided in Appendix B.

Five scenarios were modelled:

- Scenario A1 base – without project using projected vehicle volumes for 2026 and 2020 emission factors)
- Scenario A1 project – with project using projected vehicle volumes for 2026 and 2020 emission factors)
- Scenario B1 base – without project using projected vehicle volumes for 2036 and 2020 emission factors)
- Scenario B1 project – with project using projected vehicle volumes for 2036 and 2020 emission factors)
- Scenario B2 project – with project using projected vehicle volumes for 2036 and 2025 emission factors).

Scenario A2 was not modelled as the lower emission factors were used as a sensitivity analysis for which it was only necessary to assess the worst case (that is, B2).

Traffic and emissions data for the four scenarios are presented below. The base case uses projected traffic volumes and emissions without the contribution of North East Link.

Traffic data

Road traffic data was provided for three vehicle categories (passenger cars, LCVs and HCVs) over three time periods:

- Morning peak 07:00 to 09:00 hours
- Afternoon peak 16:00 to 18:00 hours
- Total daily traffic 00:00 to 24:00 hours.

For each period, predicted traffic volumes were supplied with a range of approximately 10 to 20 per cent of the actual traffic volume. As a conservative assumption, the maximum traffic volume for each period was selected for modelling. Traffic data for Lower Plenty Road to Grimshaw Street is presented in Table 14-23 and Table 14-24.

Table 14-23 North East Link Traffic: Lower Plenty Road to Grimshaw Street – project 2026

Direction	Cars	LCV	HCV	Total
Northbound	48,000	2,800	6,700	57,500
Southbound	48,000	2,800	6,800	57,600

Table 14-24 North East Link Traffic: Lower Plenty Road to Grimshaw Street – project 2036

Direction	Cars	LCV	HCV	Total
Northbound	54,000	3,200	7,900	65,100
Southbound	55,000	3,200	7,900	66,100

Pollutant emission rates

AERMOD requires pollutant emission rates, in grams of pollutant per second, for each volume source representing a section of road modelled. Emission factors are dependent on the vehicle fleet mix, vehicle speed and road gradient. Pollution emission rate data are provided in Appendix A.

For each of the modelled roads the road diurnal pattern of traffic mix and speed was applied to the daily traffic volumes to generate an hourly speed-dependent emission factor. All roads were assumed to be at grade with zero gradient, except for the North East Link road cutting between the northern tunnel portal and Elder Street, which was assumed to have an average gradient of plus 4 per cent for northbound traffic and minus 4 per cent for southbound traffic.

North East Link road gradients are expected to meet VicRoads and AustRoads guidelines and should be no greater than 5 per cent.

Pollutant emission factors were derived from COPERT Australia (see Section 14.2.6) which include tail pipe emissions and non-tail pipe emissions (tyre and brake wear), adjusted using PIARC factors for gradient (where applicable) and the future years 2020 and 2025. Emission rates for Lower Plenty Road to Grimshaw Street are presented in Table 14-19 and Table 14-20.

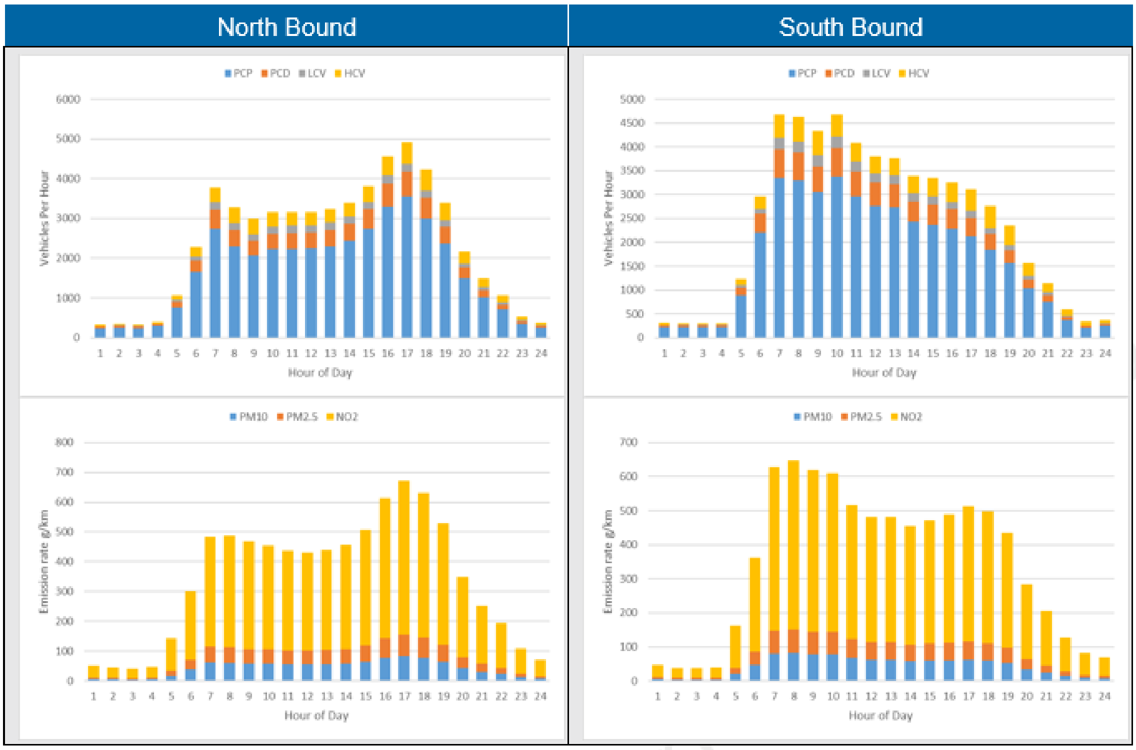

Figure 14-19 North East Link: Lower Plenty Road to Grimshaw Street – Scenario A1

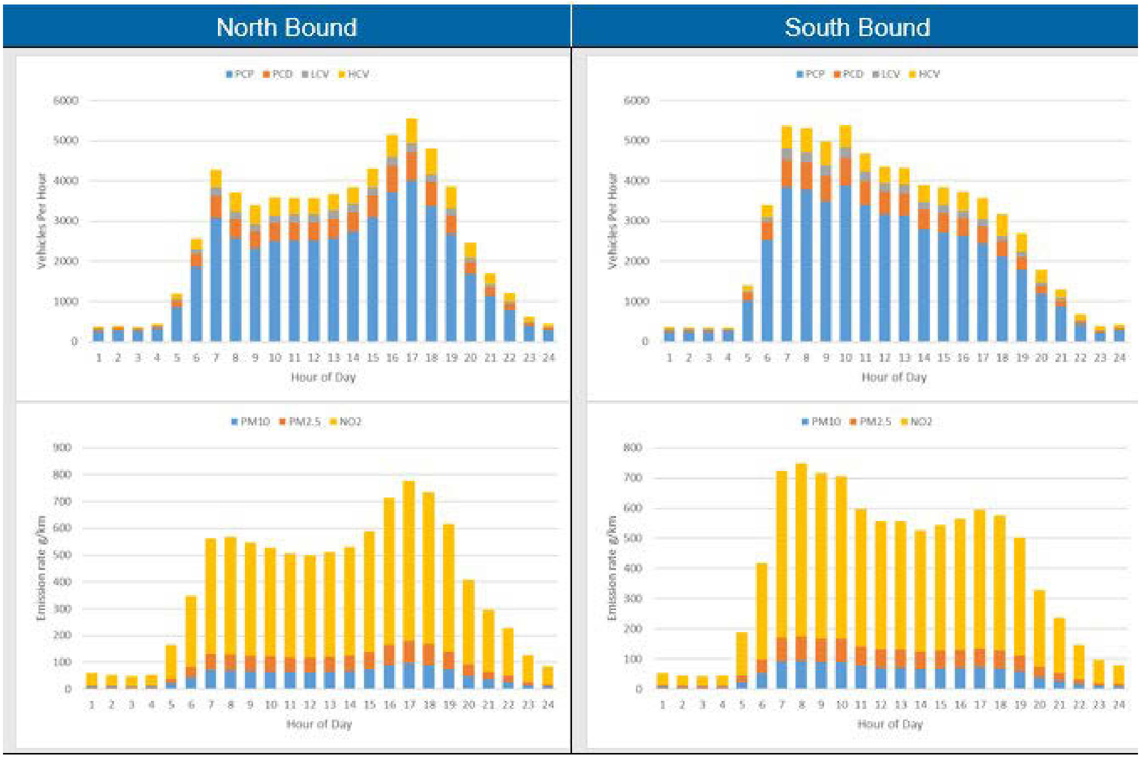

Figure 14-20 North East Link: Lower Plenty Road to Grimshaw Street – Scenario B1

Model domain and road geometry

The model comprised a 20 by 20-kilometre (400 square kilometre) model domain centred on the project boundary. This report only considers model outputs within the study area.

The selected roads are modelled as links between major intersections where traffic data is available. Each road source is modelled as a straight road link, with curved roads divided into straight line segments. Where changes in road geometry occur (such as road widening due to multiple lanes or divided roads), the road is divided into multiple segments to represent the changed road geometry.

The remaining AERMOD road geometry inputs were provided as follows:

- Separate links were defined for main carriageways where traffic data was provided for both directions
- For existing roads aerial images were used to count the number of lanes and estimate lane width and the distance between carriageways.

For proposed roads, the required road geometry inputs were determined from design drawings.

Receptor locations

Pollutant concentrations reduce significantly with increasing distances from surface roads, consequently receptor locations were selected to be representative of the sensitive receptors in close proximity to the surface roads under assessment within the study area. Figure 14-21 shows all receptor locations within the study area.

Receptors on Simpson Barracks were placed at the northern boundary along Yallambie Road and within the barracks along Stevens Road, representing the boundary between North East Link and land used by Defence personnel for activities where people are likely to be present for extended periods of time (at residences).

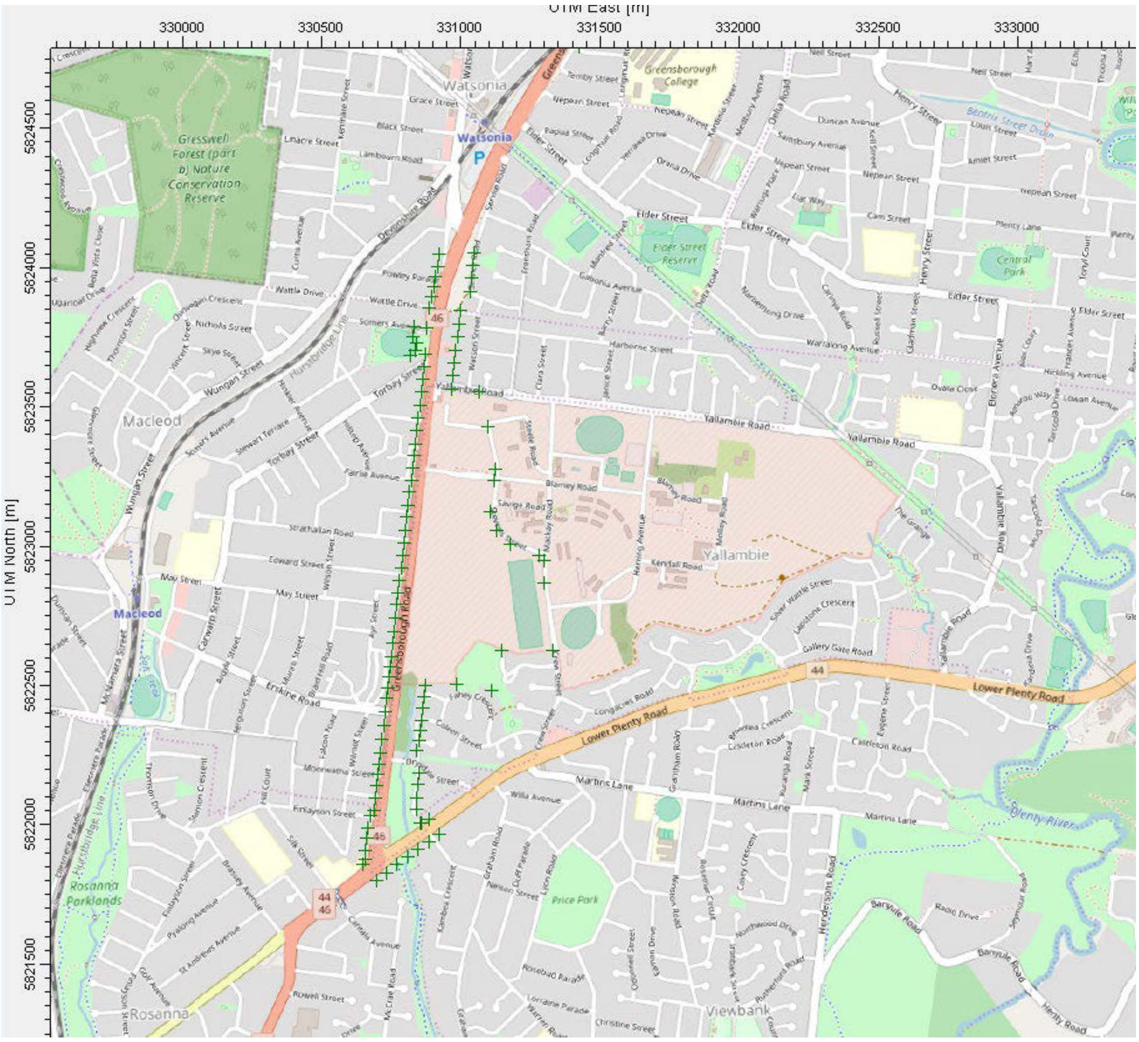

Figure 14-21 Receptor locations

Results – Simpson Barracks

Surface road modelling outputs are presented below, with results expressed as the maximum pollutant ground level concentration (GLC) (100^{th} percentile) in units of micrograms per cubic metre. GLCs are incremental levels and refer to the surface road contribution only (without background).

Changes in maximum pollutant concentrations at receptors in the study area are generally due to changes in one or more of the following factors:

- Traffic volume
- Vehicle fleet emissions, due to a change in fleet mix or speed
- The distribution of traffic along the roadway, relocating the point of maximum impact (the location may also differ between pollutants, as well as scenarios)
- The temporal distribution of traffic, leading to emissions occurring under different meteorological conditions
- Any of the above aspects along neighbouring roadways (Greensborough Road).

These factors may combine in different ways to produce changes in modelled concentrations between scenarios, pollutants and averaging periods (the concentration is dependent on the prevailing meteorological conditions during the specified averaging period).

Linear concentration plots have been used to represent surface road impacts on Simpson Barracks for PM_{10}, $PM_{2.5}$ and NO_2 respectively (Figure 14-22, Figure 14-23 and Figure 14-24 for Scenario B1. The blue area represents the maximum predicted concentration at each receptor over the entire year for the base scenario (without the project) and the orange area represents the maximum predicted concentration at each receptor over the entire year for the project scenario. Receptor locations are indicated by green dots.

Figure 14-22 Simpson Barracks 24-hour PM_{10} concentrations – Scenario B1

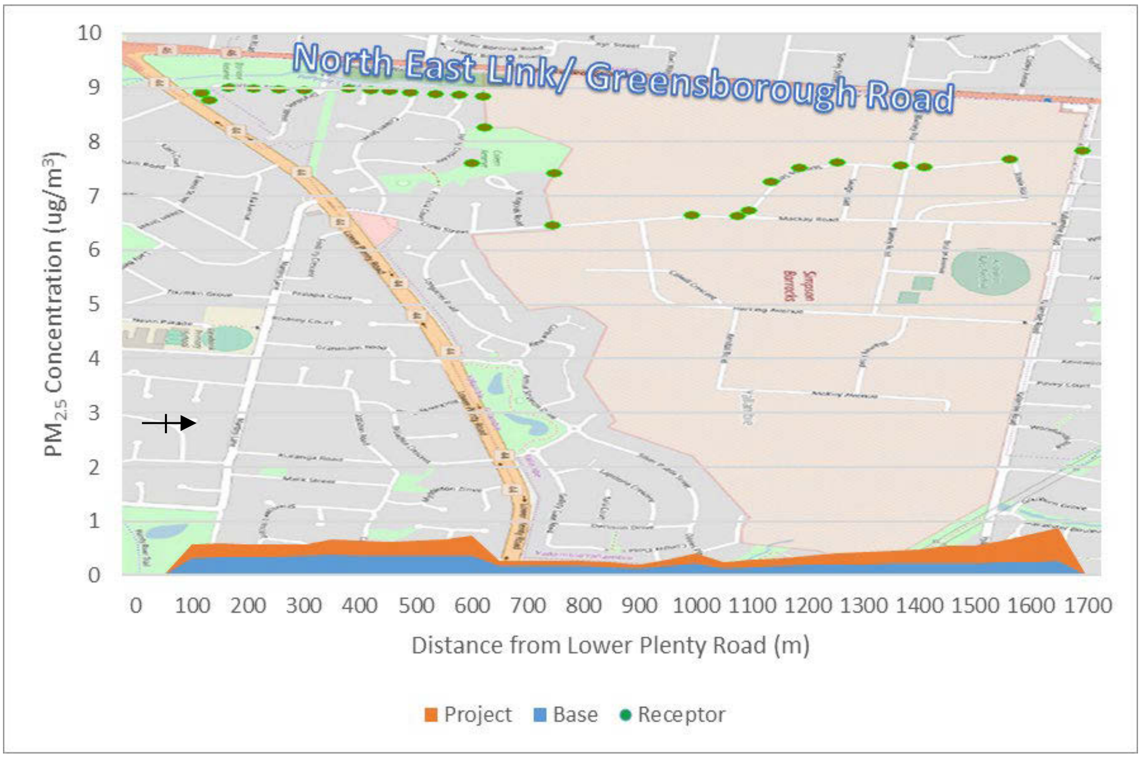

Figure 14-23 Simpson Barracks 24-hour $PM_{2.5}$ concentrations – Scenario B1

Figure 14-24 Simpson Barracks 1-hour NO_2 concentrations – Scenario B1

To provide a worst case impact for the Defence personnel receptor group, maximum receptor concentration results for Simpson Barracks are presented in Table 14-25. This receptor is located at the northern boundary on Yallambie road, approximately 300 metres east of the Yallambie Road and Watsonia Road intersection, in close proximity to North East Link extending from the northern tunnel portal exit. The location of this receptor is closer to North East Link than the identified sensitive land use locations at the barracks, and so the results presented in Table 14-25 and Table 14-26 are conservative predictions.

Table 14-25 Simpson Barracks – maximum receptor concentrations – Scenarios A1 and B1

Pollutant	Averaging period	Units	2026			2036		
			Base	Project	Difference	Base	Project	Difference
PM_{10}	24 hour	µg/m³	0.33	0.92	0.59	0.35	1.0	0.65
	Annual	µg/m³	0.13	0.37	0.24	0.14	0.42	0.28
$PM_{2.5}$	24 hour	µg/m³	0.26	0.76	0.50	0.28	0.87	0.59
	Annual	µg/m³	0.10	0.31	0.21	0.11	0.35	0.24
NO_2	1 hour	µg/m³	7.0	17	10	7.6	19	11
	Annual	µg/m³	0.53	2.3	1.8	0.57	2.7	2.1

Table 14-26 Simpson Barracks – maximum receptor concentrations – Scenario A2 and B2

Pollutant	Averaging period	Units	2026			2036		
			Base	Project	Difference	Base	Project	Difference
PM_{10}	24 hour	µg/m³	0.29	0.69	0.40	0.32	0.78	0.46
	Annual	µg/m³	0.11	0.28	0.17	0.12	0.31	0.19
$PM_{2.5}$	24 hour	µg/m³	0.17	0.43	0.26	0.18	0.48	0.30
	Annual	µg/m³	0.07	0.17	0.11	0.07	0.19	0.12
NO_2	1 hour	µg/m³	2.2	5.5	3.3	2.3	6.3	4.0
	Annual	µg/m³	0.17	0.76	0.59	0.18	0.87	0.69

Figure 14-25 North East Link 24-hour PM_{10} concentrations – Scenario B1

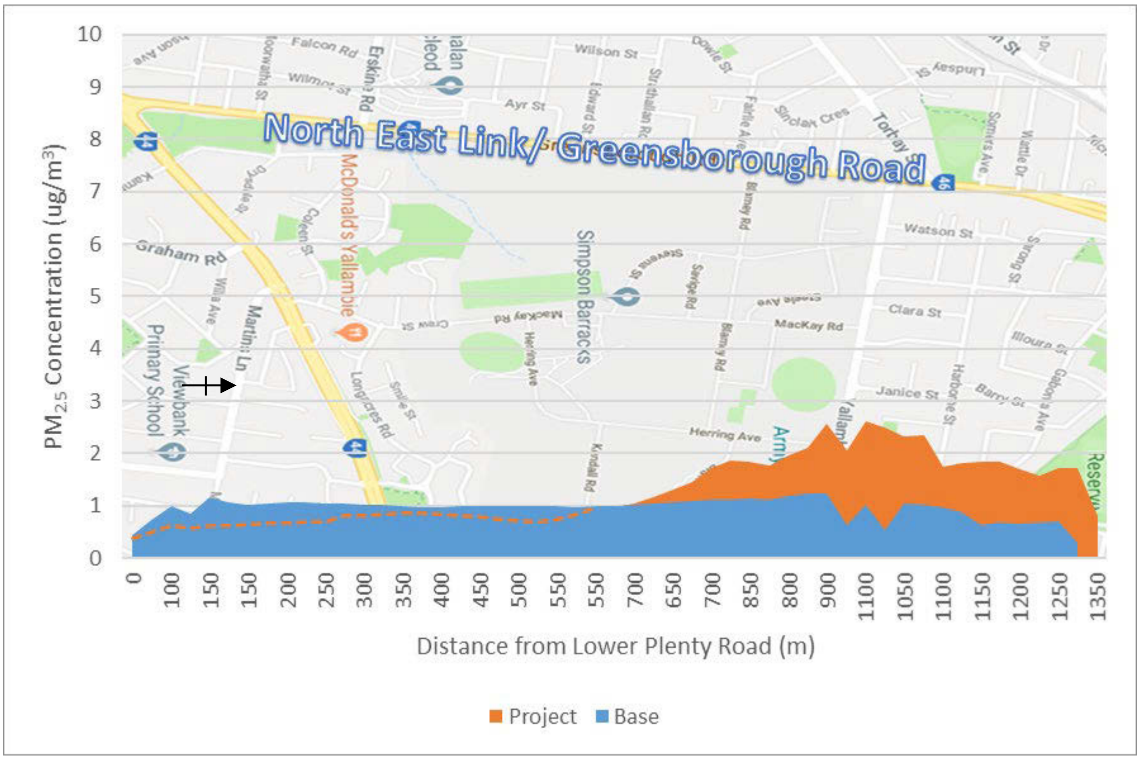

Figure 14-26 North East Link 24-hour $PM_{2.5}$ concentrations – Scenario B1

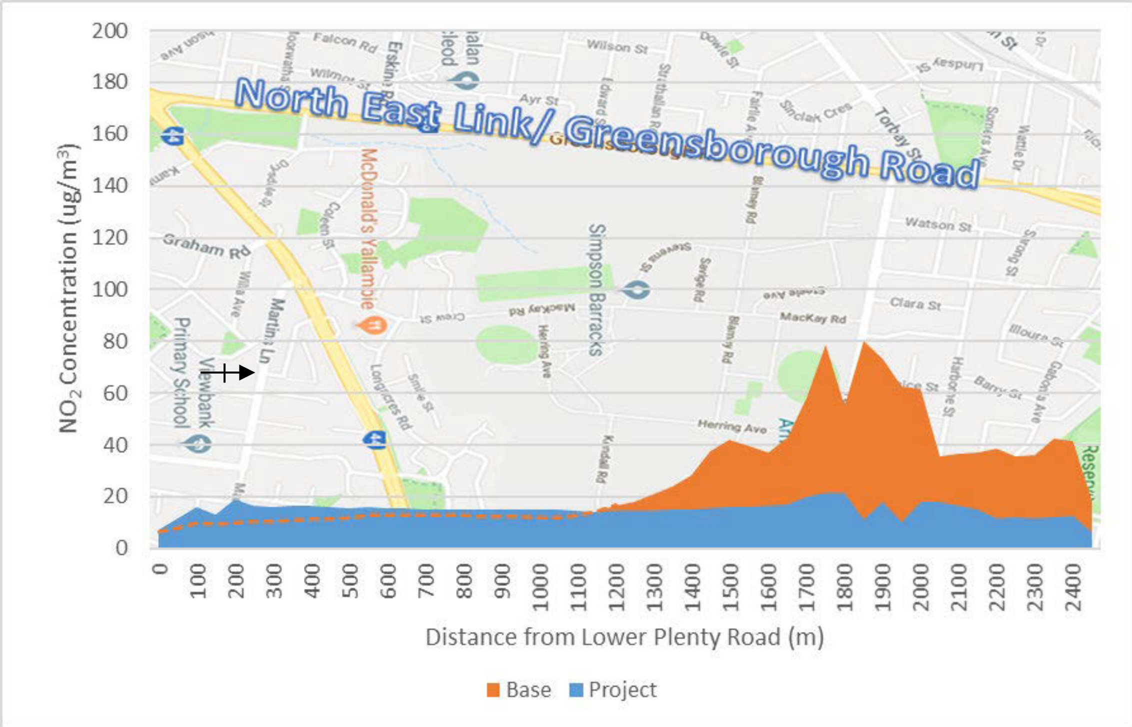

Figure 14-27 North East Link 1-hour NO_2 concentrations – Scenario B1

Discussion – Simpson Barracks

The results indicate the overall surface road impacts are greatest using the projected vehicle volumes for 2036. A discussion of the results for 2036 is presented below. A comparison of these impacts to the SEPP(AAQ) EQO is included in the combined impacts assessment (see Section 14.4.4).

The linear concentration plots in Figure 14-25 to Figure 14-27 indicate there is a marginal increase in pollutant concentrations predicted at the closest receptors along the entire length of Simpson Barracks. At the southern end of Simpson Barracks, increases in pollutant concentrations are due to new traffic lanes at the North East Link/Lower Plenty Road interchange (that extend approximately one kilometre North of Lower Plenty Road). At the northern end, there is an increase in pollutant concentrations at the receptors in close proximity to the surface roads of North East Link extending from the northern tunnel portal.

The highest predicted maximum receptor concentrations occur for Scenario B1, using 2020 emission factors in the 2036 model year. For this scenario, the maximum 24-hour PM_{10} concentration is predicted to be 0.35 micrograms per cubic metre without North East Link and 1.0 micrograms per cubic metre with North East Link, with the average concentration along the length of North East Link predicted to be 0.33 micrograms per cubic metre without North East Link and 0.59 micrograms per cubic metre with North East Link.

Similarly, the maximum 24-hour $PM_{2.5}$ concentration is predicted to be 0.28 micrograms per cubic metre without North East Link and 0.87 micrograms per cubic metre with North East Link, with the average concentration along the length of North East Link predicted to be 0.25 micrograms per cubic metre without North East Link and 0.50 micrograms per cubic metre with North East Link.

For NO_2 the maximum one-hour average concentration is predicted to be 7.6 micrograms per cubic metre without North East Link and 19 micrograms per cubic metre with North East Link, with the average concentration along the length of North East Link predicted to be 4.6 micrograms per cubic metre without North East Link and 8.9 micrograms per cubic metre with North East Link.

The sensitivity analysis provided in Scenarios A2 and B2 (2025 emission rates) provides some context as to the conservatism of the 2020 emission rates used in Scenarios A1 and B1.

North East Link contributions to Scenario A2 highest predicted maximum receptor concentrations for PM_{10} (24 hour), $PM_{2.5}$ (24 hour) and NO_2 (1 hour) were found to decrease by approximately 24 per cent, 43 per cent and 68 per cent respectively, compared with the Scenario A1 predictions.

Similarly, the project contributions to Scenario B2 highest predicted maximum receptor concentrations for PM_{10} (24 hour), $PM_{2.5}$ (24 hour) and NO_2 (1 hour) were found to decrease by approximately 25 per cent, 44 per cent and 68 per cent respectively, compared with the Scenario B1 predictions.

Proposed avoidance and mitigation measures

Proposed avoidance and mitigation measures for impacts from tunnel ventilation as well as surface traffic emissions are discussed in Section 14.4.4.

Residual impacts

The residual impacts for tunnel ventilation and surface traffic emissions are discussed in Section 14.4.4.

14.4.4 Operational impacts from tunnel ventilation structure and surface road combined emissions

Impact description

This section presents the findings of the combined impact assessment for North East Link. For the purposes of the air quality impact assessment, combined impacts refer to the combination of surface road (project scenario), tunnel ventilation pollutant emissions and background concentrations.

For each pollutant assessed, the maximum predicted concentrations due to emissions from the tunnel ventilation and surface roads were added to the background concentration to determine the combined impact at the selected maximum impacted receptors.

Model scenarios

Due to the proximity of the selected receptors to surface roads, they are primarily impacted by vehicle emissions rather than road tunnel ventilation structure emissions.

Consequently, the meteorological year chosen to assess the combined impacts, 2016, reflects the worst case year for surface road emissions, noting that the percentage difference in the tunnel ventilation structure maximum impacts between years was approximately 10 per cent.

Combined impacts were modelled for the following scenarios, consistent with those evaluated previously:

- Scenarios A1 (2020 emission factors) and A2 (2025 emission factors) – projected traffic volume and fleet mix for 2026 under normal operating conditions
- Scenarios B1 (2020 emission factors) and B2 (2025 emission factors) – projected traffic volume and fleet mix for 2036 under normal operating conditions.

Model outputs – Simpson Barracks

Individual contributions from the surface roads, tunnel ventilation structure and background concentrations to the maximum predicted PM_{10}, $PM_{2.5}$ and NO_2 GLCs in Simpson Barracks are provided in Table 14-27 to Table 14-30 for Scenarios A1, A2, B1 and B2 respectively.

Predictions greater than the SEPP(AAQ) EQO are shown in bold.

Table 14-31 to Table 14-34 present the maximum predicted PM_{10}, $PM_{2.5}$ and NO_2 GLCs in Simpson Barracks for Scenarios A1, A2, B1 and B2, without consideration of the background concentration (project only).

Table 14-27 Combined impact results: Scenario A1

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Back-ground
Simpson Barracks	PM_{10}	µg/m³	24 hour	39	50	0.057	0.30	38
			Annual	15	20	0.065	0.37	15
	$PM_{2.5}$	µg/m³	24 hour	**34**	20	0.053	0.49	33
			Annual	**7.8**	7	0.055	0.31	7.5
	NO_2	µg/m³	1 hour	96	225	4.0	13	80
			Annual	21	56	0.42	2.2	18

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-28 Combined impact results: Scenario A2

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Back-ground
Simpson Barracks	PM_{10}	µg/m³	24 hour	38	50	0.037	0.22	38
			Annual	15	20	0.045	0.28	15
	$PM_{2.5}$	µg/m³	24 hour	**33**	20	0.026	0.27	33
			Annual	**7.7**	7	0.029	0.17	7.5
	NO_2	µg/m³	1 hour	89	225	0.036	1.0	88
			Annual	19	56	0.14	0.71	18

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-29 Combined impact results: Scenario B1

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Back-ground
Simpson Barracks	PM_{10}	μg/m³	24 hour	39	50	0.069	0.34	38
			Annual	15	20	0.076	0.42	15
	$PM_{2.5}$	μg/m³	24 hour	**34**	20	0.063	0.56	33
			Annual	**7.9**	7	0.065	0.35	7.5
	NO_2	μg/m³	24 hour	99	225	5.1	14	80
			Annual	21	56	0.50	2.5	18

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-30 Combined impact results: Scenario B2

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Back-ground
Simpson Barracks	PM_{10}	μg/m³	24 hour	38	50	0.045	0.25	38
			Annual	15	20	0.053	0.32	15
	$PM_{2.5}$	μg/m³	24 hour	**33**	20	0.031	0.31	33
			Annual	**7.7**	7	0.034	0.19	7.5
	NO_2	μg/m³	1 hour	89	225	0.046	1.2	88
			Annual	19	56	0.16	0.82	18

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-31 Combined impact results: Scenario A1 – project only

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]
Simpson Barracks	PM_{10}	µg/m³	24 hour	1.1	50
			Annual	0.43	20
	$PM_{2.5}$	µg/m³	24 hour	1.0	20
			Annual	0.36	7
	NO_2	µg/m³	1 hour	35	225
			Annual	2.6	56

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-32 Combined impact results: Scenario A2 – project only

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]
Simpson Barracks	PM_{10}	µg/m³	24 hour	0.86	50
			Annual	0.33	20
	$PM_{2.5}$	µg/m³	24 hour	0.53	20
			Annual	0.20	7
	NO_2	µg/m³	1 hour	11	225
			Annual	0.85	56

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-33 Combined impact results: Scenario B1 – project only

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]
Simpson Barracks	PM_{10}	µg/m^3	24 hour	1.3	50
			Annual	0.50	20
	$PM_{2.5}$	µg/m^3	24 hour	1.1	20
			Annual	0.41	7
	NO_2	µg/m^3	1 hour	37	225
			Annual	3.0	56

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

Table 14-34 Combined impact results: Scenario B2 – project only

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	Objective[2]
Simpson Barracks	PM_{10}	µg/m^3	24 hour	1.0	50
			Annual	0.37	20
	$PM_{2.5}$	µg/m^3	24 hour	0.60	20
			Annual	0.23	7
	NO_2	µg/m^3	1 hour	12	225
			Annual	1.0	56

Notes: Concentrations rounded to two significant figures.

1 100th percentile.
2 For comparison only.

A time-series plot of the 24-hour average PM_{10} concentrations predicted for Scenario B1 is presented in Figure 14-28 for Simpson Barracks. The corresponding $PM_{2.5}$ and NO_2 (daily maximum 1-hour average) plots are presented in Figure 14-29 and Figure 14-30.

A time-series plot of the 24-hour average PM_{10} concentrations predicted for Scenario B2 is presented in Figure 14-31 for Simpson Barracks. The corresponding $PM_{2.5}$ and NO_2 (daily maximum 1-hour average) plots are presented in Figure 14-32 and Figure 14-33.

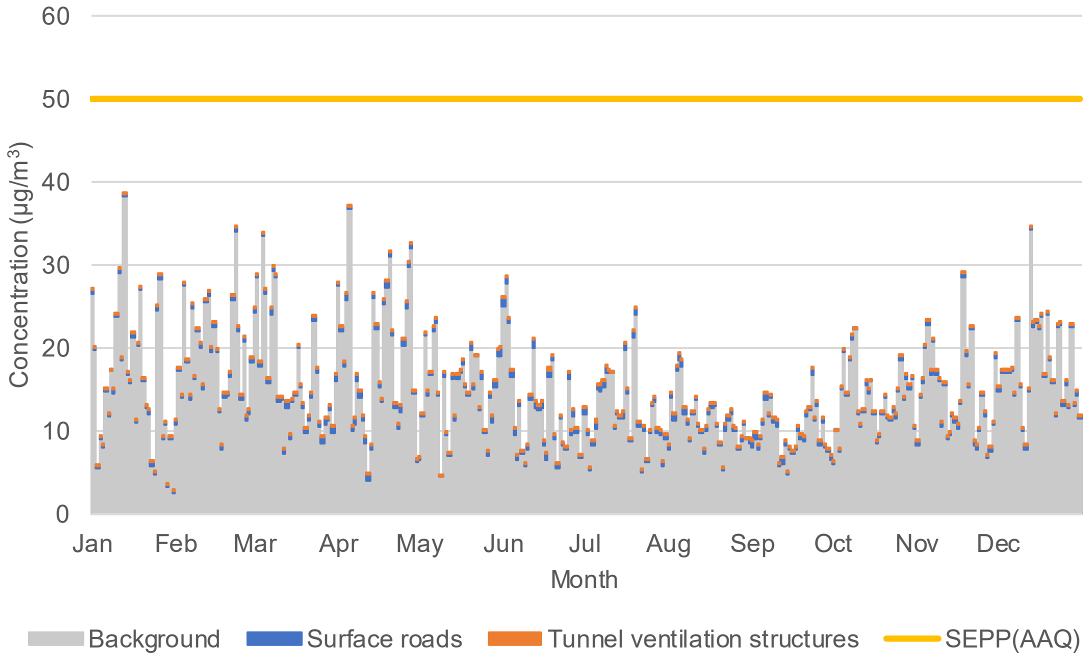

Figure 14-28 Scenario B1 (2036) predicted 24-hour average PM_{10} concentrations (Simpson Barracks)

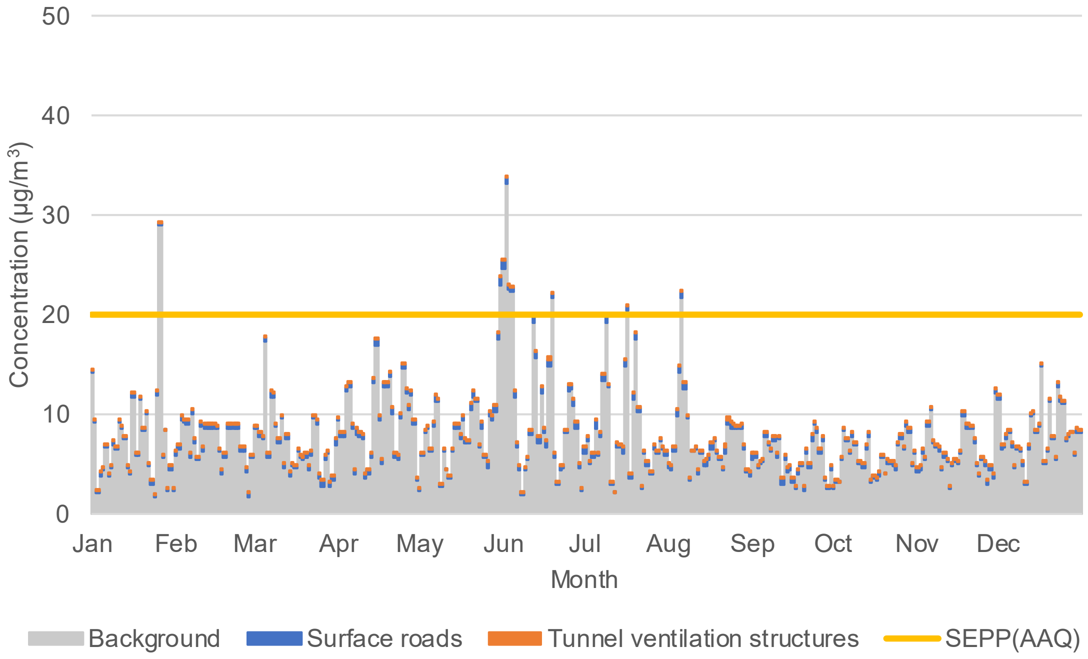

Figure 14-29 Scenario B1 (2036) predicted 24-hour average $PM_{2.5}$ concentrations (Simpson Barracks)

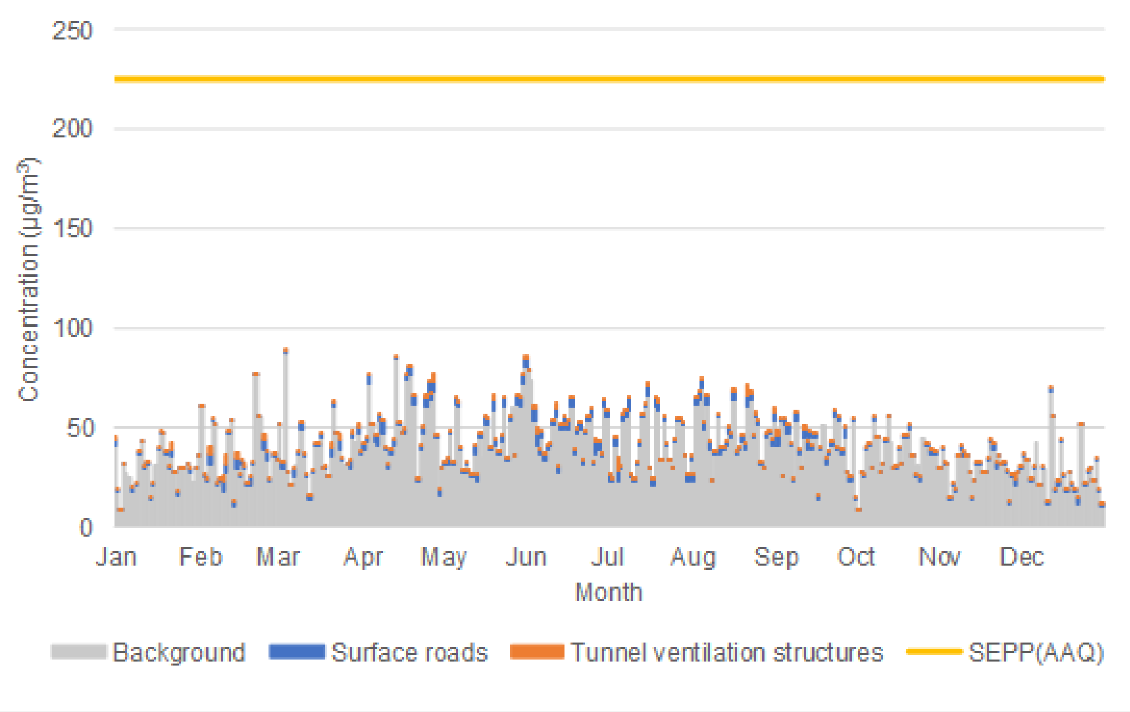

Figure 14-30 Scenario B1 (2036) predicted daily maximum 1-hour average NO_2 concentrations (Simpson Barracks)

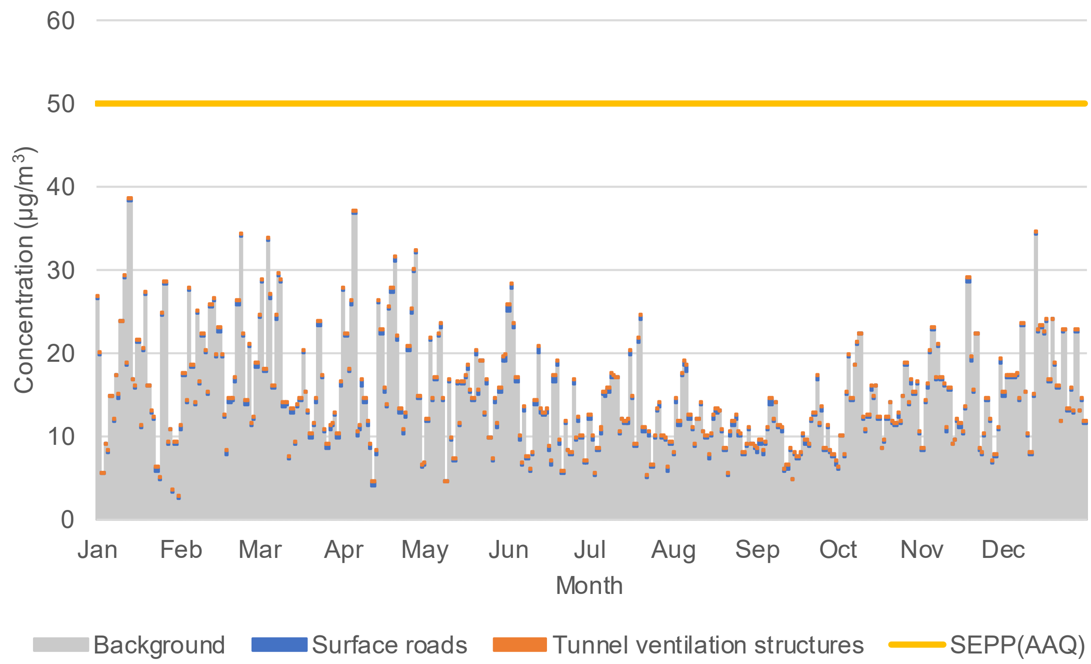

Figure 14-31 Scenario B2 (2036) predicted 24-hour average PM_{10} concentrations (Simpson Barracks)

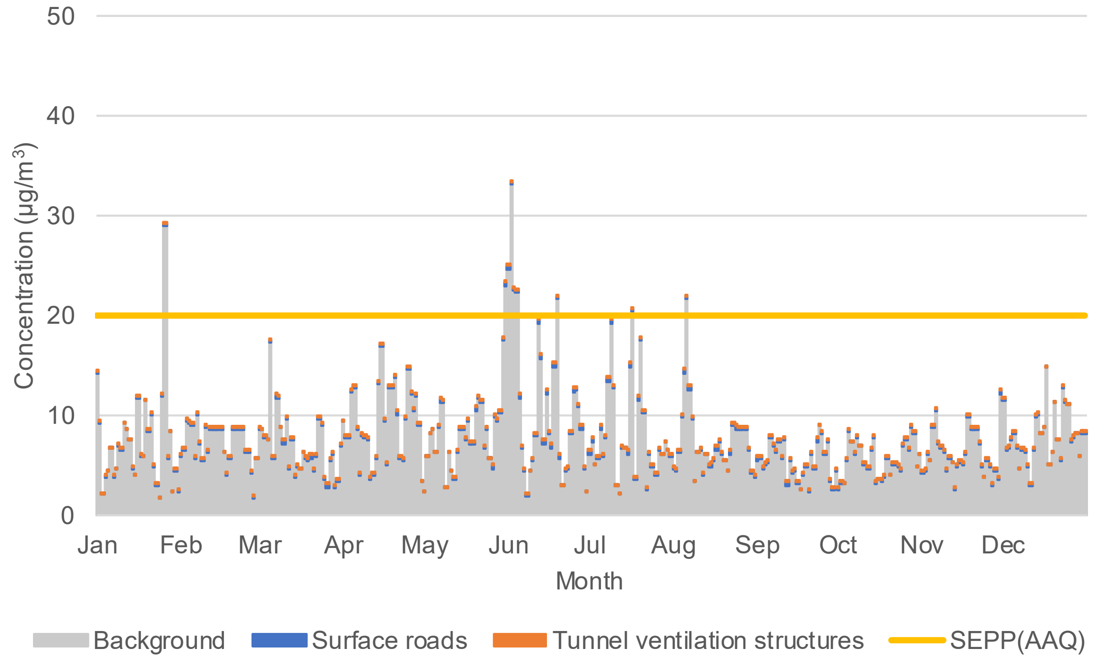

Figure 14-32 Scenario B2 (2036) predicted 24-hour average $PM_{2.5}$ concentrations (Simpson Barracks)

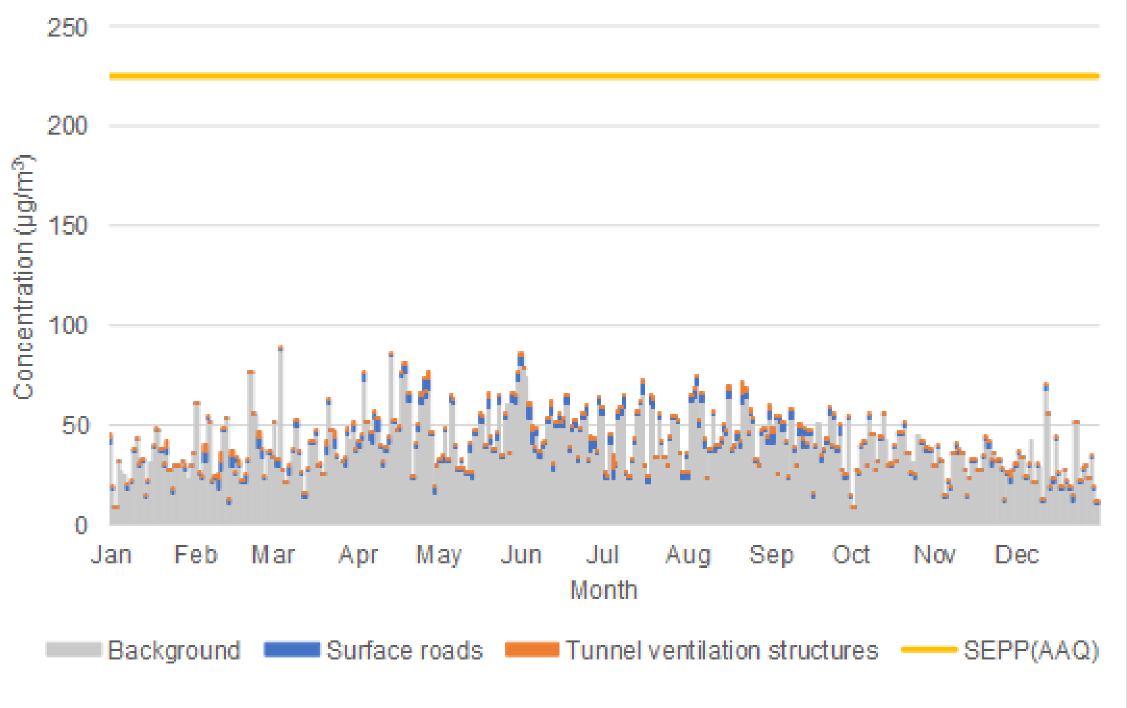

Figure 14-33 Scenario B2 (2036) predicted daily maximum 1-hour average NO_2 concentrations (Simpson Barracks)

Discussion – Simpson Barracks

The maximum pollutant concentrations resulting from the proposed tunnel ventilation and surface road emissions in 2026 and 2036 were predicted and added to 2016 background concentrations.

The time-series plots of PM_{10}, $PM_{2.5}$ and NO_2 concentrations confirm that vehicle emissions on surface roads contribute more than the tunnel ventilation at the selected receptors.

The maximum 24-hour average and annual average PM_{10} concentrations predicted for Scenarios A1, A2, B1 and B2 in Simpson Barracks are less than the SEPP(AAQ) EQOs.

When compared with the Scenario A1 results (using more conservative emission factors), the Scenario A2 project contribution to the maximum 24-hour average PM_{10} concentration in Simpson Barracks reduces from approximately 1.2 per cent to 0.9 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from approximately 3 per cent to 2 per cent. When compared with the Scenario B1 results (using more conservative emission factors), the Scenario B2 project contribution to the maximum 24-hour average PM_{10} concentration in Simpson Barracks reduces from approximately 1.1 per cent to 0.8 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from approximately 3 per cent to 2 per cent.

The maximum 24-hour average $PM_{2.5}$ concentrations predicted for Scenarios A1, A2, B1 and B2 are greater than the revised SEPP(AAQ) EQO for 2025 primarily because the background exceeds the objective on several (nine) occasions. For Scenarios A1, A2, B1 and B2 there are a further two occasions where the concentration is greater than the objective, resulting from the project contribution combined with the background concentration.

For Scenarios A1 and B1, the annual average $PM_{2.5}$ concentration is greater than the SEPP(AAQ) EQO, primarily because the background exceeds the objective, with the surface road impacts contributing approximately 4 per cent (Scenario A1) and 5 per cent (Scenario B1) of the objective. The tunnel ventilation structure contributions are less than 1 per cent.

When compared with the Scenario A1 results (using more conservative emission factors), the Scenario A2 project contribution to the maximum 24-hour average $PM_{2.5}$ concentration reduces from approximately 2 per cent to 1 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from 5 per cent to 3 per cent.
When compared with the Scenario B1 results using more conservative emission factors), the Scenario B2 project contribution to the maximum 24-hour average $PM_{2.5}$ concentration reduces from approximately 2 per cent to 1 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from 5 per cent to 3 per cent.

The maximum one-hour average and annual average NO_2 concentrations predicted for Scenarios A1 and B1 in are less than the SEPP(AAQ) EQOs. When compared with the more conservative Scenario A1 results, the Scenario A2 project contribution to the maximum one hour average NO_2 concentration reduces from approximately 17 per cent to 1 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from 13 per cent to 4 per cent. When compared with the more conservative Scenario B1 results, the Scenario B2 project contribution to the maximum one-hour average NO_2 concentration reduces from approximately 20 per cent to 1 per cent of the combined project and background predicted concentration. Annual average concentrations reduce from 14 per cent to 5 per cent.

Summary

The combined impacts of surface road and tunnel ventilation emissions are less than the PM_{10} and NO_2 SEPP(AAQ) EQOs for receptors at Simpson Barracks. The $PM_{2.5}$ SEPP(AAQ) EQO was not met, primarily because the background exceeds the objective.

The revised (2025) SEPP(AAQ) objective for $PM_{2.5}$ reflects the supposition that changes and improvements in technology will drive a future reduction in anthropogenic emissions to improve air quality. A projected reduction in background concentrations (as would be expected when vehicle emissions are reduced across the metropolitan area in line with this scenario) has not been accounted for in any of the modelling undertaken for North East Link. However, it is expected that pollutant concentrations would be lower in future years.

The 2020 emission factors used for the assessment of the tunnel ventilation structure impacts against SEPP(AQM) criteria and surface road impacts include a number of conservative elements to thoroughly evaluate the North East Link design. The 2025 emission factors used in Scenarios A2 and B2 are considered to more realistically represent the predicted improvements in vehicle engine technology by 2026 and beyond. It should also be noted the 2025 emission factors do not allow for the predicted increase in electric vehicles in the future vehicle fleet and therefore retain some conservatism.

With 2025 emission factors the combined impacts of the surface road and tunnel ventilation structure emissions are predicted to be significantly reduced.

Proposed avoidance and mitigation measures

This section presents the mitigation and management measures identified during preparation of the air quality impact assessment to manage risks resulting from the operation of North East Link.

1. **Design tunnel ventilation system to meet EPA Victoria requirements for air quality.** The tunnel ventilation system would be designed, constructed and operated to meet the requirements of the SEPP (AQM) and in accordance with the requirements of the EPA Victoria Works Approval.

2. **Achieve in-tunnel air quality performance standards.** The tunnel ventilation system would be designed to introduce and remove air from the tunnels to meet the in-tunnel air quality requirements for carbon monoxide (CO) and best practice standards for NO_2 listed below:

    - Achieve a longitudinal air velocity in the tunnels not exceeding 10 metres/second.
    - In-tunnel air quality must meet the following CO standards:
        - Maximum peak CO value of 150 ppm
        - 15-minute average CO value of 50 ppm
        - 2-hour average CO value of 25 ppm.

    The tunnel ventilation system would also be designed and operated so the tunnel average nitrogen dioxide (NO_2) concentration is less than 0.5 ppm as a rolling 15-minute average.

    Best practice Australian management techniques would be implemented to minimise impact on health from in-tunnel exposure to $PM_{2.5}$ and PM_{10}.

1. **Monitor ambient air quality.** An ambient air quality monitoring program would be developed in consultation with EPA to measure the air quality impacts of North East Link during operation. This would include at least one year of monitoring before operation and, for the ventilation structures, be in accordance with the EPA Victoria licence.
2. **Monitor compliance of in-tunnel air quality and ventilation structure emissions**. In-tunnel air quality and ventilation structure emissions would be monitored during operation of the ventilation system to demonstrate compliance the EPA Victoria licence to the satisfaction of EPA Victoria. Monitoring results would be reported publicly as agreed with EPA Victoria. Remedial action would be taken to the satisfaction of EPA Victoria if standards are not met.

Residual impacts

With the implementation of the measures described above the modelled impacts on receptors on Commonwealth land are considered to be not significant.

14.5 Residual impacts

Table 14-35 summarises the residual air quality impacts.

Table 14-35 Summary of residual air quality impacts

Impact	Mitigation	Significance of residual impact
Construction air quality impacts – short term impacts mainly relating to dust and odour from emissions due to construction activities on nearby receptors	A Dust and Air Quality Management and Monitoring Plan outlining best practice measures would be implemented during construction	Not significant
Long term impacts from operational Tunnel ventilation structure and surface road emissions on nearby receptors	The tunnel ventilation system would be designed to meet EPA Victoria requirements for air quality and to meet in-tunnel air quality standards for CO and NO_2. In-tunnel and ambient air quality monitoring programmes would be developed and implemented, with remedial action taken to the satisfaction of EPA Victoria if standards are not met.	Not significant

15. Human health

15.1 Introduction

EnRisks undertook an assessment of the human health impacts of the action on Commonwealth land. This section summarises the assessment's findings.

15.2 Assessment method

15.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land Table 15-1 summarises the other key policies and guidance relevant to the assessment.

Table 15-1 Key legislation, policy and guidance for human health

Policy/guidance	Relevance
Public Health and Wellbeing Act 2008 (VIC)	Under Part 5, Division 3, the Minister may require the conduct of a health impact assessment of the public health and wellbeing impact of a matter. The timing for completion of the assessment may be determined in such a direction. No such direction has been issued from the Minister in relation to North East Link. The Act does not specify any details relating to the completion of a health impact assessment. This study draws on other assessments that assess impacts on people (see Section 15.3.4). Specific policy and guidance for those assessments is provided in the relevant sections.

15.2.2 Relevant assessment criteria

Human health impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 16-1 summarises the performance of North East Link against these criteria.

15.2.3 Assessment scope

Study area

The assessment specifically examined human health impacts on receptors on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, both within the project boundary and within Commonwealth land to a distance of 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2).

Human health impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 16-2.

Scope of impacts considered

When considering potential health impacts within any community, health impact assessment considers the whole population as well as specific sensitive or vulnerable groups within the population. The assessment of health impacts at a community level means it is not always possible to specifically isolate and identify impacts on human health within a specific area, such as on Commonwealth land.

Where health impacts on users of Commonwealth land and the barracks community cannot be specifically identified, the health impacts for the community as a whole (including people on Commonwealth land) are presented as representative of likely impacts on the users of Commonwealth land and the barracks community. This is considered a conservative approach as the barracks community is likely to contain relatively lower proportions of sensitive and vulnerable groups (such as young children, older people, disabled people and socio-economically disadvantaged people) than the wider community.

The focus of the health impact assessment was to assess both the benefits and/or impacts to the local community and users of North East Link. The impact assessment investigated:

- Changes in air quality associated with emissions from the tunnel ventilation structures
- Changes in air quality associated with changes in emissions from major surface roads
- Exposure of vehicle occupants to emissions present within the tunnel, during operation
- Changes in noise and vibration within the community
- Health implications of social changes related to North East Link.

These areas are directly affected by changes in traffic movements in the community and so traffic changes and impacts in the local community are also addressed.

15.3 Description of environment

15.3.1 Information sources

Data sources used in the human health assessment are presented in Table 15-2.

Table 15-2 Data sources for the human health assessment

Source	Type of data
Australian Bureau of Statistics (ABS, 2018a)	Population statistics for suburbs and local government areas within the study area were available from the Australian Bureau of Statistics for the census year 2016.
Health agencies	Information relevant to the health of populations in Victoria is available from various state and Australian government agencies including the Department of Health and Human Services (DHHS), Department of Health, the Australian Institute of Health and Welfare and the Australian Commission on Safety and Quality in Health Care. These data sets are not available for individual suburbs.
Victorian Population Health Survey 2014	The Victorian Population Health Survey 2014 (Department of Health and Human Services, 2016a) provides a summary of the rate of selected chronic diseases within the Victorian population, with data for individual Local Government Authority (LGAs) compared against the rate for Victoria. More specific health indicators expected to be considered in the health impact assessment were obtained from DHHS and other published sources.

The health impact assessment drew directly upon other specific technical assessments such as traffic, air quality, noise and social impacts (see Table 15-3). All details relevant to the underlying assumptions, methodology and interpretation of impacts relevant to these specialist areas are presented in those relevant sections.

15.3.2 Impact assessment

The health impact assessment was undertaken as a desk-top assessment. The term desk-top assessment means the assessment has been conducted using additional information and has not involved the collection of any additional data beyond that provided from specific technical assessments, community consultation and statistics on the existing population.

The impact assessment was undertaken in accordance with the applicable technical guidelines from international agencies such as the WHO and USEPA, and involved quantitative and qualitative evaluations.

Air quality

The air quality impact assessment considered changes in air quality across a large grid, 10 kilometres by 15 kilometres, with varying levels of grid resolution. The assessment also considered properties located adjacent to key roadways where changes in traffic are anticipated, and hence air quality.

Construction impacts on air quality have been assessed qualitatively, where potential impacts and the identification of relevant management measures to minimise impacts (including nuisance dust) were evaluated.

The health assessment focused on the operational phases of the action, and evaluated exposures within the tunnels and within the local community to changes in air quality associated with changes in traffic composition and movements, and from tunnel ventilation structures. The health assessment has addressed potential:

- Cumulative acute and chronic health impacts from changes in air quality particularly carbon monoxide. This assessment has considered current NEPM guidance to evaluate potential health impacts.
- Incremental and cumulative acute and chronic health impacts from changes in air quality particularly from VOCs, PAHs and diesel particulate matter. This assessment has used current and appropriate health-based criteria for acute and chronic exposures and characterise risks in accordance with enHealth Guidelines.
- Cumulative and incremental health impacts from changes in air quality impacts associated with nitrogen dioxide and particulates such as $PM_{2.5}$ and PM_{10}. The assessment has used current NEPM guidance as well as current methods for assessing incremental health impacts using exposure-response functions, with health impact calculations undertaken in accordance the WHO approach.

Noise and vibration

The assessment considered health impacts in line with existing road traffic noise reduction policies in Victoria as well as current health information and assessment guidelines available from key organisations such as the WHO. The noise impact assessment considered changes in traffic composition and movements in the local areas.

The assessment of noise and vibration addressed construction (using a qualitative assessment) and operational (using a quantitative assessment) phases of the action, and evaluated changes in noise and vibration within the local community. The assessment of noise impacts considered a range of residential and other sensitive community receptors within a corridor adjacent to North East Link.

In summary, the approach adopted in the health assessment has addressed:

- Qualitatively evaluate potential impacts of changes in vibration on the local community
- Quantitatively assess potential impacts on the health of the local community because of changes in noise – the assessment has considered relevant thresholds for health impacts from noise (as established by the WHO) as well as exposure response relationships relevant to characterising health impacts from noise, including annoyance and sleep disturbance.

Social

The social assessment assessed the construction and operational of North East Link and evaluated social changes related to the action that have potential to affect the local community.

The health assessment has qualitatively assessed social characteristics which have potential to affect the health of the community (positive and negative impacts). This assessment has considered changes in air quality, noise, traffic composition and movements, pedestrian and cycle access and safety, changes in recreational uses of the local area, changes in the connectivity (or displacement) of the community and changes in the urban environment. The assessment has drawn on published studies relating to health impacts of social changes and the social impact assessment.

15.3.3 Assumptions

There are features of health impact assessment methodology that relate to the limitations of the methodology and the constraints applied within the health impact assessment to provide a focus on aspects that can be influenced as part of North East Link. These are summarised below:

- Where quantitative assessment methods are presented, a health impact assessment is typically based on a conservative estimate of impacts in the local community and so is expected to overestimate the risks for all members of the community.
- A health impact assessment involves a number of aspects where a qualitative assessment is required to be undertaken. Where this is undertaken, it provides a general indication of potential benefits or impacts only.
- The community evaluated in a health impact assessment is limited by the extent of the studies undertaken. It is not possible to evaluate impacts on the health of the community outside these areas.
- A health impact assessment relies on data provided from other assessments. The conclusions of the health impact assessment therefore depend on the assumptions and calculations undertaken to generate the data from these other assessments.
- The assessment was prepared from September 2018 to February 2019 and is based on the information provided and reviewed at that time.
- Conclusions can only be drawn with respect to impacts related to a project. Other health issues, not related to North East Link, that may be of significance to the local community are not addressed in this impact assessment.

- The health impact assessment for North East Link did not address occupational health for construction workers. Occupational health and safety (OHS) would be managed under OHS regulations and guidelines outlined and enforced by WorkSafe Victoria.
- The health impact assessment reflects the current state of knowledge regarding the potential health impacts of identified chemicals and pollutants for North East Link. This knowledge base may change as more insight into biological processes is gained, further studies are undertaken and more detailed and critical review of information is conducted.

Uncertainty

Any assessment of health risk or health impact incorporates data and information that is associated with some level of uncertainty. In most cases, where there is uncertainty in any of the key data or inputs into an assessment of health risk or health impact, a conservative approach is adopted. This approach is adopted so that the assessment presents an overestimation of potential health impacts, rather than an underestimation. The most significant factors that result in the assessment providing conservative outcomes are:

- Modelling of air quality impacts has included a range of conservative assumptions about the type of vehicles and the emissions to air that may come from these vehicles over time. The assessment has also used a model to predict ground level concentrations (that is, concentrations in the community) that are expected to be conservative.
- Modelling of noise has been undertaken using a model that provides estimates of changes in noise levels that are expected to be conservative. In addition, the assessment of health impacts has used the maximum daily change in noise in the community, rather than the change in annual average noise levels (which the noise exposure – response (health impacts) relationships are based on.
- There are a number of assumptions adopted in the characterisation of community exposure that would have overestimated exposure:
  - It is assumed the maximum changes in localised air quality, regardless of where this may occur (such as industrial area or open space area) affects a resident
  - All exposures to changes in air quality and noise that occur, in all areas, assume that all residents are at home all day, every day for a lifetime, and that changes in outdoor air pollution are mirrored indoors.

  This approach is expected to overestimate exposures and risks in the community by a factor of approximately 10-fold.
- Exposure-response – the relationships used in this assessment are based on the most current, robust studies that are relate to health impacts from exposure to changes in nitrogen dioxide, particulates and noise. The relationships adopted come from large epidemiology studies that include a number of co-pollutants (that is, exposure occurs to a wide range of factors not just the pollutant being evaluated) and confounding factors that can result in more conservative relationships being developed. In addition, it is assumed the relationships adopted are linear and apply to small changes in air quality or noise, at levels that would not be measurable with air monitoring or noise monitoring equipment.

15.3.4 Linked sections

Table 15-3 lists other technical studies from which information has been drawn for this study.

Table 15-3 Linkages to other assessment

Reference	Topic	Link
Section 6	Arboriculture	Provides an assessment of North East Link's impact on the landscape. Findings have informed the assessment of impacts on green space, in particular the loss of tree and canopy cover.
Section 9	Business	Provides an assessment of North East Link's impact on businesses. Findings from the assessment have informed the assessment of health issues related to impacts on businesses in the vicinity.
Section 10	Social and community	Provides an assessment of North East Link's potential social impacts. Information from the social assessment has informed the assessment of health implications of amenity and social changes related to the action.
Section 11	Transport	Provides an assessment of North East Links impacts on the transport network within the assessment study area. Information related to changes in traffic volumes, routes, travel times, road safety and pedestrian and cyclist safety are considered as part of the human health assessment.
Section 12	Noise	Provides an assessment of the potential surface noise and vibration impacts during construction and operation. Findings from the noise assessment have informed the assessment of the potential for changes in noise to impact on human health.
Section 13	Vibration	Provides an assessment of North East Link's potential to impact air quality during construction and operation. Findings from the vibration assessment have informed the assessment of the potential for changes in vibration to impact on human health.
Section 14	Air Quality	Provides an assessment of North East Link's potential to impact air quality during construction and operation. Findings from the air quality assessment have informed the assessment of the potential for changes in air quality to impact on human health.
Section 20	Landscape and visual impact	Provides an assessment of the visual impact of North East Link's design sensitive receptors within the section study area. Findings from the landscape and visual assessment have informed the impact assessment on amenity and character, and community infrastructure facilities.
Section 28	Contaminated land	Provides an assessment of contamination and soil issues relevant to the construction of North East Link. Findings from the contaminated land assessment have informed the assessment of potential impacts of contamination on the community during construction.

15.3.5 Stakeholder consultation

Stakeholders and the community were consulted to inform the development of North East Link and an understanding of its potential impacts. Specific consultation for the human health impact assessment included meetings with EPA Victoria and the DHHS Victoria in October and November to discuss the approach to the impact assessment, quantitative assessment methodology and key outcomes.

15.4 Description of the environment

This section summarises the demographics and existing health of the community potentially impacted by North East Link. While the key focus of the assessment was the local community surrounding North East Link (including the barracks community) some aspects of the assessment required consideration of statistics derived from larger populations, such as those within larger local government areas (LGAs) of the Melbourne metropolitan area and Victoria.

Population profile

Based on general population data, the suburbs relevant to North East Link are variable but broadly similar to that of greater Melbourne and Victoria. The composition of the populations located adjacent to North East Link is expected to be generally consistent with population statistics for the individual suburbs. The Commonwealth land is within the suburb of Yallambie and the LGA Banyule, selected demographics of which are set out in below. Barracks staff may commute from outside the local demographic area and those staying temporarily at the barracks may originate from further afield. The demographics presented relate to the local area of the base, where relevant to North East Link.

Table 15-4 Selected demographics

Location	Median age	Age 1-14 (%)	Age 30+ (%)	Age 65+ (%)	Median household income ($ week)	Average household size	Unemployment rate (%)	IRSD (Decile)*
Yallambie (suburb)	35	19.4	57.5	12.3	1871	2.9	4.3	10
Banyule (LGA)	39	16.8	63.8	17.4	1655	2.6	5.5	10

* * IRSD = index of relative socioeconomic disadvantage reported as deciles. Decile ranges from 1 which is most disadvantaged to 10 which is the least disadvantaged (Australian Bureau of Statistics Census Data (ABS, 2018a)).

Existing health of population

Information relevant to the health of populations available from various state and Australian government agencies relates to populations grouped by local government area or a metropolitan area. These data sets are not available for individual suburbs. Review of the data relevant to the LGAs of Banyule, indicates that health-related behaviours (such as smoking, alcohol drinking, prevalence of obesity) are not statistically different to those reported for Victoria. Similarly, the prevalence of chronic diseases (asthma, heart disease, cancer) are also not statistically different in Banyule when compared with Victoria. For Banyule, the prevalence of premature deaths (avoidable, circulatory, respiratory and lung cancer) is significantly lower than that reported for Victoria.

In relation to asthma prevalence, the available data indicates for children aged 5–6 years and at school entry, the rate of current asthma in the evaluated LGAs is lower or similar to the Victorian average. This is also the case for adolescents aged 12–17 years with the exception of Nillumbik and Whitehorse LGAs, which are slightly higher. No data is available that enables more detailed analysis of asthma prevalence in areas closer to existing major roadways.

Overview

Overall, the demography and health of the broader community is generally consistent with, or better than the Melbourne metropolitan area and Victorian population. At a local level, there are community concerns relating to air quality and noise impacts on the health of residents and school children in areas located close to existing major roadways.

15.5 Relevant impacts and mitigation measures

15.5.1 Air quality

Construction

During construction, while there is the potential for some impacts to occur on Commonwealth land, these impacts can be mitigated/minimised through the implementation of a Construction Environmental Management Plan (CEMP) and Dust and Air Quality Management and Monitoring Plan (DAQMMP). Assuming these plans are well implemented, construction impacts on air quality should not result in significant or measurable impacts on the health of the community relevant to the assessment of Commonwealth land.

Operation

During the operation of North East Link, in relation to potential health impacts from emissions to air from tunnel ventilation emissions and redistribution of traffic on Commonwealth land, the following can be concluded:

- Health impacts associated with exposure to volatile organic compounds and polycyclic aromatic hydrocarbons are considered to be negligible, with potential exposures to carcinogenic compounds assessed to be low and acceptable
- Health impacts associated with exposure to carbon monoxide are considered negligible
- Health impacts associated with exposure to nitrogen dioxide and particulate matter, within the local community and in areas where there may be localised impacts (such as adjacent to roadways) are low and acceptable.

During the operation of North East Link, emissions to air would be managed through the design of the ventilation structures, monitoring of in-tunnel air quality and emissions from the ventilation structures, and an ambient air quality monitoring program.

Residual impacts

Where the proposed mitigation and management measures are implemented, it is not expected there would be health impacts of concern on Commonwealth land from changes in air quality.

15.5.2 Noise and vibration

Construction

During construction there is the potential for some noise and vibration and/or regenerated noise impacts to occur to Simpson Barracks. These impacts would be managed through the implementation of a Construction Noise and Vibration Management Plan (CNVMP) which is expected to include details on the scheduling of works to minimise noise impacts, the use of localised acoustic shielding, adjusting the scale of construction equipment to control vibration and noise and vibration monitoring.

Where these management measures are implemented the potential for noise impacts to result in significant health impacts is low. However, it is expected that some individuals within the community may find construction noise annoying at times, even with mitigation.
The implementation of a Communications and Community Engagement Plan that includes a notification system and complaints management system would assist in managing these impacts.

Operation

During the operation of North East Link, noise levels are expected to be reduced by up to 4 dBA (as a result of a reduction in local traffic) in the northern portion of Simpson Barracks. Noise in the southern portion of Simpson Barracks, near the tunnel ramps, may increase up to 2 dBA which is not expected to be noticeable.

Decreases in noise levels within the community is expected to offer some level of health benefit, although these benefits are expected to be small. The potential increase in noise in the southern portion of the site is not expected to result in health impacts that would be measurable.

Noise mitigation measures have been proposed for the area around Simpson Barracks that include the use of low-noise asphalt, new noise walls and the inclusion of noise walls on the tunnel ramps at the southern end of the Commonwealth land.

No significant noise impacts that would result in significant health impacts have been predicted in relation to the operation of the tunnel ventilation facilities. It is expected that noise and vibration standards would be set to manage the operation of the tunnel ventilation facilities.

Residual impacts

Where the proposed mitigation and management measures are implemented, it is not expected there would be health impacts of concern on Commonwealth land from changes in noise.

15.5.3 Social

There are a range of changes that may occur due to North East Link that have the potential to more indirectly affect the health and wellbeing of the community. Many of the impacts assessed have the potential to increase (or decrease in some cases) levels of stress and anxiety.
These impacts have been assessed in relation to the Commonwealth land.

Construction

North East Link would involve permanent acquisition of the publicly accessible Commonwealth land south of Simpson Barracks (currently vegetated, undeveloped open space that is currently publicly accessible) and land at Simpson Barracks along the eastern side of Greensborough Road (currently undeveloped vegetated, with limited structures and not accessible to the public). The land to be acquired has limited operational use with functional areas impacted expected to be relocated within the barracks. These acquisitions are expected to be managed through a consultation process. These changes are not expected to affect the health or wellbeing of personnel at the barracks.

The permanent loss of informal public access to the publicly accessible Commonwealth land south of Simpson Barracks is not expected to adversely affect community health as there is significant other informal open space available for public access in the local area. There would be temporary loss of access to the War Services easement and Frensham SEC Reserve during construction, reducing availability for recreation over the short to medium term. However, other alternative open space would continue to be available to enable community members to pursue an active lifestyle. As a result, there are no significant impacts to health associated with the temporary acquisition of this area. Once construction is completed the area would be returned as open space.

North East Link is expected to result in some traffic changes and temporary disruption of shared use paths around the barracks during construction, which may increase local travel times and increase levels of stress and anxiety, and potential decrease safety. These impacts are expected to be minor and management measures, as detailed in a Transport Management Plan, are expected to be implemented to minimise construction impacts on local traffic, pedestrian and cycle access, with alternative access provided where needed. Where these impacts are managed, no significant impacts are expected to health and wellbeing.

Operation

Generally, operation of North East Link would provide opportunities for some health benefits associated with improved and less variable travel times, economic and employment benefits, improvements to pedestrian and cycleway access and safety.

It is expected there would be some visual changes relevant to Simpson Barracks but these changes would not affect the use of the barracks, or the wellbeing of personnel at the barracks. These impacts are expected to be minimised by designing in general accordance with the Urban Design Strategy, and to the extent practicable avoiding or minimising landscape and visual, overlooking, and shading impacts in extent, duration and intensity as well as maximising opportunities for enhancing public and private receptors, including public amenity, open space and facilities, and heritage places resulting from North East Link.

More specifically, reduced traffic on Greensborough Road due to the diversion of traffic onto North East Link may improve local travel times and accessibility to and from community facilities for defence personnel. Improved access to these facilities and reduced travel times would provide some health benefits with increased potential access to community and active recreational areas and less stress and anxiety.

Residual impacts

Where the proposed mitigation and management measures are implemented, it is not expected there would be health impacts of concern on Commonwealth land from changes in traffic and transport, property acquisition, open space and community access.

15.6 Residual impacts

Table 15-5 summarises the residual impacts on human health.

Table 15-5 Summary of residual impacts on human health

Impact	Mitigation	Significance of residual impact
Construction		
Health impacts from air emissions during construction	A Construction Environmental Management Plan (CEMP) and Dust and Air Quality Management and Monitoring Plan (DAQMMP) would be implemented to minimise air impacts, in particular dust impacts during construction.	Not significant
Health impacts from noise and vibration impacts during construction	A Construction Noise and Vibration Management Plan (CNVMP) would be developed and implemented to manage noise and vibration impacts. This would include the monitoring of noise and vibration impacts. A Communications and Community Engagement Plan would provide stakeholders with project updates and information on construction activities and impacts to enable stakeholders to plan activities with consideration to construction impacts.	Not significant
Health impacts from changes in traffic and transport, property acquisition, open space and community access	Consultation with Simpson Barracks on the acquisition of land and relocation of some facilities within the barracks would be undertaken. Traffic and transport (including pedestrian and cycle) impacts would be managed through implementation of a Transport Management Plan.	Not significant
Operation		
Health impacts from air emissions derived from tunnel ventilation and changes in road traffic	The tunnel ventilation system would be designed to meet EPA Victoria requirements for air quality and to meet in-tunnel air quality standards for CO and NO_2. In-tunnel and ambient air quality monitoring programmes would be developed and implemented, with remedial action taken to the satisfaction of EPA Victoria if standards are not met.	Not significant
Health impacts from noise and vibration impacts	Noise and vibration standards would be set and managed for the operation of the tunnel ventilation facilities.	Not significant
Health impacts from changes in traffic and transport, property acquisition, open space and community access	North East Link would be designed generally in accordance with the Urban Design Strategy. Urban Design and Landscape Plans would be developed for permanent above-ground buildings and structures. The design response would, to the extent practicable, minimise landscape and visual impacts and maximise opportunities to enhance public amenity.	Not significant

16. Relevant impacts on people and communities

16.1 Simpson Barracks

Table 16-1 summarises the performance of the action on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks) against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b).

Table 16-1 Relevant impacts on people and communities – Simpson Barracks

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Substantially increase demand for, or reduce the availability of, community services or infrastructure which have direct or indirect impacts on the environment, including water supply, power supply, roads, waste disposal, and housing	North East Link would permanently acquire of part of Simpson Barracks, including the publicly accessible Commonwealth land south of Simpson Barracks that is currently publicly accessible for informal open space recreation: • The land to be acquired at Simpson Barracks is not accessible to the public and is not used intensively by the barracks. Activities within this area could potentially be relocated to the large area of remaining undeveloped/open space within the barracks. • Although the publicly accessible Commonwealth land south of Simpson Barracks would be no longer be available for informal recreation purposes, there are considerable other areas of open space available within surrounding suburbs and the removal of this area is expected to have only a negligible impact on access to open space. Traffic and transport changes during construction from traffic and road diversions or closures have the potential to impact travel times to and from Simpson Barracks. These changes could also impact the ability of the barracks community to access business and nearby community services such as medical centres and education facilities. Some community services may have amenity impacts during construction. Access to businesses would be maintained during construction for customers, delivery and waste removal. Most goods and services provided by displaced or impacted businesses are available from other providers within a two-kilometre radius, although the loss of a fuel service station on Greensborough Road would be noticeable for commuters and the travelling public. Any impacts on the ability to access community services are not expected to be significant and would be limited to specific phases of construction. The operation of North East Link is expected to have positive impacts on traffic around and transport to and from Simpson Barracks. North East Link is not expected to have any significant impacts on the supply of utility services and there is no known groundwater abstraction for water use on Commonwealth land.

Assessment criteria	Impact
Affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants	Amenity impacts during construction could directly impact defence personnel within Simpson Barracks. Some construction activities would be audible within Simpson Barracks and modelling predicted possible noise guideline target exceedances at three locations for excavation works at five metres depth. The implementation of noise mitigation measures as part of a Construction Noise and Vibration Management Plan (CNVMP) would minimise construction noise impacts. Noise impacts from operational traffic and the tunnel ventilation structure are not considered to be significant. Tunnel vibration or regenerated noise is not considered likely to affect the health, safety, welfare or quality of life of people at Simpson Barracks. Defence personnel within Simpson Barracks are not expected to experience direct views of construction sites and activities due to the densely vegetated buffer between uses within the barracks and project corridor, although they would encounter construction activities entering and leaving the barracks via the Blamey Road entrance. During construction potential air quality impacts, including dust and odour, from surface works would be localised and occur over a defined period. The implementation of a Dust and Air Quality Management and Monitoring Plan (DAQMMP) would minimise impacts on nearby sensitive receptors and the receiving environment. During operation, impacts related to combined emissions from the ventilation structure and surface roads are not considered significant. The tunnel ventilation system would be designed to meet EPA Victoria requirements for air quality and to meet in-tunnel air quality standards for CO and NO_2. In-tunnel and ambient air quality monitoring programmes would be developed and implemented, with remedial action taken to the satisfaction of EPA Victoria if standards are not met. Following the implementation of avoidance and mitigation measures, the temporary social impacts of visual, noise and air quality change on nearby residents are expected to have minor to moderate impacts on the quality of life of the barracks community. These impacts are not considered to be significant. No significant or measurable impacts to the health of Defence personnel within Simpson Barracks are predicted to occur from operation of North East Link, assuming proposed mitigation measures are implemented. This assessment considered potential for impacts as a result of changes in air quality (from emissions from the tunnel ventilation structures or changes in road traffic), noise and vibration or indirect impacts from changes in traffic and transport (including pedestrian and cycle movements), permanent property acquisition or access and use of open space areas.
Cause physical dislocation of individuals or communities, or	North East Link would not involve relocating or impeding access for any component of the Simpson Barracks community. The land to be acquired within Simpson Barracks otherwise has limited operational use and any other activities within this area can be relocated to the large area of remaining undeveloped/open space within the barracks.

Assessment criteria	Impact
Substantially change or diminish cultural identity, social organisation or community resources?	The land to be acquired would include Assembly Place and Commemorative Plantings located south of Blamey Road within the barracks. These places were formerly used for ceremonial purposes. Although this area has not been used officially for some time, it may retain some social value for barracks personnel. Assuming the ceremonial and commemorative function is relocated and maintained elsewhere within the barracks, the removal of the Assembly Place and Commemorative Plantings is expected to have only a minor impact on defence personnel. Removal of the heritage place is discussed further in Section 18.4.1.

16.2 War Services easement

Table 16-2 summarises the performance of the action on Commonwealth land at the War Services easement against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b).

Table 16-2 Relevant impacts on people and communities – War Services easement

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Substantially increase demand for, or reduce the availability of, community services or infrastructure which have direct or indirect impacts on the environment, including water supply, power supply, roads, waste disposal, and housing	The permanent impact from part of the War Services easement being acquired for permanent infrastructure would be minimal. Ninety-six per cent of Frensham SEC Reserve would remain available for informal recreation after construction is completed. As there are considerable other areas of open space available within surrounding suburbs, acquisition of this small area of land is expected to have only a negligible impact on access to open space. Traffic Management Plans (TMPs) would identify a detour route for any closure of the existing shared use path during construction. During operation, the upgraded shared use path would enhance pedestrian and bicycle movements. New towers would be built adjacent to the War Services easement to support the existing 220 kV overhead electricity transmission lines. Given the importance of these transmission lines to power supply in the north-east, this would be done in a way that maintains power supply during construction.
Affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants	The War Services easement and Frensham SEC Reserve would be occupied for the duration of North East Link's construction, meaning there would be no users of the easement to experience noise or vibration impacts. Outside the occupation period, noise and vibration impacts would be audible although intermittent. The implementation of a Construction Noise and Vibration Management Plan (CNVMP) would minimise construction noise and vibration impacts. Tunnel construction work would be sufficiently distant to the War Services easement that no vibration impacts on the easement are expected. After construction is completed, the whole of Frensham SEC Reserve including the War Services easement would benefit from new noise walls that would be provided to meet noise criteria at nearby residential properties.

Assessment criteria	Impact
	Combined impacts of tunnel ventilation and surface road emissions are comparable to impacts predicted for Simpson Barracks with surface road emissions having a greater contribution to total concentrations (due to the relative proximity of North East Link and distance from the ventilation structure). No significant or measurable impacts to the community in relation to the use of the War Services easement and Frensham SEC Reserve are expected, where proposed mitigation measures are implemented. This assessment considered impacts as a result of changes in air quality (from emissions from the tunnel ventilation facilities or changes in road traffic), noise and vibration or indirect impacts from changes in traffic and transport (including pedestrian and cycle), temporary acquisition during construction or access and use of open space areas. Alternative open space would continue to be available for the community to continue to pursue an active lifestyle.
Cause physical dislocation of individuals or communities, or	As the War Services easement is used for informal recreation and as an electricity easement only, the action would not involve dislocation of individuals or communities. Ninety-six per cent of Frensham SEC Reserve would remain available for informal recreation after construction is completed. As there are considerable other areas of open space available within surrounding suburbs, acquisition of this small area of land is expected to have only a negligible impact on access to open space.
Substantially change or diminish cultural identity, social organisation or community resources?	As the War Services easement is used for informal recreation and as an electricity easement only, the action would not change or diminish cultural identity or social organisation. Ninety-six per cent of Frensham SEC Reserve would remain available for informal recreation after construction is completed. As there are considerable other areas of open space available within surrounding suburbs, acquisition of this small area of land is expected to have only a negligible impact on access to open space.

Part D Culture and heritage values

17. Aboriginal heritage

17.1 Introduction

Andrew Long and Associates undertook an assessment of the Aboriginal heritage impacts of the action on Commonwealth land. This section summarises the assessment's findings. The assessment has been undertaken in parallel with the preparation of the North East Link Cultural Heritage Management Plan (CHMP).

17.2 Assessment method

17.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (see Chapter 6 and Attachment VI of the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 17-1 summarises the other key policies and guidance relevant to the assessment.

Table 17-1 Key legislation, policy and guidance for Aboriginal heritage

Policy/guidance	Relevance
Native Title Act 1993	To provide recognition and protection of native title for Aboriginal and Torres Strait Islanders. Determining whether native title exists and compensation for acts affecting native title.
National Heritage List (NHL)	Lists places of outstanding heritage significance to Australia protected under the EPBC Act. Requires that approval be obtained before any action takes place that could have a significant impact on the national heritage values of a listed place.
Aboriginal Heritage Act 2006 (VIC) and Aboriginal Heritage Regulations 2018 (VIC)	The *Aboriginal Heritage Act 2006* provides for the protection and management of Victoria's Aboriginal heritage with processes linked to the Victorian planning system. The Regulations set out the circumstances in which a Cultural Heritage Management Plan (CHMP) is required to be prepared, and the standards for the preparation of a CHMP. A CHMP is required if an EES is required (Part 4 Div 2 s49).
Victorian Aboriginal Heritage Register (VAHR)	Established under the Aboriginal Heritage Act, the VAHR holds the details of all registered Aboriginal cultural heritage places and objects within Victoria. This enables assessment of whether the action intersects with registered Aboriginal cultural heritage places.

17.2.2 Relevant assessment criteria

Impacts on Aboriginal heritage are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 19-1 summarises the performance of North East Link against these criteria.

17.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on Aboriginal heritage on Commonwealth land.

Although direct impacts would occur within the project boundary (see Section 3.1), indirect impacts on may occur beyond this. The assessment therefore examined impacts on Aboriginal heritage on Commonwealth land at Simpson Barracks the publicly accessible Commonwealth land south of Simpson Barracks, both within the project boundary and within Commonwealth land to a distance of 500 metres of the project boundary, as described in Section 4.2.2.

Aboriginal heritage impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 19-2.

Scope of impacts considered

Within the Commonwealth land, the assessment examined all places where a potential impact was considered likely to occur. Places assessed include previously registered VAHR places, places listed on relevant LGA planning schemes and places identified during the course of field investigation works undertaken during the preparation of a CHMP for the action as a whole.

Potential impacts considered are primarily construction related, however, there is scope for some operation phase impacts to occur, associated with potential changes to groundwater levels as a consequence of tunnel construction and ongoing operation.

17.2.4 Description of environment

Desktop assessment

The desktop assessment examined a range of sources. Table 17-2 lists sources of information used in the assessment.

Field assessment

The field assessments undertaken comprised a standard assessment (pedestrian survey) and complex assessment (sub-surface testing) undertaken as a part of the preparation of the CHMP.

As a part of the CHMP process, consultation with the Registered Aboriginal Party (RAP), the Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation (WLCCHC or 'the Wurundjeri') is ongoing. The CHMP involves standard assessment (field survey) and complex assessment (sub-surface testing) undertaken across the CHMP activity area, including the Commonwealth land. Subsurface investigation is currently being undertaken as part of the CHMP and where consultation with the RAP has indicated the potential for Aboriginal cultural heritage.

The aims of the field survey were as follows:

- To undertake a general assessment of the archaeological sensitivity and level of ground disturbance and thereby determine the archaeological potential across the study area
- To inspect a sample of the study area through pedestrian survey and at these locations to examine areas with ground surface visibility for Aboriginal archaeological sites within the study area
- To characterise parts of the study area through a vehicular survey
- Involve representatives of the RAP and provide an opportunity to discuss any broader cultural values or oral information relating to the study area.

The field survey methodology was determined by the need to examine the study area and confirm the results of the desktop assessment. Given the large size and urban nature of much of the study area it was not possible or necessary to undertake a comprehensive pedestrian survey of the entire study area. The field survey was undertaken by both systematic pedestrian transects that were generally walked and supplemented by vehicular survey/reconnaissance.

Where pedestrian survey occurred, each member of the field team was spaced approximately two metres apart. This spacing enabled each individual to examine all surface exposures within the study area in accordance with archaeological practice outlined in (Burke & Smith, 2004, 65–69).

Pedestrian spacing was sufficient to identify any areas of significant ground exposure. According to regulation 63 (3) of the Aboriginal Heritage Regulations 2018, which stipulates what a standard assessment must include, where pedestrian survey occurred, the field survey involved the examination for potential mature trees, caves, rock shelter or cave entrances within the study area. There were occasional mature eucalyptus trees growing within the accessed part of the study area and these were all inspected for cultural scarring, with no previously unregistered culturally scarred trees identified to date.

The specific aims of the subsurface testing program are, as follows:

- Initially establish the stratigraphy through controlled hand-excavation
- Determine the presence or absence of subsurface archaeological deposits and gather more information on the nature of soil deposits through a program of test pits
- Conduct a detailed analysis of all Aboriginal cultural heritage material collected from subsurface excavations
- Determine the nature and significance of any identified Aboriginal cultural heritage places
- Determine the extent of any identified Aboriginal cultural heritage places within the study area, through the targeted excavation of test pits (Phase 2 testing).

Archaeological testing as part of the complex assessment involves the excavation of one-by-one metre and 0.5-by-0.5 metre test pits. Testing would include testing within the project boundary on Commonwealth land with specific locations detailed in the CHMP.

17.2.5 Information sources

Data sources used in the Aboriginal heritage assessment are presented in Table 17-2.

Table 17-2 Data sources for the Aboriginal heritage assessment

Source type	Description	Reference
A review of the landforms or geo-morphology	The geographic context of the study area provides an understanding of the possible resources available to Aboriginal people prior to European contact. In addition, this provides information as to whether natural environmental processes (such as the weathering of land surfaces) may have impacted on Aboriginal cultural heritage.	Victorian Geomorphological Framework (VGF) – http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/ pages/landform_geomorphological_framework
Historical environment	The environmental context of the study area and the possible resources available to Aboriginal people prior to European contact provides an understanding of what parts of the study area may have served as a focus for Aboriginal use and occupation. A review of environmental datasets was undertaken to provide insight into the environment used by hunter-gather groups within the region.	Discussed in Section 17.3.2 and listed in Section 31 'References'.
Heritage register VAHR (Aboriginal Victoria) VAHR Supplementary Lists – Aboriginal Historic Places and Action File (Aboriginal Victoria) National Heritage List (Australia).	A review of the relevant registers is necessary to identify known heritage and characterise heritage site types and locations likely to be present within the study area.	A search was undertaken of the Australian NHL and the VAHR, accessed through the Aboriginal Cultural Heritage Register & Information System (ACHRIS) on March 7, 2018.
Historical and ethnohistorical accounts of Aboriginal occupation in the region	A review of available ethnohistorical and historical information relating to Aboriginal people in the study region assists in formulating a model of Aboriginal subsistence and occupation patterns in the study area. In conjunction with an analysis of the documented archaeological record of the region, the ethnohistorical information also assists in the interpretation of archaeological sites in the wider area, and in predicting the potential location of archaeological site types within the study area.	Discussed in Sections 17.3.3 and 17.3.4 and listed in Section 31 'References'.

Source type	Description	Reference
Review of reports about Aboriginal cultural heritage	Reports of investigations into Aboriginal cultural heritage assist in characterising the general pattern of archaeological site distribution across a broad regional environment.	Proposed M1048 Watermain Replacement, Watsonia to Yallambie (Matic A. , 2006) Rehabilitation works at Koonung Creek Lower, Bulleen (Ricardi , Flynn , & Thiele , 2009) 71 Banyule Road, Rosanna, Multi-Unit Development, CHMP 11708 (Barker, 2011a) 6 Borlase Street, Yallambie (O'Connor, 2012) Residential Development, 314 Lower Plenty Road, Rosanna (Patton, 2016) Residential Subdivision, 8 Maleela Grove, Rosanna (Falvey, 2016) M80 Ring Road Upgrade, Greensborough Highway interchange to Plenty Road (Tucker, C; MacCulloch, J, 2016) North-Eastern Program – Initial works package for Level Crossing Removal Authority (Spry, 2017) 19-35 Graham Road, Viewbank, Residential Development, CHMP 15156 (Holzheimer, 2017) 69-71 Banyule Road, Rosanna, Residential Subdivision, CHMP 15455 (Welsh & Janson, 2018) Four-lot subdivision at 60 Buckingham Drive, Heidelberg (Hyett, 2010) Wurundjeri Spur, Yarra Bend Park (Howell-Meurs, 2010) Dights Falls (Berelov, McMillan, & Thiele, 2010) Yarra Bend Park Main Yarra Trail (Berelov, McMillan, & Thiele, 2011) Kew North Branch Sewer Upgrade and North Yarra Main Sewer Replacement (Barker, 2011b) Darebin/Yarra Trail Link (Stage 3) (Jones, 2016) Yarra Valley Country Club Bulleen (Berelov & Vines, 2016) 160-162 Mountain View Road Balwyn North (Matic A. , 2017)

17.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to Aboriginal heritage impacts during construction and operation are listed in Table 17-3.

Table 17-3 Aboriginal heritage assessment method

Phase	Approach
Construction	This study has assessed the potential Aboriginal cultural heritage impacts during construction of the action on the assets and values to be protected. Impact assessment included the following: • Review of North East Link • Identifying impacts on Aboriginal places • Identifying measures to avoid, minimise or mitigate impacts. An impact assessment was undertaken for all places where it was considered there would be the potential for an impact associated with North East Link.
Operation	During operation of North East Link there may be potential for additional impacts to Aboriginal cultural heritage places as a result of ongoing changes to groundwater conditions. Impacts associated with groundwater drawdown have been considered as part of the assessment.

17.2.7 Assumptions

This assessment has involved a combination of desktop and field-based investigations. While the desktop assessment has been effectively undertaken for all of the land assessed in this study, the field investigations have been limited to land directly within the EPBC boundary of North East Link. Consequently, land within the area assessed here but situated to the east and west of the EPBC boundary have not been subject to field investigations.

17.2.8 Linked sections

The Aboriginal heritage assessment has links to several other assessments described in other sections of this report or other PER technical sections. These links are summarised in Table 17-4.

Table 17-4 Linkages to other assessments

Section	Topic	Link
Section 5	Flora and fauna	Assessment of potential impacts on trees and other vegetation including potentially including culturally significant vegetation
Section 18	Historic heritage	Covers non-Aboriginal heritage values
Section 24	Groundwater	Provides modelling of changes to groundwater which would occur due to the proposed works

17.2.9 Stakeholder consultation

Stakeholders and the community were consulted to support the preparation of the North East Link EES and PER and to inform the development North East Link and an understanding of potential impacts.

The Commonwealth land is within the boundary of the Wurundjeri Land & Compensation Cultural Heritage Council Aboriginal Corporation (Wurundjeri) Registered Aboriginal Party (RAP). The Wurundjeri have been appointed as the Registered Aboriginal Party for this area under the provisions of Victoria's *Aboriginal Heritage Act 2006.*

North East Link requires a CHMP approved by Wurundjeri. CHMP investigations with Wurundjeri have been ongoing throughout 2018 on standard and complex assessments, and would be completed in 2019.

NELP has been working in collaboration with Wurundjeri on multiple levels. This has included involvement in the development of the EES, Urban Design Strategy (UDS), Cultural Values Mapping, attendance at the Technical Review Group (TRG) and related meetings, workshops and walks on Country.

A series of workshops and field visits with Wurundjeri Elders have been undertaken for the cultural values mapping exercise for North East Link and to prepare the project's UDS. This work has informed this Aboriginal cultural heritage assessment, CHMP, EES and UDS.

Table 17-5 lists specific engagement activities relating to Aboriginal cultural heritage, with more general engagement activities occurring at all stages of North East Link.

Table 17-5 Stakeholder engagement undertaken for Aboriginal cultural heritage

Activity	When	Matters discussed	Outcome
Meeting with DoD	31 July 2018	CHMP results of standard and complex assessments	No specific outcome to meeting.
Meetings with Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation (Wurundjeri).	9 March 2018	Inception meeting, introduction to the action, discussion of existing condition results, desktop assessment, cultural values assessment, site access process and staged approach to standard and complex assessment. Meeting frequency was also discussed.	Broad agreement about the staged process to standard and complex assessment.
	30 April to 1 May 2018	CHMP standard assessment	No specific oral information was collected. Agreement that the activity area has been subject to varying levels of ground surface impacts. The need for complex assessment was discussed.

Activity	When	Matters discussed	Outcome
	21 May 2018	Results meeting to discuss the results of the first part of the standard assessment and to discuss proposed testing locations.	The RAP, Sponsor and heritage advisor agreed on locations where the initial complex assessment works would occur. Additional locations for standard assessment were also discussed and agreed.
	6-8 & 22 & 25 & 29 June 2018	CHMP standard and complex assessment	No specific oral information was collected. Agreement that the activity area has been subject to varying levels of ground surface impacts. The identified Aboriginal cultural heritage was assigned a high cultural significance.
	28 June 2018	Results meeting to discuss updated standard and complex assessment results. Cultural values mapping process was also discussed and agreed.	Cultural values mapping would involve a series of workshop and site visits and look at broader Aboriginal cultural values within the project boundary and study area. Areas for future and further subsurface testing were discussed and agreed.
	29 June 2018	CHMP standard assessment	No specific oral information was collected.
	6, 9-10 July 2018	CHMP standard assessment	No specific oral information was collected.
	11-13 July 2018	CHMP complex assessment	No specific oral information was collected.
	20, 23, 26-27 & 30 July, 13 & 27 August 2018	CHMP complex assessment	No specific oral information was collected.
	24 August 2018	Results meeting to discuss updated standard and complex assessment results	Discussion of results including artefact finds. Areas for future and further subsurface testing were discussed and agreed.
	3 September 2018	CHMP standard assessment.	No specific oral information was collected.
	5 September 2018	Cultural Values Assessment	Inspection of scarred trees within Simpson Barracks. Both trees deemed to be non-cultural in origin.
	4, 6, 7, 14, 17, 20 & 21 September 2018	CHMP complex assessment.	No specific oral information was collected.
	2 October 2018	Results meeting to discuss updated standard and complex assessment results.	Discussion of results including artefact finds. Areas for future and further subsurface testing were discussed and agreed.

Activity	When	Matters discussed	Outcome
	15-19 and 22-26 October 2018	CHMP complex assessment.	No specific oral information was collected.
Meetings with Aboriginal Victoria	10 & 15 August 2018	Meeting to discuss place registration procedures.	Meeting discussed the number of registered VAHR places in the activity area, approaches to 'delisting' sites should all parties agree they should not be on the register and arrangements around registering intangible heritage.
	22 October 2018	Meeting to provide update on the desktop assessment results in non-RAP area and discuss expectations around the requirement for any additional assessment.	Meeting included a summary of the desktop results in the non-RAP area and a discussion about the extent of proposed impacts from the activity in non-RAP area. It was agreed by all parties that based on the results a desktop assessment for the area was sufficient and there is no requirement for a standard or complex assessment of the non-RAP part of the activity area.

17.3 Description of the environment

17.3.1 Review of landforms or geomorphology

The PER study area (see Section 17.2.3) is predominantly located within the Victorian Eastern Uplands geomorphic land system and contains one dominant geomorphological units including a 'Moderately dissected ridge and valley landscapes associates with the northern part of the study area.

There are two dominant geological units within the study area:

- Melbourne Formation (Sxm) sedimentary deposits of mudstone and very fine-grained sandstone associated with the north, west and centre-east of the study area
- Anderson Creek Formation (Sxa) a marine mudstone (deposited during fast flow currents).

The study area includes or intersects with one waterway, Banyule Creek.

17.3.2 Historical environment

Environment

The following information provides general context to the environment of the current study area.

The climate of Australia has altered and fluctuated since the time of earliest human occupation within the Pleistocene period around 40,000-60,000 years ago. The Pleistocene period is conventionally dated from two million to 10,000 years ago (Mulvaney & Kamminga, 1999; Aguirre & Pasini, 1985; Lourens, 2008). During the Pleistocene, lower sea levels were present across Australia, and the southern coastline extended southwards, connecting Tasmania to the Australian mainland (Cosgrove, 1999). During the Late Pleistocene to Early Holocene (Holocene period generally dates from around 10,000 years ago to the present day, (Mulvaney & Kamminga, 1999), 103 sea levels began to rise in response to post-glacial marine transgression resulting from the melting of Late Pleistocene ice sheets (Lambeck & Nakada, 1990). This rise in sea levels separated Tasmania from the mainland and reduced the Australian coastline. Victorian sea levels stabilised and reached modern levels before around 6,000 years before present (BP) (Lambeck & Nakada, 1990).

During the period of Aboriginal occupation of the Melbourne region, the climatic conditions varied greatly regarding temperature and rainfall levels. During the Last Glacial Maximum of the Pleistocene period (21,000-15,000 years BP), temperatures were approximately 6-10 degrees lower than today (Mulvaney & Kamminga, 1999). During the late Pleistocene period, there was less rainfall and less precipitation throughout the continent, reducing the woodland forest areas of southern Australia and resulting in a predominance of grasslands. Within this time, there is evidence for dry/shallow lakes with conditions likely to have been too dry to support swamp or open-water environments (Bowler, 1981; Aitken & Kershaw, 1993). The inland of Australia was characterised by arid and dry conditions and it is likely that Aboriginal people during this period would have experienced severe drought. Within southern Victoria these climatic conditions generally discouraged tree growth, although some trees survived in particularly sheltered and watered areas (Mulvaney & Kamminga, 1999).

In the late Pleistocene to early Holocene (around 12,000 to 9,000 years BP), warmer temperatures and increased precipitation resulted in the expansion of woodland and forest areas dominated by Eucalypts (Aitken & Kershaw, 1993). During this time, the Tadpole Swamp (now located within the Cranbourne botanic gardens) was formed, possibly supported directly by precipitation or, as is more likely, a rise in the regional water table caused by wetter conditions (Aitken & Kershaw, 1993). At Tadpole Swamp, pollen and charcoal sample analysis of sediment cores indicate that permanent wet conditions in the Cranbourne area were in existence after 8,500 years BP. The highest moisture levels occurred 7,000 to 5,000 years ago as evidenced by the expansion of wet sclerophyll taxon *Pomaderris* in the understorey (Aitken & Kershaw, 1993). Similar peaks in *Pomaderris* also occurred in data from the Gippsland Lakes and with the period of highest lake levels in the volcanic crater lakes from the Western Plains (Aitken & Kershaw, 1993; Kershaw, *et al.,* 2004).

The analysis from Cranbourne also displays the fluctuating environmental conditions of the Holocene, with data indicating that after 5,000 years ago, vegetation in the Cranbourne area became more diverse with an increased representation of understorey vegetation relating to *Eucalyptus* (Aitken & Kershaw, 1993). Aitken and Kershaw suggest that it is likely the eucalypt canopy became more open with an understorey mosaic of heath, bracken and grassland, possibly resulting from climatic variability with lower rainfall experienced in the Late Holocene, and the possible result of increased burning indicated by relatively high levels of charcoal (Aitken & Kershaw, 1993). Palaeoecological studies of the Gippsland Lakes also indicate that lower levels of moisture were available during the late Holocene, with fluctuating fresh water conditions experienced at Lake Wellington (Reid, 1989). Data from crater lakes in south-western Victoria also show a decline in water levels during the mid-Holocene, with a more substantive decline after approximately 5,000 years, and water levels oscillating perhaps a result of fluctuating temperatures until the later Holocene from around 1,800 to 1,300 thousand years ago (Wilkins, Gouramanis, De Deckker, Keith Fifield & Olley, 2013). Aitken and Kershaw's investigations at Cranbourne also highlight vegetation changes during the period of European occupation, with analysis from Tiger Snake Swamp within the Cranbourne botanic gardens revealing the addition of exotic vegetation including pines, docks and sorrels, plantains and asters/daisies, and an increase in shrub understories of woodland vegetation or the replacement of woodlands by shrub land and heath vegetation (Aitken & Kershaw, 1993).

This general increase in grasses is partially a response to vegetation clearance activities, with bracken and *Casuarina* showing a marked decline.

Modelled pre-1750 vegetation of the study area

The modelled pre-1750 vegetation of the study area provides insight into the environment used by hunter-gather groups within the region, and the resources available before European land clearance and development. The 1750s EVCs within the study area are dominated by Plains woodlands or forests, with Grassy Dry Forest and Creekline Grassy Woodland also present. This includes the project boundary within Commonwealth land at Simpson Barracks.

Aboriginal occupation often focused on waterways, and areas adjacent to water sources, including swamps, and these areas would have provided a wide range of food and material resources for Aboriginal people. The study area contains a number of water sources, including major water courses such as the Yarra River, Plenty River and major creeks such as Merri Creek, sections of Darebin Creek and Salt Creek. These water sources would have contained a variety of food and medicinal resources that would have been used by Aboriginal people. Such resources would have included aquatic birds, fish, eels, as well as supporting animals such as kangaroos, wallabies and emu.

John Helder Wedge explored and surveyed lands purchased by the Port Phillip Association and studied at land around Plenty River in the east, and the lower reaches of the Yarra River (Forster, 1968: 3). Wedge noted that wildlife in the more open country included emus and kangaroos with wild ducks, geese, cranes and black swans as well as wild native dogs around the swamps and water courses. Wedge also noted that Aboriginal people used the following native foods: kangaroos, kangaroo rat, fish, edible roots from various plants, black swans, ducks, birds and various reptiles including snakes (Forster, 1968: 3-4).

Water rushes and marsh vegetation as well as plant-food resources important to Aboriginal people would have grown in nearby watercourses and swamps. The rivers, creeks, lagoons and swamp areas, would have supported various species of fish, eel, frogs, tortoises and other aquatic species as well as various birds, kangaroos, wallabies, wombat, possums and emu inhabiting the plains of the wider geographic region. Plants were used for non-culinary purposes; such as making nets, baskets, and ornaments. Grasses such as Kangaroo Grass (*Themeda triandra*), were used in the manufacture of fishing nets (Zola, 1992), while tussock grass fibres were used to make string for bags, baskets and mats.

17.3.3 Review of historical and ethnohistorical accounts of Aboriginal occupation in the region

Archaeological evidence within the Melbourne metropolitan region suggests an extensive history of human occupation dating at least over 31,000 years BP. The Keilor archaeological area, located approximately 16 kilometres north-west of Melbourne (and outside the study area), lies near the confluence of the Maribyrnong River and Dry Creek. Contained within the site are Aboriginal stone artefacts of the Australian Small Tool tradition (no older than 5,000 to 6,000 years ago) overlying deeper deposits containing older technological classes and a myriad of megafauna remains. The stratigraphic profile of the site is reflective of gradual geomorphological and fluvial processes that have shaped the area over thousands of years and is divisible into four distinct depositional layers: the Ploughzone; overlying Doutta Galla Silt (Keilor Terrace); overlying D Clay (Arundel Terrace); overlying ODCA (Arundel Terrace) (Duncan, 2001). The river terraces formed by these processes were clearly important to the human occupants in the area, as demonstrated by the wealth of archaeological material uncovered within the site.

Radiometric dating has elucidated this evidence of human occupation in the area as one of the oldest in Victoria. The Keilor archaeological site is most famously known for the discovery of a human cranium in 1940 during quarrying works in the area, the dating of which was calculated to be around 14,700 BP, using radiocarbon dating and 254luorine-phosphate analysis.[5] Radiocarbon dates of charcoal samples obtained from hearths within the Doutta Galla Silt depositional layer revealed a date of 13,300 +1100/-900 years BP (Munro, 1997: 30) demonstrating at least a Late Pleistocene occupation of the area. These dates have been pushed back even further with radiocarbon dating of D Clay (Arundel Terrace) deposits containing lithic artefacts illustrating dates of 31,600 + 1100 - 1300 years BP (Gallus, 1983). The dates obtained from river terrace deposits in Keilor are some of the oldest documented evidences of the antiquity of human occupation within Victoria.

The lives of Aboriginal groups in the Melbourne area were severely disrupted by the establishment and expansion of a European settlement. As a result, little information is available regarding the pre-contact lifestyle of Aboriginal people in the area. A full ethnographic search was outside the scope of this assessment and the following section summarises major syntheses previously undertaken on Aboriginal associations with the Melbourne area in general in the pre-contact and post-contact period (Clark, 1990; Clark & Heydon, 1998; Presland, 1985).

There are several problems concerned with correctly identifying and describing 19th century Aboriginal groups within the geographic region. This is largely a result of discrepancies in early European accounts and the difficulties early settlers had in understanding Aboriginal languages and social systems. Furthermore, the devastating impacts on Aboriginal people of European presence, such as the loss of traditional lands and resources, spread of disease, social breakdown and removal of groups and individuals to reserves and mission stations compounded the difficulties associated with accurately recounting an early ethnohistory of the Aboriginal people of the Melbourne region (Barwick, 1984).

Ethnohistorical accounts

At the time of European colonisation, central and north-eastern Victoria was occupied by a collection of peoples known as the *Kulin*, who shared certain cultural, social and language characteristics (Barwick, 1998). The *Kulin* were in turn divided by distinctive language variations and organisational attributes, resulting in the definition of individual groups by contemporary observers as 'tribes'. Today they are more consistently defined by ethnohistorians as groups linked by commonalities of language, or 'language groups'. In contemporary Aboriginal society in the Melbourne region, the terms 'tribe', 'people' or 'nation' are more commonly used by Aboriginal people to demonstrate a traditional identity or allegiance, beyond the strictly academic term 'language group'.

A language group consisted of independent groups of closely related kin, or 'clans', who were spiritually linked to designated areas of land through their association with topographic features connected to mythic beings or deities. Clan lands were inalienable and clan members had religious responsibilities (such as conducting rituals) to ensure 'the perpetuation of species associated with the particular mythic beings associated with that territory' (Berndt, 1982). Unfortunately, there is no available information at this level of study regarding mythic associations with landscape features within the study area.

According to (Clark, 1990), at the time of European contact, clans from one language group, the *Woi wurrung* (spelling according to (Clark, 1990), however numerous variants exist) are believed to have occupied land in the study region. The *Woi wurrung* occupied the basins of the Yarra River and Maribyrnong River (Clark, 1990).

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5 Gary Presland, *Keilor Archaeological Site* – http://www.emelbourne.net.au/biogs/EM00792b.htm – Sourced 27th May 2016

The *Woi wurrung* are part of the Kulin Nation language group, and the *Woi wurrung* clan most closely associated with the study region were the *Wurundjeri willam*, who identified with the Yarra River and Plenty River (Clark, 1990). Barwick identifies three sub-groups of the *Wurundjeri willam*; Jacky Jacky's group from the south bank of the Yarra River, from Gardiner's creek upstream to Yarra Flats and north slopes of Dandenong mountains; Billibellary's group on the north bank of Yarra River 'about Kew', at Melbourne, west of Darebin Creek to east bank of Saltwater (Maribyrnong) River and Jackson's Creek, north near Mt William Quarry; and Bebejan's group 'at Hydleburg', up Yarra to Mt Bawbaw, about Yering (Barwick, 1984). Barwick bases these divisions on Howitt's information (Howitt, 1904: 309) about the *Wurundjeri willam*, whom he calls '*Kurnaje-berring*'.

Clan boundaries were defined by mountains, creeks and rivers, and clans were very familiar with the geography of their territory and the seasonal availability of resources within it. At contact with Europeans, Bebejan was a *ngurungaeta* (clan head) of the *Wurundjeri willam* whose territory included the area around Darebin Creek (Howitt, 1904: 309). Bebejan was the father of William Barak (Clark, 1990). Most references to *Wurundjeri willam* describe Aboriginal associations with either the Yarra River or Mount William, west of Kilmore (Presland, 1985). The *Wurundjeri willam* had an extensive network of political, economic and social relations with neighbouring clans, including those from other language groups. Marriage was sought from the *Bunjil* moieties of the *Bun wurrung* (spelling according to (Clark, 1990) to the south, the *Taungurong* to the north and a clan near Mount Macedon and Lancefield (Barwick, 1984).

Post-contact history

After the establishment of Melbourne and the rapid dispersal of pastoralists around Port Phillip in search of quality grazing and water for stock, the *Woi wurrung* and *Bun wurrung* were swiftly excluded from traditional food resources and the more reliable water sources in the region. In particular, the yam daisy or myrrnong, a staple food found in swamps, was rapidly destroyed by introduced grazing animals. Access to the woodlands, swamps and billabongs became difficult following the establishment of station homesteads at significant locations. In addition to the dislocation and social breakdown caused by this conflict, the limited resource diversity available to each group became critical, forcing the survivors increasingly to dependence on government and station supplied rations.

The development of Melbourne and its hinterland during the mid-19th century resulted in not only the rapid loss of traditional lands and resources, but also the spread of diseases including venereal disease, social breakdown and the removal of Aboriginal groups and individuals to reserves and mission stations (Caldere & Goff, 1991).

The close proximity of the mass of urban settlers to these Aboriginal groups inevitably caused problems for the Colonial administration, and consequently a Government Mission was set up in 1837 on an 895-acre site at South Yarra, close to an established camping area on the current-day site of the Royal Botanic Gardens. George Langhorne was responsible for its management. Rather than resolving Aboriginal grievances, the objective of the mission was to 'civilise' Aboriginal people and those who decided to live at the mission were provided with rations in exchange for agricultural endeavours. Children were also provided with rations for attending school classes. *Woi wurrung* people were mainly associated with the mission although a few *Bun wurrung* individuals and members of other language groups were noted as being affiliated to the mission in 1838 (Clark & Heydon, 1998). The mission was short-lived, and alternative locations were sought away from the 'influence' of Melbourne.

Various reserves were subsequently established as refuges for Aboriginal people around Port Phillip and Westernport by Assistant Protector William Thomas from 1839 to 1843 in an attempt to move the remaining Aboriginal people further away from Melbourne. These included Arthurs Seat, Merri Creek, Mordialloc Creek and most importantly the Westernport Protectorate Station on the Dandenong Creek at Narre Warren (Clark & Heydon, 1998; Barwick, 1998). Thomas hoped the stations would encourage Aboriginal people to take up an agricultural lifestyle, but he spent most of his time unsuccessfully trying to keep Aboriginal people out of Melbourne. One of the major problems was the way in which the *Woi wurrung* and *Bun wurrung* were frequently treated as the same group, leading to internal dissent and dissatisfaction. The Westernport Protectorate Station, for instance, was located on *Woi wurrung* land, which was not acceptable to the *Bun wurrung*, who were treated like strangers.

In 1839 a census requested by George Robinson, the Chief Protector of Aborigines in the Port Phillip Protectorate, of Aboriginal people living in and around Melbourne found the probable Aboriginal population at this time consisted of 140 *Woi wurrung*, 50 *Wada wurrung* and 12 *Bun wurrung* people (Lakic & Wrench, 1994). However, it is likely the numbers of Aboriginal people in Melbourne varied greatly throughout this period and subject to the influx of various groups and individuals.

From the 1830s onwards, Aboriginal people continued to camp close to the township of Melbourne. Mostly they were Aboriginal people belonging to *Woi wurrung* and *Bun wurrung* clans, and their preferred camping places were along the south bank of the Yarra River, opposite the settlement of Melbourne, and Government Paddocks (between Princess Bridge and Punt Road) (Clark & Heydon, 1998). *Woi wurrung* and *Bun wurrung* people camped from the falls (near Princess Bridge) for approximately 1.5 kilometres south-east along the river. A particularly favoured location for camping was on the hill overlooking 'Tromgin', a swamp south of the Yarra River. Robinson and Thomas, an Assistant Protector, reportedly spent much time throughout the late 1830s to mid-1840s attempting to 'break up' Aboriginal camps by the Yarra River and discouraging Aboriginal people from visiting the township itself (Clark & Heydon, 1998). In 1840, Thomas noted that:

> *By what I can learn, long ere the settlement was formed the spot where Melbourne now stands and the flats on which we are now camped on the south bank of the Yarra was the regular rendezvous for the tribes known as Warorangs, Boonurongs, Barrabools, Nilunguons, Gouldburns twice a year or as often as circumstances and emergences required to settle their grievances, revenge deaths…(Thomas in Presland 1985, 35).*

The population of *Woi wurrung* and *Bun wurrung* people declined steeply in 1847, caused by an influenza epidemic, leading to deaths and the dispersal of Aboriginal people from camps by the Yarra River (Clark & Heydon, 1998).

Through the influence of the Government, Missionary Societies and the new 'land owners', the number of Aboriginal people in the area dwindled due to high mortality rates and forced movement out of the township. Complaints from settlers who wanted to exclude Aboriginal people from their newly acquired land and move them further into the 'bush' and requests by Aboriginal people themselves for a 'station' of their own, led to the establishment of an Aboriginal reserve known as Coranderrk, near Healesville in 1863. The majority of *Woi wurrung* people lived at Coranderrk from 1863 to the early 1900s when the introduction of the *Aborigines Act* 1909 requiring all 'half castes' to leave Mission Stations, resulted in Aboriginal people moving back to Melbourne, attracted by work opportunities (Rhodes, Debney & Grist, 1999).

17.3.4 Land use history

This section contains a brief synthesis of available local historical records and relies heavily on the land use history prepared by Lovell Chen for North East Link.

Land in Section 8 of the Parish of Keelbundora, now the site of Simpson Barracks, was purchased in 1838 by Thomas Wills, and subsequently acquired in 1839 by Thomas Walker (Biosis & ERM, 2017). This land was the first of early land owner Walker's subdivisions, preceding the sale of his Glanville Estate, which was located closer to Melbourne. Section 8 was bounded approximately by Martins Lane to the south, Plenty River to the east, Greensborough Road to the west, with Elder Street generally indicative of its northern boundary. The property was subdivided into 12 allotments and sold in June 1839, with W T Elliot purchasing five of the blocks (Garden, 1972).

By 1842, 605 acres (245 hectares) of Walkers' allotments had been consolidated into Yallambie Park by John and Robert Bakewell. Artist Edward La Trobe Bateman visited the property in c. 1853, and produced a set of drawings which show the station overlooking the Plenty River as a complex of timber buildings, extensive garden with vineyard and grazing cattle (Bateman). The property retained the name Yallambie when it was purchased by pastoralist Thomas Wragge. It was Wragge that constructed the large residence known as Yallambie, which remains in Tarcoola Drive (Victorian Places, Yallambie, accessed 19 June 2018).

The Bakewells' vineyard has been cited as one of the earliest vineyards in Victoria (Henderson, 2017). An undated, but c. 1850 survey plan of 'Yallambee' shows the layout of the paddocks in the property, with cultivation concentrated to the east near the Yarra River. The grassed paddocks are the later location of Simpson Barracks. The plan also shows a damn at the west of the property, close to Greensborough Road.

The Wragge family remained owners of the property into the 1930s (Biosis & ERM, 2017). Thomas Wragge passed away in 1910, and the inventory of his estate described Yallambie Park as:

> *… having frontages to Greensborough and Lower Plenty Roads and on the East a short frontage to the River Yarra and containing about 604 ½ acres. On the land is erected a large old fashioned two-storey brick stuccoed dwelling with slate roof … The outbuildings consist of a dairy, Man's room, laundry, lumber-room, stabling and buggy sheds, Feed and harness room, old two roomed hut, cattle yard, bales &c. The land is fenced and divided into five paddocks and two acres are used as a fruit and vegetable garden, the remainder for grazing. (Wragge, accessed 2017).*

Under the terms of Wragge's will, an acre of land at the south-east corner of Greensborough Road and Yallambie Road was granted to the Church of England for the construction of a church on the site. In 1926, the new church was dedicated as a memorial to Wragge (Argus, 1926).

In 1935, the remainder of the property was purchased by prominent and ground-breaking psychiatrist Dr Ainslie Meares. Meares' substantial residence, Aldermaston, was constructed the following year at the south of the property, to a design by architect Les Forsyth (Biosis & ERM, 2017). Soon after, in 1938, the Australian Army took 100 acres (40 hectares) of the property for training purposes. During World War II, the Army purchased this land, and requisitioned the remainder of Meares' property for training, which it purchased in 1951. By 1945, the Meares had left the property (Biosis & ERM, 2017).

The training facility became known as Watsonia Camp, and barracks, rifle ranges, camp reception and transit camp were established, and Aldermaston was taken over as a hospital. Defence development in this period was concentrated in the northern half of the site. By 1946, the camp was 'almost deserted' (Biosis & ERM, 2017). From 1946 to 1951, it was used for emergency housing by the Victorian Government, before the Army took control of the site again.

It was redeveloped for regional training and personnel depot headquarters, and officially opened as Watsonia Barracks in May 1960. New buildings included mess, assembly hall, and accommodation blocks (National Archives of Australia) with the new arrangement of the barracks visible in an aerial photograph of 1962. It was renamed Simpson Barracks in 1986. Change in occupation and use by the Army saw a portion of the site to the south-east sold and subdivided into residential allotments (Biosis & ERM, 2017). The site remains in use as a defence facility.

17.3.5 Heritage register searches

At the time of the VAHR search a total of four registered Aboriginal cultural heritage places were registered within the study area (see Section 5.3). These places comprise three scarred trees located within Commonwealth and a low-density artefact distribution site situated to the south of Lower Plenty Road.

The registration details of two of these places are in the process of being revised and updated as part of the Cultural Heritage Management Plan (CHMP) preparation as part of which two of the scarred trees located on Commonwealth land would likely be deregistered.

Please note that two additional cultural heritage places have been identified during preparation of the CHMP for North East Link. These places consist of a low-density artefact distribution place and an artefact scatter and both are located outside Commonwealth land to the south of Lower Plenty Road.

The study area contains a number of areas of cultural heritage sensitivity as defined in the Aboriginal Heritage Regulations 2018, including:

Regulation 25 – Registered cultural heritage places

- A registered cultural heritage place is an area of cultural heritage sensitivity.
- Subject to subregulation (3), land within 50 metres of a registered cultural heritage place is an area of cultural heritage sensitivity.
- If part of the land within 50 metres of a registered cultural heritage place has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity.

Regulation 26 – Waterways

1. Subject to subregulation (2), a waterway or land within 200 metres of a waterway is an area of cultural heritage sensitivity.
2. If part of a waterway or part of the land within 200 metres of a waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity.

A search of the NHL, Commonwealth Heritage List and World Heritage List (Australia) did not reveal any listings in the study area.

Table 17-6 Aboriginal places, previously registered and currently unregistered on Commonwealth land

VAHR	Name	Component number	Component type
7922-0577	SAB 1	7922-0577-1	Artefact scatter
7922-0578	SAB 2	7922-0578-1	Artefact scatter
7922-0579	SAB 3	7922-0579-1	Artefact scatter
7922-0580	SAB 4	7922-0580-1	Artefact scatter

VAHR	Name	Component number	Component type
7922-0581	SAB 5	7922-0581-1	Scarred tree
7922-0582	SAB 6	7922-0582-1	Scarred tree
7922-0583	SAB 7	7922-0583-1	Scarred tree
7922-0587	SAB 11	7922-0587-1	Scarred tree
7922-0584	SAB 8	7922-0584-1	Scarred tree*
7922-0585	SAB 9	7922-0585-1	Scarred tree*
7922-0586	SAB 10	7922-0586-1	Scarred tree*
7922-0588	SAB 12	7922-0588-1	Scarred tree

* Based on ongoing assessments these items would likely be de-registered as non-cultural items.

17.3.6 Review of reports about Aboriginal cultural heritage – local studies

Heritage assessment for Simpson Barracks (Ford, 2017)

(Ford, 2017) undertook a desktop assessment and archaeological survey for Simpson Barracks. The assessment included considerations of Aboriginal and historical heritage values.
The assessment covered the entirety of the barracks, the western part of which overlaps with the activity area of the current CHMP.

As part of the assessment, areas of archaeological potential were identified, this included the central and southern part of Simpson Barracks that overlaps with the activity area for this CHMP (Ford, 2017: 43).

Two registered scarred trees (7922-0584 and 7922-0585) that overlap with the current activity area were re-identified during the field survey. The trees were 20 to 50 metres from the locations described on the VAHR. The scars on these trees (7922-0584 and 7922-05858) were assessed to not be cultural in origin and rather natural in origin (such as limb breaks) and this matter was discussed with Elders from Wurundjeri (Ford, 2017: 40).

There has not yet been an update of these results on the VAHR and the two scarred trees are still registered places at the time of the current desktop assessment.

Other studies in the vicinity

A large number of other studies (see Table 17-2) were examined, in general indicating that:

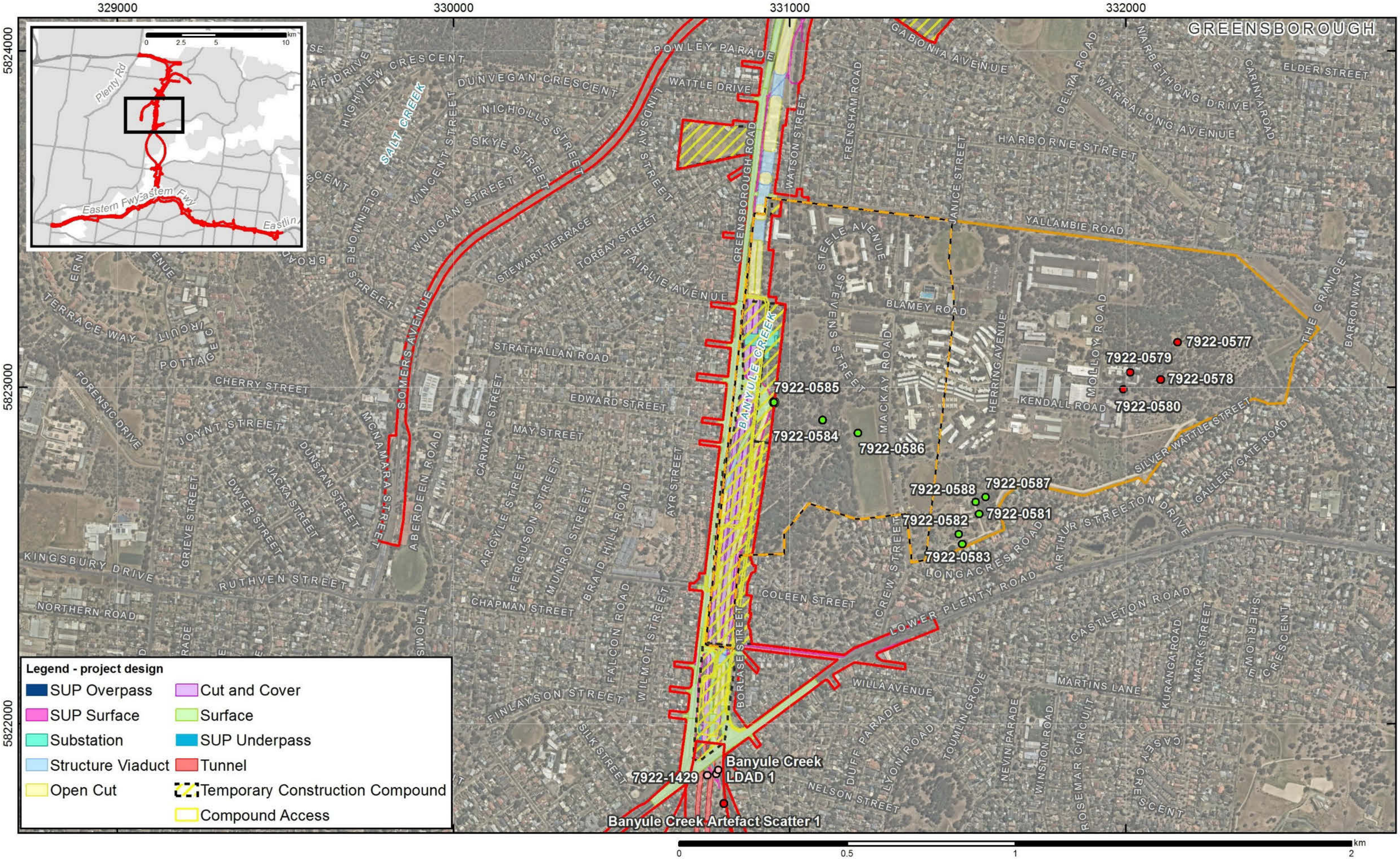
- The results of previous archaeological investigations have suggested that landforms away from water courses have lower archaeological potential often due to land modification. Urban development and modification that has taken place close to watercourses has likely been responsible for the destruction and loss of Aboriginal cultural heritage places.
- Localised archaeological studies have indicated that land that has been highly modified by activities such as ground preparation for urban development are unlikely to contain Aboriginal cultural heritage material.
- Localised archaeological studies have also indicated it is possible that Aboriginal cultural heritage may be present in areas that contain previous disturbance particularly in areas that contain sensitive landforms associated with water courses.

17.3.7 Implications of previous archaeological investigations relating to the current study area

By comparing the results of the background research and the archaeological investigations previously undertaken within the geographic region, the following conclusions can be drawn regarding the nature of Aboriginal archaeological material within the activity area:

- The study area is located within the traditional language area of the Woi wurrung language group and the Woi wurrung clan most closely associated with the study region were the Wurundjeri willam, who identified with the Yarra River and Plenty River.
- The study area contains a single watercourse – Banyule Creek which would have contained a variety of food and medicinal resources that would have been used by Aboriginal people.
- Inside the broader region that comprises the study area, there are six previously registered or recently identified Aboriginal cultural heritage places. Half of these places consist of places containing stone artefacts (artefact scatters or low density artefact distributions) (50 per cent) and half are scarred trees (50 per cent).
- Aboriginal places have been found on landforms associated with water courses including river terraces and elevated land in proximity to water.
- Previous archaeological investigations within the study region have indicated that despite the modifications that have taken place to many of the waterways in and around Melbourne, there is a high likelihood of Aboriginal cultural heritage being found in proximity to permanent watercourses.
- The results of previous archaeological investigations have suggested that landforms away from water courses have lower archaeological potential often due to land modification. Urban development and modification that has taken place close to watercourses has likely been responsible for the destruction and loss of Aboriginal cultural heritage places.
- Localised archaeological studies have indicated that land that has been highly modified by activities such as ground preparation for urban development are unlikely to contain Aboriginal cultural heritage material.
- Localised archaeological studies have also indicated that it is possible that Aboriginal cultural heritage may be present in areas that contain previous disturbance particularly in areas that contain sensitive landforms associated with water courses.

The activity area comprises landforms that may be sensitive for Aboriginal cultural heritage material including creek margins, terraces and elevated landforms associated with water courses. Buried deposits consisting of stone artefacts may survive within undisturbed landforms present within the activity area, depending upon the impacts of disturbance from historical and modern land uses.



North East Link Project

Known Aboriginal cultural heritage places within 500m of Commonwealth land within the construction footprint

City of Banyule, City of Boroondara, City of Manningham, Nillumbik Shire, City of Whitehorse, City of Whittlesea and City of Yarra

Project Boundary - surface	Low-density artefact distribution
Commonwealth land	Scarred tree
EPBC 500m buffer	Scarred tree - place extent
Artefact scatter	Road

N

Project Code: NELP_2711

GDA94 MGA Zone 55

Drawn by: Josara de Lange

Date: 27 February 2019

ANDREW LONG + ASSOCIATES

17.4 Relevant impacts and mitigation measures

17.4.1 Removal of place

Impact description

North East Link would likely involve the use of land intersecting with the scarred tree SAB 9 (7922-0585). The proposed initial use is as a construction compound. However, part of the land would subsequently be occupied by a new at grade roadway.

North East Link would likely require the permanent removal of the place. However, it is understood this place is likely to be deregistered and listed as a non-site following consultation with the RAP and Aboriginal Victoria and a site inspection undertaken with the RAP which has determined this item as non-cultural.

Proposed avoidance and mitigation measures

No avoidance or mitigation is recommended. This place would likely be listed as a non-site because of the assessments undertaken as part of the preparation of the CHMP and through consultation with the RAP and Aboriginal Victoria.

The CHMP currently being prepared is the next step in the process of managing the impacts as identified in this assessment. The CHMP process includes:

- Ongoing consultation with the primary stakeholder for the study area, the Wurundjeri (the RAP) and Aboriginal Victoria (the Victoria Government body responsible for cultural heritage management and protection).
- Standard assessment (field survey) and complex assessment (sub-surface testing) undertaken across the CHMP activity area. The standard assessment has already taken place and subsurface investigation is currently being undertaken as part of the CHMP in a number of locations across North East Link and where consultation with the RAP has indicated the potential for Aboriginal cultural heritage.

Residual impact

Residual impact significance is predicted to be negligible.

17.4.2 Disturbance of place

Impact description

At this stage there is no likelihood that North East Link would involve an impact of disturbance (permanent) to either 7922-0584 or 7922-0586. The place 7922-0584 is closest to the project boundary, but like the scarred tree 7922-0585 discussed in Section 17.4.1, this place has been determined to be a non-cultural item and would be deregistered before construction of North East Link started; 7922-0586 is situated outside the project boundary and would not be impacted.

Proposed avoidance and mitigation measures

No avoidance or mitigation is recommended. One of these places would likely be listed as a non-site because of the assessments undertaken as part of the preparation of the CHMP (see Section 17.4.1) and through consultation with the RAP and Aboriginal Victoria. The second place would not be impacted.

Residual impact

Residual impact significance is predicted to be negligible.

17.4.3 Disturbance of unregistered Aboriginal cultural heritage

Impact description

The potential for direct, permanent disturbance of unregistered Aboriginal cultural heritage places is present. However, desk studies (which indicate a high degree of disturbance from development and other land uses) and field evaluation undertaken on Commonwealth land as a part of the preparation of the CHMP has indicated it is unlikely that significant cultural heritage places would be present within Commonwealth land.

Proposed avoidance and mitigation measures

In the unlikely event of discovery of unregistered Aboriginal cultural heritage North East link would prepare and comply with the requirements of the approved CHMP (see Section 17.4.1).

Residual impact

Residual impact significance is predicted to be negligible.

17.4.4 Damage to Aboriginal cultural heritage from changes to groundwater levels

Impact description

The assessment considered potential for a permanent, indirect impact on Aboriginal cultural heritage from changes to groundwater due to North East Link. Changes to groundwater conditions are considered in PER Technical Appendix B – Groundwater technical report. Construction of a trenched structures within Commonwealth land would likely change groundwater levels. These changes would have temporary and permanent components. Groundwater drawdown modelling for the study area indicates a projected drawdown of one to two metres at a distance of 500 metres from the tunnel. Groundwater drawdown impacts increase to three to six metres at a distance of within 200 metres from the tunnel at completion of construction.

Two scarred trees within 500 metres of the EPBC boundary may potentially be using ground water and may, as a consequence be impacted by changes in groundwater levels. However, one of the places in question (SAB 8 – 7922-0584) is likely to be deregistered and listed as a non-site shortly, following consultation with the RAP and Aboriginal Victoria and a site inspection undertaken with the RAP. The second place (SAB 10 – 7922-0586) is yet to be fully assessed in the field.

While current modelling indicates changes in groundwater levels through drawdown because of construction, it is unlikely these changes would have a substantial impact on the two places discussed above. There is potential to affect currently unregistered sites, but, as discussed in Section 17.4.3, this is unlikely.

Proposed avoidance and mitigation measures

No avoidance or mitigation are proposed.

Residual impact

Residual impact significance is predicted to be negligible.

17.4.5 Construction impacts of a northern TBM launch

The potential Aboriginal cultural heritage impacts of the alternative design for the northern portal launch site have been reviewed.

This would alter the construction layout but would not affect the project boundary. It would not result in any changes to the impact on Aboriginal cultural heritage values, as at this point in time, there are currently no identified values in this area. The proposed alternative northern portal launch site has been subject to archaeological investigations as part of the preparation of the CHMP for the action. These investigations did not result in the identification of Aboriginal cultural heritage.

17.5 Residual impacts

Table 17-7 summarises the residual Aboriginal heritage impacts.

Table 17-7 Summary of residual Aboriginal heritage impacts

Impact	Mitigation	Significance of residual impact
Removal of place	None proposed. The works would be covered by a CHMP which, as discussed in Section 17.4.1, involves consultation with the RAP and Aboriginal Victoria, field and, where appropriate, complex survey, and management measures and contingences in the event that previously unknown items of Aboriginal cultural heritage are uncovered during construction works.	Not significant
Disturbance of place		Not significant
Disturbance of unregistered Aboriginal cultural heritage		Not significant
Damage to Aboriginal cultural heritage from changes to groundwater levels	None	Not significant

18. Historic heritage

18.1 Introduction

Lovell Chen undertook an assessment of the historical heritage impacts of the action on Commonwealth land. This section summarises the assessment's findings.

18.2 Assessment method

18.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 18-1 summarises the other key policies and guidance relevant to the assessment.

Table 18-1 Key legislation, policy and guidance for historic heritage

Policy/ guidance	Relevance
National Heritage List Commonwealth Heritage List	The EPBC Act establishes the NHL and Commonwealth Heritage List (CHL) and sets out the requirements for the management of heritage places on these registers. National Heritage values and Commonwealth Heritage values are defined by the EPBC Act. North East Link would intersect with Commonwealth land at Simpson Barracks, east of Greensborough Road. While not included in the Commonwealth Heritage List, the barracks site has been identified in the draft and unpublished Heritage Assessment for Simpson Barracks (Biosis & ERM, 2017) for the DoD as meeting one or more Commonwealth heritage criteria. In addition, the former residence known as Aldermaston, located on Simpson Barracks, has previously been nominated for the Commonwealth Heritage List (Biosis & ERM, 2017). This report is discussed further in Section 18.3.2.
The Burra Charter (Australia ICOMOS, 2013) Includes practice notes	An industry standard which is frequently referenced as a guide to best practice management of cultural heritage places in Australia is the Australia ICOMOS Burra Charter, 2013 (Burra Charter). It is recognised by the Heritage Council and the Executive Director, Heritage Victoria and is also sometimes referenced by planning authorities. The Burra Charter provides definitions for terms and processes associated with conservation of places of cultural significance and establishes a series of conservation principles, conservation processes and guidelines for conservation practice. It also defines the values that contribute to cultural heritage significance; being aesthetic, historic, scientific, social or spiritual value. The Burra Charter is relevant in providing a philosophical and methodological framework within which heritage can be considered.
Conservation management plans and other heritage assessments	Conservation management plans (CMPs), Heritage Management Plans (HMPs) or alternative forms of heritage assessment reports are typically prepared for places included in the NHL, CHL and Victorian Heritage Register (VHR), as well as for some places of local significance. CMPs and HMPs follow a standard format as endorsed by the Australian Heritage Council, Heritage Victoria or other heritage bodies. The purpose of these plans is to establish the nature and extent of heritage significance and provide guidance on future works and development. CMPs usually are a key reference tool in making decisions on applications for heritage places. No CMPs or HMPs were located for places within the study area. As noted earlier, an unpublished Heritage Assessment for Simpson Barracks (Biosis & ERM, 2017) was available.

18.2.2 Relevant assessment criteria

Impacts on historical heritage are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b), Table 19-1 summarises the performance of North East Link against these criteria.

18.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on the historical heritage on Commonwealth land.

Although direct impacts would occur within the project boundary (see Section 3.1) indirect impacts on heritage may occur beyond this.

Impacts on historic heritage on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks are considered within the project boundary and up to 500 metres from the project boundary as described in Section 4.2.2.

The assessment also examined the impact on the historical heritage value of Simpson Barracks when considered as a single heritage feature.

Historic heritage impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 19-2.

Scope of impacts considered

Within the Commonwealth land, the assessment examined:

- Potential for direct physical impacts from the works on heritage places, including archaeological sites where there is the potential for sub-surface disturbance
- Potential for adverse visual impact on settings or views of heritage places resulting from the proximity or design of new infrastructure
- Potential for damage to heritage buildings and structures from construction vibration or ground settlement
- Potential short and long-term adverse impacts on heritage places form changes to groundwater
- Potential for permanent impact on use of and access to certain ceremonial sites of potential significance within the study area.

18.2.4 Description of environment

The existing conditions description was supported by a combination of desktop research and fieldwork.

Desktop research

The desktop research comprised a review of the existing heritage documentation and historical research of the study area and specific sites.

This has included the current statutory listings and controls, as established under the following acts:

- EPBC Act – NHL and CHL
- Heritage Act – Victorian Heritage Register (VHR) and Victorian Heritage Inventory (VHI)
- Planning and Environment Act – HO, SLO, VPO and Environmental Significance Overlays (ESO) in local planning schemes.

A list of relevant municipal, area, thematic, environmental and typological studies was compiled to assist in determining data gaps for the study area, and to inform an understanding of the heritage places and values within the study area. These studies provided information on heritage places with existing controls, as well as places which had been identified as being of potential heritage significance, but had no controls applied. A list of places previously nominated to the VHR was also provided by Heritage Victoria.

A draft heritage assessment for Simpson Barracks (Biosis & ERM, 2017) was reviewed and informs the description of the environment and assessment of impacts presented here. The findings and recommendations from earlier studies for Aldermaston (Woodhead , 2006)and Simpson Barracks (Kinhill, 2000) were reviewed and incorporated into the Biosis and ERM work. These earlier studies were not available in the preparation of this PER.

The following sources were also consulted as part of the desktop research:

- National Trust: Trust of Australia (Victoria) Register: The National Trust is a community organisation which works towards preserving and protecting heritage places. The identification and classification of heritage places by the National Trust does not constitute legal recognition of their significance, or statutory protection. Although the National Trust plays an important role in advocating heritage protection, it is not responsible for issuing heritage or planning permits. No places included to the National Trust register were identified within the PER study area.
- Victorian Heritage Database, an online database containing information about local and state listed heritage places; incorporates the Victorian War Heritage Inventory (VWHI) (a non-statutory database of sites relating to Victoria's war history). Several entries within the VWHI relate to Simpson Barracks.

A land use history of the study area was also prepared to consider the broad patterns of land use and occupation and to inform identification and an understanding of the significance of heritage places within the study area. This history was informed by existing heritage studies, as well as published histories and primary resources including reports, historical photographs and maps.

Fieldwork

Targeted fieldwork was undertaken between December 2017 and June 2018 including places with existing statutory controls and places which had been identified in the desktop study as being of potential heritage value.

Generally, heritage places were viewed externally only and from either the street or from public land. In the case of the Commonwealth land at Simpson Barracks, a more detailed inspection was undertaken in December 2017 and June 2018.

18.2.5 Information sources

Data sources used in the historic heritage assessment are presented in Table 18-2.

Table 18-2 Sources of information used in the assessment

Source type	Reference
Primary sources	
Directories	Sands & McDougall directory, various dates Melway Victoria Government Gazette, accessed via State Library of Victoria
Newspapers	Argus
Maps	Parish plans, Central Plan Office, Land Victoria Melbourne and Metropolitan Board of Works, 160' to 1" plans, 1890-1900s, various locations, held by State Library of Victoria Melbourne and Metropolitan Board of Works, Detail Plans, 1890s-1900s, various locations, held by State Library of Victoria Melbourne and Metropolitan Board of Works, 800' to 1" plan, 1931 held by State Library of Victoria Historic Plan Collection, VPRS 8168, Public Record Office Victoria Vale Collection, State Library of Victoria Geological Survey Office, State Library of Victoria
Images	Land Victoria Historical Aerial Photography Collection 1945 Melbourne Photo-Maps, University of Melbourne Library B6295, National Archives of Australia National Gallery of Victoria National Library of Australia Nillumbik Historical Society Public Record Office Victoria, Flickr State Library of Victoria Airspy, photographic collection, State Library of Victoria Yallambie Wordpress
Archival sources	W Thomas, VPRS 11/P0/10, Item 658, Public Record Office Victoria Probate and Administration Files, VPRS 28/P3/137, Public Record Office Victoria

Source type	Reference
Secondary sources	
Studies and reports	Banyule Heritage Places Study: Volume 1 – An Urban History (Allom Lovell & Associates, 1999) Banyule Heritage Places Study (Allom Lovell & Associates, 1999) Banyule Heritage Places Study – Heritage Areas (Allom Lovell & Associates, John Patrick Pty Ltd, 1999) Biosis and ERM, Heritage Assessment for Simpson Barracks, (unpublished) (Biosis & ERM, 2017) Heidelberg Conservation Study (Graeme Butler & Associates, 1985) Banyule Heritage Review (Context, 2012) Banyule Thematic Environmental History (Context, 2018) Plenty River & Banyule Creek: Landscape Studies for the City of Heidelberg, 1983 (Gerner, 1983) Survey of Post-War Built Heritage in Victoria (Heritage Alliance, 2008)
Published sources	Heidelberg: The Land and Its People, 1838-1900 (Garden, 1972) R Henderson, From Jolimont to Yering and along our Yarra valleys with Neuchatel's bachelor vignerons, Roundabout Pub, Kilsyth, 2006 (Henderson, 2006)
Websites	eMelbourne, Encyclopaedia of Melbourne, University of Melbourne, http://www.emelbourne.net.au/, various pages, accessed February-May 2018 Greensborough Historical Society, <http://www.greensboroughhistorical.org.au/Articles>, accessed 26 April 2018 Heritage Council of Victoria, Victorian Heritage Database, <http://vhd.heritagecouncil.vic.gov.au/>, various pages, accessed various dates February-May 2018 Victorian Places, Monash University, <http://www.victorianplaces.com.au/>, various places, accessed various dates February-May 2018 Yallambie Wordpress, <https://yallambie.wordpress.com>, various pages, accessed various dates February-May 2018

18.2.6 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to historical heritage impacts during construction and operation are listed in Table 18-3.

Table 18-3 Historical heritage assessment method

Phase	Approach
Construction	• Review of the reference project • Identifying impacts on heritage places and associated heritage values • Identifying the measures for mitigation of the identified impacts, and any residual impacts that may occur despite the proposed mitigation. • In all cases, the potential for impact was considered and where a place is not included in impact assessment a reason has been provided. • Consideration has also been given for the potential for construction activities to have an impact on use and access to certain ceremonial sites of potential significance within the study area.

Phase	Approach
Operation	• Consideration has been given to the potential for ongoing changes such as those to groundwater to have an adverse physical impact to heritage places directly or through their environmental setting. These issues are considered based on the relevant specialist technical sections. • Consideration has also been given for the potential for the permanent works and operational environment to have an impact use and access to certain ceremonial sites of potential significance within the study area.

18.2.7 Assumptions

The historical heritage study has involved a combination of desktop investigations, historical research and fieldwork. The following limitations and assumptions are identified:

- The majority of heritage places and buildings were inspected from surrounding roads or public land or are themselves on public land.
- The historical heritage assessment for the PER has relied in large part upon the draft heritage assessment for Simpson Barracks prepared by Biosis and ERM for the Department (November 2017) and the values identified in that study are referenced in this assessment. The report was identified as Draft version 02 and the timing for a final version of the report is not known.
- Specific assessments prepared by the Banyule City Council for the former residence (Aldermaston) within the barracks site were also reviewed. Access for fieldwork was granted to the Simpson Barracks site as a whole. This fieldwork was directed at gaining an understanding of the referenced values in the Biosis and ERM assessment. The full barracks site was not inspected in detail, rather, targeted fieldwork was undertaken, including reviewing the key significant elements in that study (Aldermaston and Building 147) and the western part of the site, where North East Link would be located. In the course of that work, additional features were identified.
- No detailed consultation with barracks or other relevant personnel has yet been undertaken in terms of the specific use and associations of memorials and monuments on the barracks site.

18.2.8 Linked sections

The historic heritage assessment has links to several others described in other sections of this section or other PER technical sections. These links area summarised in Table 18-4.

Table 18-4 Linkages to other assessments

Section	Topic	Link
Section 24	Groundwater	Provides modelling of changes to groundwater which would result from the proposed works.
Section 20	Landscape	Provides consideration of impacts on landscape relevant to setting of heritage.
Section 21	Ground movement	Assesses likely ground movement due to the action on which assessment of impacts on heritage buildings and places in this section are based.

Section	Topic	Link
Section 12	Surface noise and vibration	Assesses potential impacts on existing buildings and structures (including heritage places) due to surface vibration from construction works.
Section 13	Tunnel vibration	Provides an assessment of potential impacts on existing buildings and structures (including heritage places) due to vibration from tunnelling works.
Section 6	Arboriculture	Provides an assessment of the impacts on trees including some trees within heritage places.

18.2.9 Stakeholder consultation

Stakeholders and the community were consulted to support the preparation of the North East Link EES and PER and to inform the development of North East Link and an understanding of potential impacts.

Table 18-5 lists specific engagement activities relating to historical heritage in the PER study area, with more general engagement activities occurring at all stages of North East Link.

Some of these engagement activities occurred before the referral of North East Link under the EPBC Act. However the subjects discussed and information generated were equally relevant to the preparation of the PER.

Table 18-5 Stakeholder engagement undertaken for historical heritage

Stakeholder	When	Matters discussed	Outcome
Meeting with Heritage Victoria	29 March 2018	A range of issues were discussed, including information about existing VHR and VHI places, earlier archaeological investigations and places that are under assessment or had been subject to previous nominations for the VHR.	The discussions confirmed there were no previous nominations within the PER study area.
Meeting with Heidelberg Historical Society (HHS)	29 March 2018	Potential sites of interest broadly in study area, and relevant sources held by HHS.	Information relevant to the PER assessment informed the discussion of historical land use.
Meeting with Banyule City Council and subsequent communications	6 April 2018	Heritage study future strategic work, documentation of potential additional heritage places.	Council officers provided additional information including significant tree spatial and values information, information on Banyule's Banyule Heritage Review 2018 project including a Draft Thematic Environmental History; ecological and cultural heritage assessments of places within the broader area but outside the PER study area, information on significant tree nominations; and assessments and previous nomination of Aldermaston (at Simpson Barracks) to the CHL.

Stakeholder	When	Matters discussed	Outcome
Meeting with Greensborough Historical Society (GHS)	26 April 2018	Relevant sources held by GHS and history of area.	Discussion with three historical society members on history of Greensborough Road environs, Greensborough, Grace Park (Watsonia), and sources available as part of GHS collection. Additional information on War Service Homes area of Watsonia, and early agricultural land use/development.
Consultation by NELP with the DoD	June 2018	Confirmation of the accuracy of draft history, description, use and historical heritage values of Commonwealth land at Simpson Barracks, including information in relation to memorials and other features of potential heritage value on the site.	A reviewed draft of the Historic Heritage EES technical report was provided with some comments provided by the DoD.
Meeting with National Trust of Australia (Victoria)	28 August 2018	Potential for the National Trust to hold other classification files (such as significant landscapes, significant trees) relevant to the historic heritage assessment; other areas of interest to the Trust.	National Trust staff have provided a list of landscapes and other places on which they hold material. This list was reviewed as part of this assessment and no additional places were identified within the PER study area.
Base Manager, Simpson Barracks	8–9 November 2018	Social/historical values and current use and potential impacts of works on three memorials at Simpson Barracks.	Responses were provided by email to a series of questions.

18.3 Existing conditions

18.3.1 Overview of heritage places

There are no heritage places on Commonwealth land within the study area which have been recognised through statutory listing and controls. Unlisted places of heritage significance or potential heritage significance on Commonwealth land are listed below in Table 18-6, with locations displayed in Figure 18-4. No sites of historical archaeology have been identified within the study area.

Table 18-6 Potential heritage places on Commonwealth land

Name	Heritage control/listing	Considered in impact assessment?	Significance
Simpson Barracks (whole of place)	No	Yes	Locally significant
Aldermaston	No Previously nominated for the CHL, but currently ineligible for the priority assessment list, could be re-nominated.	Yes >500 metre from project boundary but included due to potential for visual impacts.	Locally significant
Building 147	No	No, Building 147 is well separated from construction works	Locally significant
Watsonia Simpson Barracks Memorial	No	Yes	Contributing element to the local historical values of Simpson Barracks as a whole. Social significance at a local level.
Assembly Place and Lone Pine Commemorative Plantings	No	Yes	Contributing element to the local historical values of Simpson Barracks as a whole. Social significance at a local level.
138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial	No	Yes	Contributing element to the local historical values of Simpson Barracks as a whole.

18.3.2 Simpson Barracks

As a whole, Simpson Barracks is considered to have a local level of significance.

Land in Section 8 of the Parish of Keelbundora, now the site of Simpson Barracks, was purchased in 1838 by Thomas Wills, and subsequently acquired in 1839 by Thomas Walker (Biosis & ERM, 2017). In 1938, the Australian Army took 100 acres (40 hectares) of the property for training purposes. During World War II, the Army purchased this land, and requisitioned the remainder of Meares' property (an additional 59.5 ha) for training, which it purchased in 1951. By 1945, the Meares had left the property (Biosis & ERM, 2017).

Buildings and structures from the WWII period have been removed and replaced in major construction programs in the 1950s and 1960s and more recently. A portion of the original land acquisition was separated in 1996 for the Streeton Views estate. The majority of buildings on the site are located in the centre and northern parts, within a bushland setting.

The VHWI, a non-statutory register, includes reference to Simpson Barracks as a whole, as well as to two elements within the site, the residence Aldermaston and the Watsonia Simpson Barracks Memorial. These individual places are discussed separately below.

Simpson Barracks as a whole was identified in the Banyule Heritage Review (Context, 2012) as a place requiring further assessment. The unpublished heritage assessment for the DoD (Biosis & ERM, 2017) identified a local level of historical significance applying to the place as a whole. It also identified two individual significant buildings of the site, the residence Aldermaston, and the former communications facility, Building 147. These are discussed separately below. None of the other buildings on the site were assessed as of significance and none of the landscaping was assessed as of significance for historical heritage reasons.

The summary findings of the Biosis & ERM report are as follows:

> *Simpson Barracks as a whole; and Aldermaston and Building 147 at an individual level, meet the CHL threshold at a local level under criterion (a). However much of the heritage significance associated with the associational, technical and rarity aspects of Aldermaston and Building 147 does not apply to the majority of other built assets or Simpson Barracks as a whole. Any HMP prepared for the site should focus on the management of Aldermaston and Building 147 (Biosis & ERM , 2017)*

Simpson Barracks accommodates a range of defence functions and organisational units. As a result, a number of flag stations, memorials, and commemorative elements are found throughout the Commonwealth land area. Although these features were not identified in the unpublished Biosis/ERM draft heritage assessment, it is considered these contribute to the historical values of the place as a whole and may have contemporary social significance to barracks personnel.

The identification of a full inventory of commemorative elements at Simpson Barracks has not been undertaken. Most of these elements are located at considerable distance from North East Link, where no impacts to physical fabric, setting or use would be anticipated.

Three features which are close to North East Link construction works were identified in the desktop study and fieldwork and shown in Figure 18-4. These are:

- Watsonia Simpson Barracks Memorial, north of Blamey Road
- Assembly Place and Lone Pine Commemorative Plantings south of Blamey Road
- 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial, north of Blamey Road.

North East Link would pass through Commonwealth land in an area proximate to the western boundary of the barracks, which was not developed as part of the barracks' use of the site. Since grazing access to these lands was discontinued in the c. 1940s, an extensive area of land along the western boundary has been subject both to natural regeneration as well as planned revegetation works undertaken by the Commonwealth. It has been reported that a portion of that area also served as a nine-hole golf course until the late 1980s.

That area comprises mainly recent vegetation with scattered older gum trees and a small number of large remnant trees that may date from the pre-contact period. Some of these remnant trees are visible along the Greensborough Road edge, others are located within the regenerating stands to the east. While forming part of the barracks complex (found by Biosis and ERM to have a level of historical significance), no specific historical heritage associations or values have been identified with respect to this vegetation.

It is relevant to note that the barracks site has undergone a series of phases of change over its history, having accommodated the construction of new buildings and facilities as well as the adaptation and reuse of many existing structures over the course of its history. The nature of the use of the place in housing a variety of military units and functions has also resulted in frequent change, as units and responsibilities are rotated and reorganised both within the site and to other defence facilities.

The advent and growth of the surrounding suburban areas of Macleod, Watsonia, Yallambie and Rosanna has also principally occurred subsequent to the barracks' initial development as has the related expansion of the Greensborough Highway, on the perimeter of the barracks. These changes have reconfigured the context of the place from the rural pastoral setting it occupied at its initial development during World War II to a densely suburban setting. This has previously included the separation of an area of surplus land from the Commonwealth land holding for the construction of the Streeton Views residential estate.

18.3.3 Aldermaston

The current Barracks complex includes a former residence, Aldermaston (former Ainslie Meares House), constructed in 1936 and incorporated into the barracks in c. 1951. Aldermaston is located in the southern part of the barracks, adjacent to the present-day Streeton Views residential estate.

Aldermaston has been considered to be of low to moderate significance. Sensitivity of the majority of assessments have concluded the place is of local significance, but one assessment, the Heidelberg Conservation Study (Graeme Butler & Associates, 1985) assessed it as of state significance.

The residence was designed by architect Les Forsyth and built by HG White in 1936 as a residence for the family of Dr Ainslie Meares (1910-1986), a pioneering Australian psychiatrist. It is constructed in the Old English style, with decorative panels of clinker brick, steep slate-clad gabled roofs, multi-paned windows and a variety of embellishments. Aspects of the original residential landscape remain, including the tree-lined front drive and turning circle, stone terraced rear garden and remnants of the former orchard. The residence is presently used by the Defence School of Music.

Aldermaston (former Ainslie Meares House) has been the subject of several heritage assessments, for the DoD and the former Heidelberg and Banyule City councils. It was assessed in 1985 (Graeme Butler & Associates, 1985) as of state significance, and in 1999 as of local significance in Banyule Heritage Places Study (Allom Lovell & Associates, 1999). The Banyule Heritage Review (Context, 2012) 36 recommended the place for the CHL. Most recently, the Biosis & ERM assessment identifies Aldermaston as significant at a local level against Commonwealth heritage criteria for historical (a), aesthetic I and associational (g and h) values.

As noted by Biosis & ERM (Biosis & ERM, 2017), the place has been nominated to the CHL (Place ID 106255) but has yet to be assessed or included in the CHL. Aldermaston is also included in the VWHI, a non-statutory register.

The residence is located approximately 500 metres east of the project boundary, on higher ground with some limited views north-east towards the proposed works. At its closest point, North East Link would be separated from Aldermaston by a portion of the Streeton Views residential estate, as well as by the retained bushland.

The residence was constructed on a local high point and would originally have enjoyed substantial views over the surrounding area. However, following development of the barracks and more recent residential development near the residence to the south and west, the broader context of the Aldermaston site has changed.

18.3.4 Building 147

Building 147 is a former satellite communications facility, custom-built in a joint US and Australian venture, and was purpose-built for the operation of a large satellite communications dish antenna, since removed (Biosis & ERM, 2017). It was decommissioned from its communication role in 1995, and subsequently repurposed to house a Signals Museum (Biosis & ERM, 2017)

Building 147 is considered to have low sensitivity reflecting its assessed local level significance.

In the Biosis and ERM heritage assessment, Building 147 was identified under the CHL criteria for historical significance (a) and for its rarity (b), at a local level. According to that assessment, its historical significance relates to its association with the Defence Secure Communications Network (DISCON) program; the building was also assessed as being 'an uncommon example of a United States prefabricated communications building in Australia and specifically Victoria'. The Biosis study notes that 'the removal of the satellite dish limits the interpretation of (the building's) technical significance'.

It is located in the north-east corner of Simpson Barracks, at a distance of approximately one kilometre from the proposed works.

18.3.5 Watsonia Simpson Barracks Memorial

Reference to a 'Watsonia Simpson Barracks Memorial' has been included in the VWHI, a non-statutory register; the reference is thought to refer to the memorial which is located immediately west of the Blamey Road Gatehouse, which was installed c. 1965 (see Figure 18-1).

The Watsonia Simpson Barracks Memorial is considered to be of significance as a contributing element to the local historical values of Simpson Barracks as a whole. It may also have contemporary social value; this value would also be at the local level.

The Simpson Barracks Memorial consists of a maturing Lone Pine tree planted at the head of a small parterre. The parterre consists of a cross-shaped, concrete walled planter raised above a bed of gravel, with the Lone Pine planted above the cross. The cross-shaped planter has been planted with rosemary. The gravel bed is edged with a flush concrete kerb, with a low post-and-chain enclosure. All concrete is white washed, as is the chain and posts. A short flagpole is positioned just to the west of the parterre, adjacent to the footpath.

At the head of the cross-shaped planter, a small plaque is presented on a wedge-shaped plinth. The plaque is of a standard, diamond-shaped design used on other c. 1965 memorials.

The plaque bears a red and white diamond insignia, as well as the torch insignia of the Legacy Clubs. The plaque conflates Aleppo Pine (*Pinus halepensis*) with Turkish Pine (*Pinus brutia*); lone pine plantings have traditionally been cultivated as descendants from the *Pinus halepensis* growing at the Australian War Memorial.

The Watsonia Simpson Barracks Memorial is understood to have been a focus of ANZAC day services at the barracks until the services became too large for this space. These services are now held elsewhere within the barracks.

18.3.6 Assembly Place and Lone Pine Commemorative Plantings

An informal assembly place is located south of the Blamey Road entrance to the barracks. This place is understood to no longer have an official purpose.

The Assembly Place and Lone Pine Commemorative Planting is considered to be of significance as a contributing element to the local historical values of Simpson Barracks as a whole and as an individual element of potential social value to those associated with the barracks; this value would also be at the local level.

A public ANZAC Day Dawn service was previously held at this location until 2016, when public services were discontinued at Simpson Barracks and the barracks' internal service was relocated to another location within the barracks complex. Since then the place has not been used, however a level of contemporary social value may continue to apply to the place and its elements based upon this history of use and the embedded values and expectations attached to the plaques, tree plantings and flagpoles.

The place consists of a sloping lawn terminating at a small constructed mound (see Figure 18-2). A flagpole is located atop the mound, which is framed by two Aleppo Pine (*Pinus halepensis*) trees planted in 2005. Each pine has a plaque at its base, comprised of engraved steel mounted on rough-hewn slabs of bluestone.

The mound, flagpole and relatively young trees are located approximately 95 metres from the Greensborough Road perimeter fence.

18.3.7 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial

This monument appears to date from the c. 1950s, when facilities for the Army Headquarters Signal Regiment were established at the barracks (Biosis & ERM, 2017).

The flag station and memorial are considered to be of significance as a contributing element to the local historical values of Simpson Barracks as a whole and as an element of potential social value to those associated with the barracks and in particular the units affiliated with the feature.

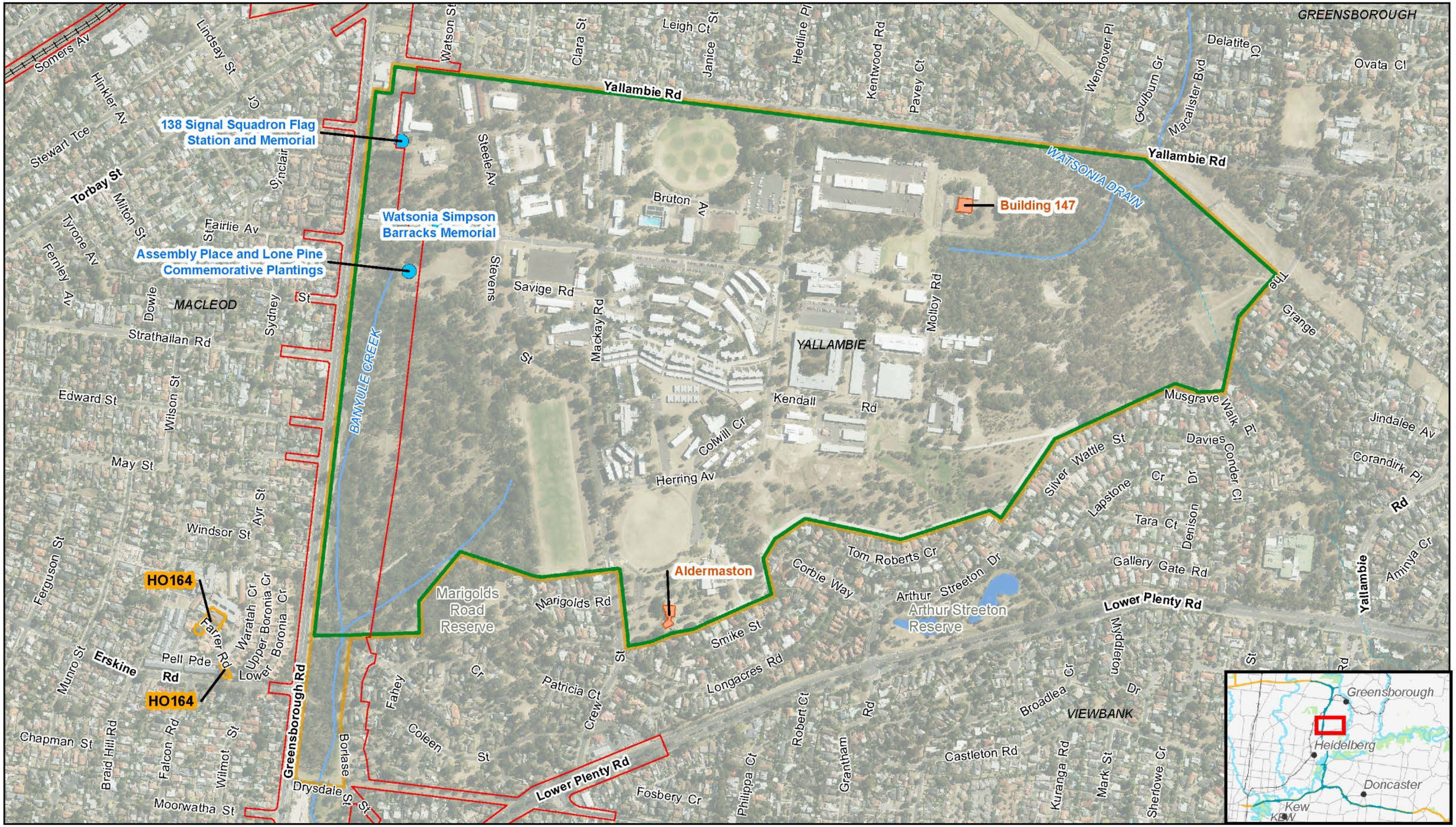
It is used both as a flag station and a memorial by the current 138 Signal Squadron. It comprises a raised mound with random rockwork sides, with a tiled unit insignia set into the walling; the flagstaff sits forward of this. Two large boulders are located at the entry to the monument and these have a series of plaques commemorating servicemen or women who have died (see Figure 18-3).

The flag station and memorial are understood to be in active use.

Figure 18-1 Simpson Barracks Memorial, located to the west of the gatehouse on Blamey Road

Figure 18-2 View to the Assembly Place and Lone Pine commemorative plantings, Simpson Barracks, south of Blamey Road, view from the east

Figure 18-3 Flag station and memorial



Paper Size A4

0 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Barracks fenceline
- Reference Project boundary - surface
- Commonwealth land
- Heritage Overlay
- Potential Heritage Place - Point
- Potential Heritage Place - Building
- Railway
- Stream
- Drain/channel/other
- Lake

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	D
Date	03/04/2019

Heritage features on Commonwealth land

Figure 18-4

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2019 Created by: bkaemmerling

18.4 Relevant impacts and mitigation measures

18.4.1 Planned permanent removal of historic heritage

Impact description

Assembly Place and Lone Pine Commemorative Plantings

While the need to remove the memorial from its current location has not been confirmed, it is assumed that North East Link would directly affect the Assembly Place and Commemorative Plantings, as it is just north of the northern tunnel ventilation structure.

This feature was not identified in the Biosis and ERM heritage assessment of Simpson Barracks as of individual significance within the barracks complex but it is considered to contribute to the overall local historical significance of the barracks and may also have level of contemporary social value for barracks personnel.

Proposed avoidance and mitigation measures

If removal is required, it is recommended Simpson Barracks be consulted in more detail to identify management protocols and any further mitigation measures to enable the elements of the place to be treated appropriately. Depending on the outcome of this consultation, there may be potential to salvage elements of the place. These items would be received by the base on behalf of the DoD. If required, the memorial could be relocated and re-established in an alternative location within the barracks complex, and in that case the values would be retained or recovered.

If relocated for North East Link, an appropriate methodology would be developed consistent with the ICOMOS Burra Charter and with defence protocols. Whether or not the memorial is re-established, it should be recorded before its removal. A museum is located within Simpson Barracks and it may be appropriate for some components of the place (such as brass plates) to be included in its collection.

Residual impact

Based on the contribution of the element to the overall historical values of the barracks as a whole, there would be a minor impact on these values from the removal of this element, if that is required. This impact could be mitigated through a careful and respectful approach to the works to a negligible residual impact.

18.4.2 Damage to historic heritage from construction vibration and ground movement

Impact description

There may be potential for North East Link to impact the memorial features (largely ‘built landscape elements’) close to the project boundary through:

- Vibration associated with construction or operational vibration
- Ground movement caused by excavations.

Simpson Barracks

The assessment of vibration impacts to buildings and structures is described in Section 21.

Impacts from tunnelling vibration, including trench piling and excavation works which would occur in proximity to buildings and built elements at Simpson Barracks are expected to generate a maximum level of vibration of less than 1.5 millimetres per second, below the accepted value for the onset of superficial damage to buildings.

Although the section does not evaluate the potential for impacts to occur to built landscape features, it does specifically evaluate potential impacts to Simpson Barracks Building 1. The west wing of Building 1 is located up to 15 metres closer to North East Link trenching works than the adjacent 138 Signal Squadron Flag Station and Memorial. The vibration study concluded there is no potential for damage to Building 1 from tunnelling vibration. Consequently, no impacts to the 138 Signal Squadron and Flag Station and Memorial or the more distant Watsonia Simpson Barracks Memorial would be expected from the proposed works.

The ground movement assessment (see Section 21) did not evaluate the potential for impacts to occur to constructed landscape elements in the study area, although it does evaluate impacts to Simpson Barracks Building 1, which is located adjacent to the 138 Signal Squadron Flag Station and Memorial and is the closest occupied building to the proposed works. In comparison to the Flag Station, the west wing of Building 1 is located up to 15 metres closer to the main trenching works. The assessment of that section is that ground movement impact to Building 1 would be negligible; this evaluation would be expected to hold true for the adjacent 138 Signal Squadron Flag Station and Memorial and for the more distant Watsonia Simpson Barracks Memorial.

Proposed avoidance and mitigation measures

Mitigation for the impacts of ground borne vibration are described in Section 21 and centre on the development of a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP would identify any heritage buildings or structures that could be impacted by the works and implement appropriate limits or other monitoring and management measures to avoid and minimise impacts.

Mitigation for the impacts of ground movement are described in Section 21. As for vibration, in the event damage does occur, mitigation would include rectification of damage to affected structures or other actions in consultation with the property or asset owner. As related to historical heritage, remediation measures would be to the satisfaction of the Executive Director, Heritage Victoria.

Residual impact

Residual impacts have been assessed as negligible for the assessed places. Ground movement and vibration levels would be monitored as per the mitigation strategies detailed by the respective specialist disciplines; any unexpected impacts to significant buildings or structures would be rectified.

18.4.3 Visual impacts to the setting and sightlines of historical heritage places

Impact description

Simpson Barracks

North East Link would result in physical impacts to the western boundary of the barracks alongside Greensborough Highway and within the adjacent bushland area and creekline, affecting the landscape setting and context of Simpson Barracks, a place assessed as having historical heritage significance at a local level.

While the removal of some woodland trees and placement of permanent infrastructure on Commonwealth land on the western perimeter of the barracks would significantly alter the context for the barracks, the generalised historical values identified for the place as a whole would not be undermined by the change. These impacts would be restricted to the western boundary and to those buildings and facilities to which this area forms a backdrop or context; a fraction of the total complex.

The historical interest in the place as a major defence institution in the local area is not reliant on a particular physical/visual setting and there have been multiple changes to the extent and layout of the place. Additionally, the barracks is a military campus that has developed as an inward-looking community with a degree of anonymity and privacy from its surroundings. Views from within much of the barracks site, and particularly towards the west, are not considered of importance in a heritage context, and there would be little to no impact on the identified values.

Aldermaston

This was identified as a place of potential local heritage significance (and as potential state significance in a 1985 assessment) and within Commonwealth land. The proposed actions, including the construction of the new infrastructure, would not result in impacts to the visual setting of Aldermaston, which is already much altered and reduced from its original physical extent. Views to the house would not be compromised nor would its presentation be affected. To the extent that these might change, views out of the Aldermaston site are not considered to be a heritage issue. There would be no impact from North East Link and this is not further assessed below.

138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial

The 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial would be relatively close to the new infrastructure to the west. The flag station is currently located within the secure perimeter of the barracks and Greensborough Highway is located some distance to its west. The roadway would be in trench at the nearest point to the memorial, although there may be an awareness of the change in context which would occur as the result of the proposed actions, and the potential impact is assessed below.

A change would occur to the immediate context of the flag station where new infrastructure would be located immediately to its west. However, the flag station and memorial does not rely on a defined broader setting of a particular character, and notwithstanding the close proximity of the works, it is not expected the change would pose a challenge to its visual/presentational qualities. A low impact significance has been identified.

Watsonia Simpson Barracks Memorial

Changes would occur to the broad context of the Watsonia Simpson Barracks Memorial, with the construction of the ventilation structure to its south, the focus of activity at and viewsheds to the memorial are to the north. The proposed ventilation structure, while proximate, would not interfere with the direct engagement with the memorial and no visual impact to the immediate setting of this place has been identified. Broader views from this location are already limited and are not relevant to its significance.

Building 147

There would be no impact on the heritage values of Building 147 from the proposed actions and permanent infrastructure of North East Link.

Assembly Place and Commemorative Plantings

It is assumed that the Assembly Place and Commemorative Plantings would be removed. If not, there would be a change to the immediate surrounds of the memorial with the construction of the northern ventilation structure and associated infrastructure with a potentially adverse impact on the visual presentation of the feature. The area is understood not to have been used for ceremonial purposes for several years and would not be expected to be reused for ANZAC day or other services following North East Link construction. The impact would therefore be a visual one, and the identified historical and social values would not be affected.

Proposed avoidance and mitigation measures

While little to no adverse impact on the historical values of the barracks would be expected related to the changes on its western edge, ecological, urban design and landscape elements are proposed that would ameliorate some of the visual impacts to the context through the promotion of new canopy (see Arboriculture in Section 6).

The same works could also address the reinstatement of landscape character close to the Assembly Place and Commemorative Plantings and to the surrounds of the 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial. If the former was not directly removed due to North East Link, further consultation with Simpson Barracks would seek to determine if relocation of this memorial to an alternative location with a more appropriate setting would result in a better heritage outcome.

Residual impact

North East Link would result in some visual impact to the character and setting of the barracks but is expected to have little to no adverse impact on the identified historical values.
The barracks has accommodated a variety of changes over the course of its history, and its capacity to adapt to and integrate further impacts would be expected to continue.

Two memorials would experience a change in their visual context. However, in considering the historical and social values, and the potential for new urban design and landscape reinstatement works, the impacts are limited. In the case of the 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial, little to no residual impact on their values would be expected.

If not directly removed for North East Link, the visual impact on the Assembly Place and Commemorative Plantings – an element in a broader landscaped setting – is likely to be greater, with a low impact significance. The option of relocation of this element could also be considered, resulting in an impact of negligible significance.

18.4.4 Visual impacts of historic heritage value from vegetation changes due to groundwater drawdown

Impact description

Changes to groundwater conditions are addressed in PER Technical Appendix B – Groundwater technical report. Excavation and construction of underground and trenched structures on Commonwealth land would change groundwater conditions, causing short and long-term drawdown of the water table. The current groundwater drawdown modelling in this area shows a drawdown of approximately one to two metres up to 500 metres from the tunnel following excavation and completion of base slab by early 2024. This drawdown increases to three to six metres along the alignment of the tunnel and within 200 metres of the tunnel itself at the end of construction.

The potential for groundwater drawdown to result in impacts to indigenous and cultivated vegetation (such as significant trees) was identified, and this has since been assessed by the appropriate technical disciplines (PER Technical Report – Flora and fauna and in Section 6 Arboriculture).

Within Commonwealth land, a portion of the regenerating Eucalypt woodland along the western boundary of the barracks complex may experience impacts from changes to the groundwater condition. No historical heritage values have been established for this vegetation. However it is part of Simpson Barracks and a characteristic of the layout of the site, and in that context any impacts to historical heritage values are assessed below.

If these impacts occurred, they would contribute to the thinning and alteration of a woodland area which now forms a part of the visual setting of the barracks. However, it is not considered this change would impact the historical values of the place as a major defence complex in the local area.

Exotic vegetation associated with commemorative places on Commonwealth land within the barracks site (particularly the Assembly Place and Commemorative Plantings, the Watsonia Simpson Barracks Memorial and 138 Signal Squadron Flag Station and Memorial), would not be expected to be accessing groundwater resources. The arboriculture assessment concludes that impacts associated with groundwater drawdown are unlikely for exotic trees in cultivation.

Proposed avoidance and mitigation measures

Mitigation related to impacts on vegetation from groundwater drawdown is discussed in Sections 5 and 24 as well as PER Technical Appendix B – Groundwater technical report.

Residual impact

No residual impacts are anticipated.

18.4.5 Impacts to use and access of a historic heritage place during construction

Impact description

North East Link would impact the nature and layout of the secure boundary of Simpson Barracks, and could temporarily alter access arrangements to Blamey Road entry and to features within the complex. Such changes could affect use and access to the following places identified as having potential contemporary social significance within the barracks.

Watsonia Simpson Barracks Memorial

The Watsonia Simpson Barracks Memorial on Blamey Road would be close to the project boundary. However, this memorial is no longer actively used as part of the official ANZAC Day service at Simpson Barracks, and its context has previously undergone substantial changes from the recent development of a new gatehouse facility. The current level of access to this place would be maintained, as would any casual use or private interest in the memorial that may sustain some degree of social attachment or significance for the place. A negligible impact significance has been identified.

138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station

The 138 Signal Squadron (formerly Army Headquarters Signal Regiment) Flag Station and Memorial is actively used and maintained. This place would be in relatively close proximity to the new infrastructure to the west, but no change to use and access to the flag station by defence personnel is anticipated. Based on consultation with the Base Manager at Simpson Barracks, there would be no change to its use or associated activities from works or permanent infrastructure in proximity and the impact is considered low and not significant.

Assembly Place and Commemorative Plantings

This feature is within the project boundary and expected to have no access to it during construction, if it is not removed. However, this memorial is not in active use and if it is retained in situ, visual and physical access to this place would be expected to be reinstated following the completion of works. A negligible impact significance has been identified.

Proposed avoidance and mitigation measures

Further to consultation undertaken to date, Simpson Barracks would be further consulted in relation to the memorials and any required mitigation or management measures.

Residual impact

In the case of all three memorials, residual impacts have been assessed as of low to negligible significance.

18.4.6 Impacts of a northern TBM launch

A northern TBM launch would not change the project boundary and hence no specific additional impacts on historic heritage were identified.

18.5 Residual impacts

Table 18-7 summarises the residual historical heritage impacts.

Table 18-7 Summary of residual historical heritage impacts

Impact	Mitigation	Significance of residual impact
Historic heritage – Planned Permanent Removal	Consultation over protocols for removal or relocation	Not significant
Historic heritage – Damage from construction vibration and ground movement	A CNVMP as discussed in Section 12. A Ground Movement Plan (GMP) as discussed in Section 20.	Not significant
Historical heritage – Visual impacts to the setting and sightlines of heritage places	Mitigation for loss of tree canopy as discussed in relevant sections covering ecological, landscape, and arboricultural mitigation.	Not significant
Historical heritage – Effect on heritage value from vegetation changes due to groundwater drawdown	Groundwater controls as discussed in Sections 5 and 24 as well as PER Technical Appendix B – Groundwater technical report.	Not significant
Historical heritage – Impacts to use and access of a historic heritage place during construction	Further to consultation with Simpson Barracks in relation to access and use of the memorials and any required mitigation or management measures.	Not significant

19. Relevant impacts on culture and heritage

19.1 Simpson Barracks

Table 19-1 summarises the performance of North East Link on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks) on culture and heritage against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b).

Table 19-1 Relevant impacts on culture and heritage – Simpson Barracks

Assessment criteria	Summary of impact
Is there a real chance or possibility that the action will:	
Permanently destroy, remove or substantially alter the fabric (physical material including structural elements and other components, fixtures, contents, and objects) of a heritage place	There are no listed historical heritage places on Commonwealth land in the study area. North East Link would likely require one unlisted historical heritage place to be removed from Simpson Barracks. Consultation would be carried out with the management of Simpson Barracks to identify suitable protocols for removal or relocation. North East Link would require one listed Aboriginal heritage place (scarred tree SAB 9 (7922-0585)) to be removed from Simpson Barracks. However this feature was determined, in consultation with the RAP, to be non-cultural and would be de-listed as part of the ongoing CHMP process, so its removal would not represent a cultural heritage impact. Desk studies (which indicate a high degree of disturbance from development and other land uses) and field evaluation undertaken on Commonwealth land as a part of the preparation of the CHMP indicate that it is unlikely that significant cultural heritage places would be present within Simpson Barracks. In the event that previously unknown items of Aboriginal cultural heritage are uncovered during project works, any discoveries would be managed according to the CHMP which, as discussed in Section 17.4.1, involves consultation with the RAP and Aboriginal Victoria, field and, where appropriate, complex survey, and management measures and contingences.
Involve extension, renovation, or substantial alteration of a heritage place in a manner which is inconsistent with the heritage values of the place	No relevant impacts

Assessment criteria	Summary of impact
Involve the erection of buildings or other structures adjacent to, or within important sight lines of, a heritage place which are inconsistent with the heritage values of the place	North East Link may cause visual impacts to the setting and sightlines of the historical heritage feature 138 Signal Squadron Flag Station and Memorial and to the heritage value of Simpson Barracks as a whole from erection of new structures, including the ventilation structure. These would be cumulative with the impacts of vegetation loss described in Table 7-1. The flag station and memorial does not rely on a defined broader setting of a particular character and the change is not expected to compromise its visual/presentational qualities. The generalised historical values identified for the barracks as a whole would not be undermined by the change. Other heritage values on Simpson Barracks are considered unaffected.
Substantially diminish the heritage value of a heritage place for a community or group for which it is significant	No relevant impacts, beyond those involving potential to inhibit existing uses discussed below.
Substantially alter the setting of a heritage place in a manner which is inconsistent with the heritage values of the place, or	North East Link may cause visual impacts to the historical heritage feature 138 Signal Squadron Flag Station and Memorial and to the heritage value of Simpson Barracks as a whole directly. This is due to removal of vegetation along the western boundary of Simpson Barracks, indirectly from potential groundwater drawdown affecting mature trees and (as discussed above) from the erection of new structures including the ventilation structure. The flag station and memorial does not rely on a defined broader setting of a particular character and the change is not expected to compromise its visual/presentational qualities. The generalised historical values identified for the barracks as a whole would not be undermined by the change. Other heritage values on Simpson Barracks are considered to be unaffected. Aboriginal heritage place 7922-0586 (scarred tree) would be impacted by the project's construction and s close to the area of disturbance (7922-0584 (scarred tree) is located is located close to the area of disturbance. However, both of these places have been and 7922-0586) would either not be impacted or are determined to be a non-cultural item and would be de-listed as part of the CHMP process.
Substantially restrict or inhibit the existing use of a heritage place as a cultural or ceremonial site?	Due to proximity to the project boundary, access to and use of the 138 Signal Squadron Flag station may be affected. Further consultation with Simpson Barracks would occur in relation to access and use of the memorials and any required mitigation or management measures. This is also relevant to the criteria '*substantially change or diminish cultural identity, social organisation or community resources*' discussed in Table 16-1 of Part C People and Communities.

19.2 War Services easement

Table 19-2 summarises the performance of North East Link on Commonwealth land at the War Services easement on culture and heritage against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b).

Table 19-2 Relevant impacts on culture and heritage – War Services Easement

Assessment criteria	Summary of impact
Is there a real chance or possibility that the action will:	
Permanently destroy, remove or substantially alter the fabric (physical material including structural elements and other components, fixtures, contents, and objects) of a heritage place	No places of potential Aboriginal or historic heritage significance were identified on or close to the War Services easement. In the event that previously unknown items of Aboriginal cultural heritage are uncovered during construction, this would be managed according to the CHMP which involves consultation with the RAP and Aboriginal Victoria, field and, where appropriate, complex survey, and management measures and contingences.
Involve extension, renovation, or substantial alteration of a heritage place in a manner which is inconsistent with the heritage values of the place	No relevant impacts
Involve the erection of buildings or other structures adjacent to, or within important sight lines of, a heritage place which are inconsistent with the heritage values of the place	No relevant impacts
Substantially diminish the heritage value of a heritage place for a community or group for which it is significant	No relevant impacts
Substantially alter the setting of a heritage place in a manner which is inconsistent with the heritage values of the place, or	No relevant impacts
Substantially restrict or inhibit the existing use of a heritage place as a cultural or ceremonial site?	No relevant impacts

Part E Landscape and soils

20. Landscape and visual impact

20.1 Introduction

GHD and XURBAN undertook an assessment of the landscape and visual impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

20.2 Assessment method

20.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land.

20.2.2 Relevant assessment criteria

Landscape and visual impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 22-1 summarises the performance of North East Link against these criteria.

The assessment also examines visual impacts on people. Although not specifically mentioned in the PER Guidelines, these are deemed to fall under the criteria '*affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants*' which are discussed in Part C, Table 16-1.

20.2.3 Assessment scope

Study area

The assessment looked specifically at impacts on the landscape of Commonwealth land and the visual impacts on people within the Commonwealth land.

The study area of the assessment is based on the extent of visibility for an assumed height of constructed elements provided in the reference project using conservative maximum height.

The study area comprises the Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, and receptors within it. The extent of impacts within this area is based on the parameters of human vision. The study area extends to where the constructed elements would take up 5 per cent of the 10° cone of view of the central field of view in the human vision. This may extend beyond the 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2).

Landscape and visual impacts on the historical heritage of the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 22-2.

Zone of theoretical visibility

The zone of theoretical visibility (ZTV) is the area around a designated point in the landscape from which that point is theoretically visible. It is calculated using elevation data from a digital elevation model with a spatial resolution of 10 metres. The ZTV does not take into account existing buildings and vegetation that may screen views. The ZTV is therefore, a conservative approach. The ZTV was been calculated on the following parameters:

- Ventilation structure at 30 metres (75 per cent of the design height)
- Noise walls at 50 per cent of the design height for all new walls.

Scope of impacts considered

The assessment looks at landscape and visual impacts on receptors that are on Commonwealth land including:

- Landscape and visual impacts during construction on receptors that are on Commonwealth land
- Ongoing landscape and visual impacts on receptors that are on Commonwealth land from the operation of North East Link.

20.2.4 Description of environment

Landscape character areas for North East Link are based on the physical characteristics within the study area. The characteristics that assist in defining the landscape character areas include geology, vegetation, topography and drainage patterns, as well as the extent of modifications and urban development. Desktop research has also informed these character areas, including a comprehensive review of local council policies and strategies.

Landscape sensitivity is defined as the extent to which the landscape can accept a change of a particular type and scale without unacceptable adverse impacts on its character. Generally, the greater the extent of existing modifications within the landscape, the lesser its sensitivity to change.

The description of the environment is reflected through the human perception of the existing landscape character, instead of the environment in its natural state. The existing landscape character and its sensitivity is therefore defined by the surrounding people and communities.

20.2.5 Information sources

Generally, the landscape and visual impact study was based on direct observations and modelled information of terrain and visibility. Information was also drawn from other technical assessments as set out in Table 20-1.

20.2.6 Impact assessment

The landscape and visual assessment is a tool to identify the effect of change resulting from development and to assess the significance of these impacts. Assessment identifies the impacts on the landscape as a resource in its own right, the impacts on specific views and visual amenity experienced by people.

Landscape character

Landscape character areas for the action are based on the physical characteristics within the study. The characteristics that assist in defining the landscape character include geology, vegetation, topography and drainage patterns, as well as the extent of modifications and urban development.

Landscape sensitivity

Landscape sensitivity is defined as the extent to which the landscape can accept a change of a particular type and scale without unacceptable adverse impacts on its character. Generally, the greater the extent of existing modifications within the landscape, the lesser its sensitivity to change.

The assessment provides a conservative assessment of the visual impact of North East Link. Viewpoints were selected from two locations around the Commonwealth land to give a reflection of the various types of viewer and landscapes located throughout the study area.

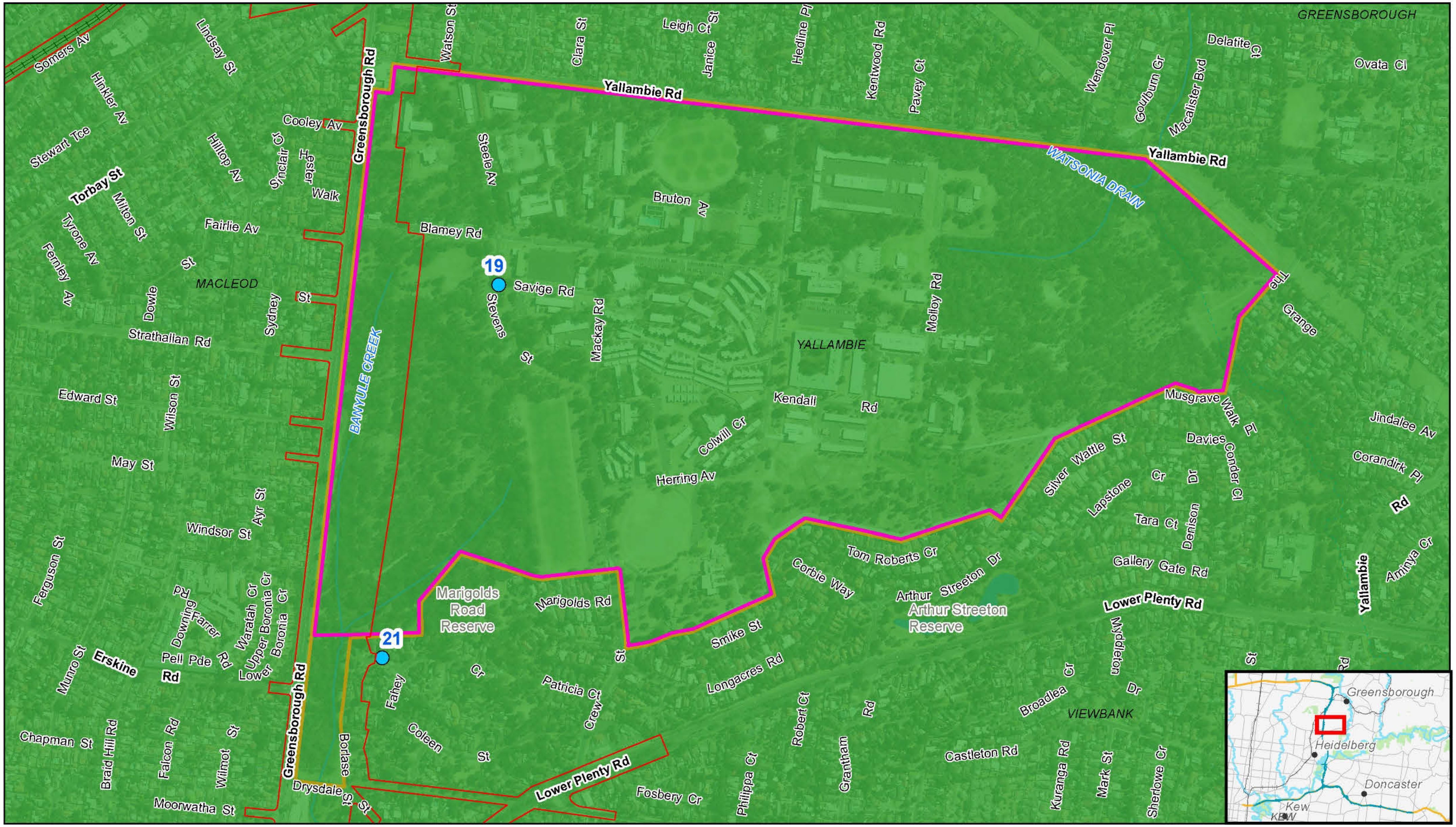
Viewpoints

In assessing the visual impact of North East Link from the Simpson Barracks, the assessment of visual impact is undertaken from a range of viewpoints and is based on four criteria:

- **Visibility** – the visibility of North East Link can be affected by intervening topography, vegetation and buildings.
- **Distance** – the distance of the viewer from the proposed nearest component of the action; the level of visual impact decreases as distance increases.
- **Landscape character and viewer sensitivity** – the character of landscape around North East Link and adjacent to the viewing location must be considered. Generally, a modified landscape is considered to have a low sensitivity and a pristine landscape is considered highly sensitive. Typically, landscapes seen from a residential property or parkland would be given high sensitivity. Local roads and other public places would be given a medium sensitivity, with freeways and industrial precincts given a low sensitivity. Landscape and viewer sensitivity are linked. A viewer in a pristine natural environment has a greater sensitivity than when the same viewer is situated in an industrial area. Public open space viewpoints are assessed as reflecting a high or medium rating for landscape and viewer sensitivity. Public open space viewpoints that are located in a natural setting, such as Bolin Bolin Billabong, would have a high rating and modified open spaces such as sporting fields would have a medium rating, as the main focus of the landscape or viewer is not the landscape setting.
- **Number of viewers** – the level of visual impact decreases where there are fewer people able to view the action. Alternatively, the level of visual impact increases where views are from a recognised vantage point with a larger number of viewers. Simpson Barracks is not publicly accessible and, during normal operations, visual impacts would be expected to affect only a small number of viewers at any given time.

These four criteria have been considered in the assessment of visual impact. However, the ratings of each criterion are not numerically based and cannot be simply added together and averaged to arrive at an overall rating. The overall assessment, based on these ratings, can also change with time. For example, as landscape matures adjacent to the noise walls, their visibility and their visual impact may reduce significantly.

The viewpoints assessed are shown in Figure 20-1.



Paper Size A4

0 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Barracks fenceline
- Character Area - Ridgeline
- Project boundary - surface
- Commonwealth land
- Viewpoints
- Railway
- Stream
- Drain/channel/other
- Lake
- LVIA study area

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

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Revision	B
Date	04/04/2019

Landscape Character Areas and assessment viewpoints

Figure 20-1

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: trighetti

Scale of effects

The scale of effects, for rating the overall visual impact of North East Link from publicly accessible and private domain viewpoints, range from no impact (Nil) to a positive visual impact. Negative visual impacts are graded from negligible to high.

- Nil – there would be no perceptible visual change.
- Positive – would be a visual change that improves the outlook or view.
- Negligible – minute level of effect that is barely discernible over ordinary day-to-day effects. The assessment of a 'negligible' level of visual impact is usually based on distance. That is, North East Link elements would either be at such a distance that when visible in good weather, these elements would be a minute element in the view within a modified landscape, or they would be predominantly screened by intervening topography and vegetation.
- Low – visual impacts that are noticeable but would not cause any significant adverse impacts. The assessment of a 'low' level of visual impact would be derived if the rating of any one of four criteria is assessed as low; that is visibility, distance, viewer numbers and landscape sensitivity. Therefore, North East Link in a landscape which is modified and which already contains many buildings or other similar built form may be rated as a low level of visual impact. Similarly, if the distance from which it is viewed means that its scale is similar to other elements in the landscape it would also be assessed as a low level of visual impact.
- Medium – visual impact occurs when significant effects may be able to be mitigated/remedied. The assessment of a 'medium' visual impact will depend on all four assessment criteria being assessed as higher than 'low'.
- High or adverse effect – extensive adverse effects that cannot be avoided, remedied or mitigated. The assessment of a 'high or adverse effect' from a publicly accessible viewpoint requires the assessment of all four factors to be high. For example, a highly sensitive landscape, viewed by many people, with North East Link in close proximity and largely visible would lead to an assessment of an adverse effect.

20.2.7 Assumptions

Limitations and assumptions associated with this assessment are as follows:

- The Landscape and Visual Impact Assessment (LVIA) is based on a reference project. The reference project is not the final design. In order to assess the built form and landscape visual implications, assumptions have been made as to the urban design and landscape proposals that would eventuate. The urban design and landscape proposals are based on the guidance and requirements outlined in the Urban Design Strategy, the document outlining the project's approach to urban and landscape design. These are outlined in Section 3 of the PER main document.
- The soft landscape proposed would change over time as planting matures. To illustrate this change, viewpoint assessments have been made immediately after construction (Year 0), and year 10, after the freeway construction (including the landscaping) is completed.
- Growth rates for proposed landscaping have been assumed as one metre per year based on best practice plant installation methods such as selection of healthy plant stock, soil preparation (deep ripping, rotary hoe and harrow), best practice planting and allowance for a twelve-month maintenance period including watering.

- During construction and commissioning there would be a number of works that would cause temporary disruption to specific areas. The assessment of the construction compounds is based on the indicative locations shown in the reference project.
- Details of any art installations that form part of the final design are not known and therefore are not assessed in the LVIA.

20.2.8 Linked sections

Table 20-1 lists other technical assessments from which information has been drawn for this study.

Table 20-1 Linkages to other technical assessments

Reference	Topic	Link
Urban Design Strategy	Urban Design and Landscape Strategy	This section is linked with the Urban Design Strategy (UDS). The UDS contains the performance requirements for the built form and landscape elements within the action. The findings from the LVIA have informed the development of the UDS. The UDS provides the urban design project requirements, and establishes the targets and benchmarks which North East Link would be assessed against. The approach to urban design can influence the appearance, form and the ability of the road alignment to sit sensitively in the surrounds. This also includes landscape elements, which can assist North East Link to integrate with the surrounding landscape character and visual environment, and to revegetate and screen proposed new elements. The UDS has been considered in the preparation of the LVIA.
Section 5	Flora and Fauna	Provides an assessment of the potential impacts of North East Link on flora and fauna on Commonwealth land. Findings from the flora and fauna assessment have assisted in the preparation of the existing conditions section of this section, and informed the impact assessment.
Section 8	Land Use Planning	Provides an assessment of the potential impacts of North East Link on land use, and how it aligns with policy in relation to Commonwealth land. Information from the land use planning assessment has assisted in the review of relevant planning policy outcomes and existing conditions. Linkages to land use planning include impacts on landscape values and views, light spill, overshadowing and built form. This has informed the impact sections of this section.
Section 12	Noise and Vibration	Provides an assessment of the potential effects of North East Link on noise levels and noise wall placement on Commonwealth land. Information from the noise and vibration assessment has informed the impact assessment on noise walls in particular.
Section 17	Aboriginal Cultural Heritage	Provides an assessment of the potential effects of North East Link on Aboriginal cultural heritage values on Commonwealth land. Information from the Aboriginal cultural heritage assessment has assisted in the preparation of the existing conditions section of this section, and informed the impact assessment on public domain viewpoints in particular.
Section 18	Historic Heritage	Provides an assessment of the potential effects of North East Link on post contact heritage values on Commonwealth land. Information from the historic heritage assessment has assisted in the preparation of the existing conditions section of this section, and informed the impact assessment on public domain viewpoints in particular.

20.2.9 Stakeholder consultation

Relevant local councils were consulted and invited to provide viewpoints and feedback from community consultation sessions was taken into consideration. Further detail on the consultation program for the PER and the wider North East Link project are provided in Chapter 14 of the PER main document.

20.3 Description of the environment

20.3.1 Geology

A map of the local topography is presented in Figure 20-2. The geology of the area is described in Section 24.2.1. A map of the local geology is presented in Figure 20-2.

20.3.2 Topography and drainage

The topography of the area undulates with ridgelines and shallow valleys, and slopes gradually towards the Yarra River valley to the south. The main drainage feature on the Commonwealth land is Banyule Creek. Further details of this are provided in PER Technical Appendix C – Surface water technical report. Figure 20-3 presents the topography of the local area.

20.3.3 Soil

Soils are generally one to three metres in thickness of top soil underlain by clay (weathered bedrock). In these areas, the alluvial sediments can be absent and the streambed is mostly founded upon weathered basement rocks. However, downstream in the flatter grades, the alluvial sediments may form the streambed materials.

20.3.4 Vegetation cover

The landscape character in which Simpson Barracks lies is primarily suburban with mainly planted vegetation along streets and in people's properties. Vegetation cover on Commonwealth land is more extensive particularly on the western side of Simpson Barracks which is dominated by remnant native vegetation. A map of the vegetation cover is presented in PER Technical Appendix A – Flora and fauna technical report.

20.3.5 Landscape character

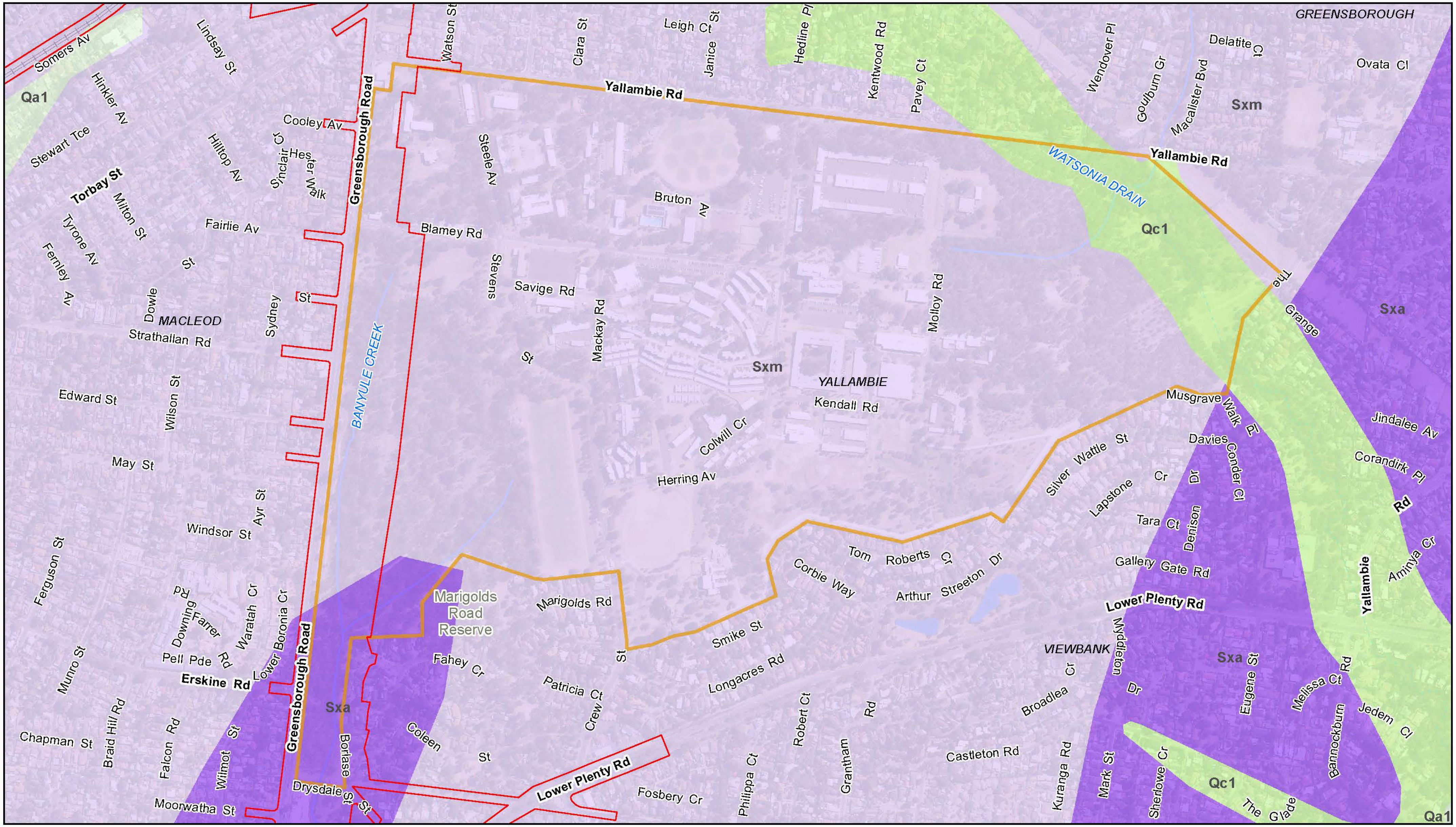
The Commonwealth land is a small component of the areas impacted by North East Link and assessed within the LVIA. As part of this overall assessment a range of landscape character areas were defined. The Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks is within the Ridgeline landscape character area.

The Commonwealth land is seen form Greensborough Road and residential areas to the West of Greensborough Road, as well as by users of Simpson Barracks.

The Ridgeline character area has a distinct suburban residential character set in an elevated topography with schools and aged care facilities. Long views are provided to and from treed ridgelines, with multiple ridgelines present throughout the character area. Simpson Barracks is located along one of the key ridgelines within the character area and the dense, predominately native established vegetation within the barracks provides visual relief from the surrounding urban environment. The Ridgeline character area is shown in Figure 20-1.

20.3.6 Zone of Theoretical Visibility

The ZTV maps those areas from which the elements of North East Link could be seen as shown in Figure 20-4 and Figure 20-5.



Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

Project boundary

- Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake

Geological units (50k)

- Qa1
- Qc1
- Sxa
- Sxm

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	C
Date	25/02/2019

Geology map

Figure 20-2

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

Project boundary

- Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake
- Contour (10m)

North East Link Project
Public Environment Report

Job Number | 31-35006
Revision | C
Date | 25/02/2019

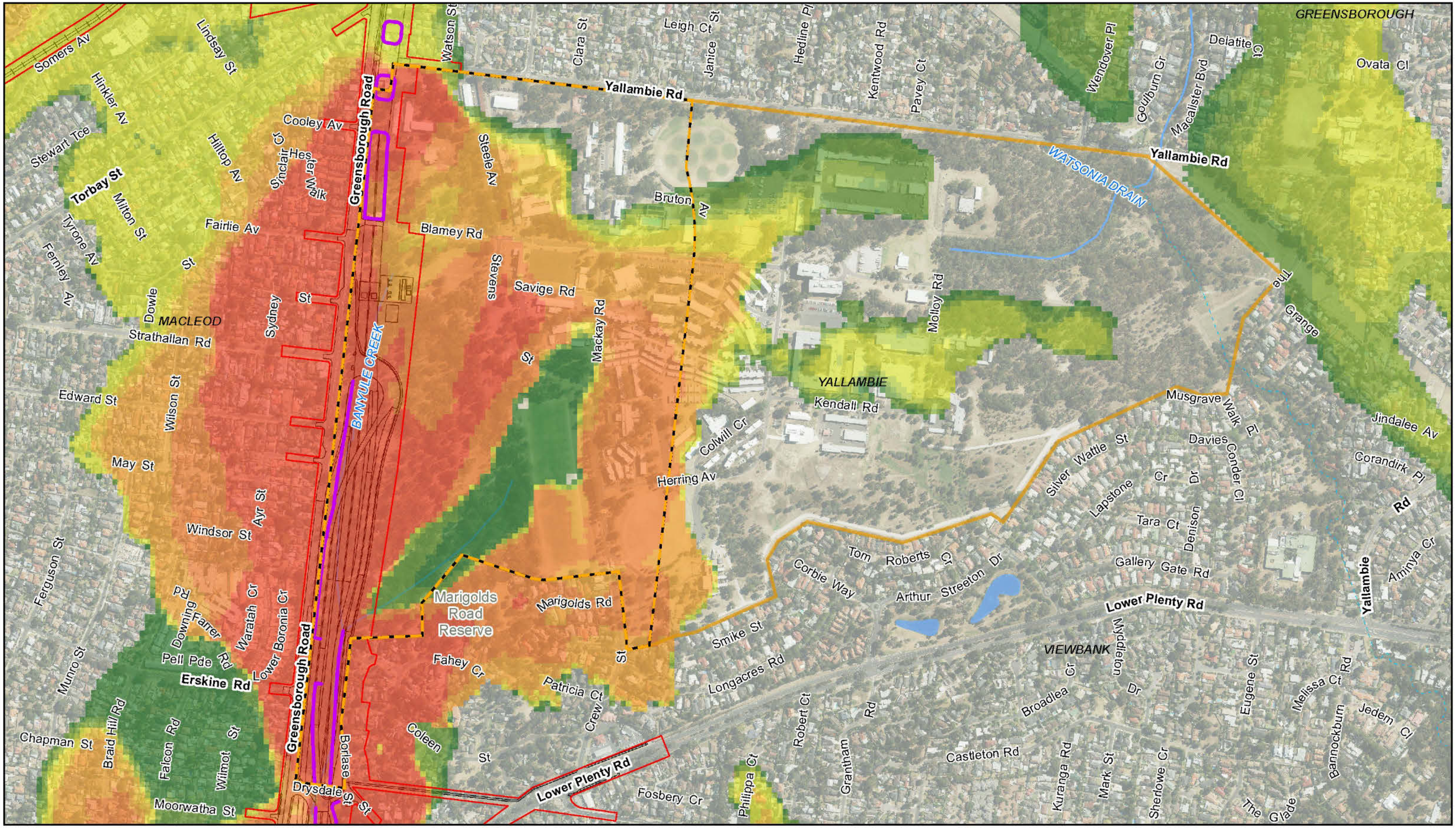
Topography and waterways map

Figure 20-3

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives



Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- PER 500m buffer
- **Project boundary**
- Project boundary - surface
- Commonwealth land
- Proposed reference project
- Railway
- Stream
- Drain/channel/other
- Lake
- Noise Walls

Area of Horizontal Visability

- 1 - 19.4
- 19.4 - 37.8
- 37.8 - 56.2
- 56.2 - 74.6
- 74.6 - 93
- 93.0 - 111.4
- 111.4 - 129.8
- 129.8 - 148.2
- 148.2 - 166.6
- 166.6 - 185

North East Link Project
Public Environment Report

ZTV for noise walls within study area

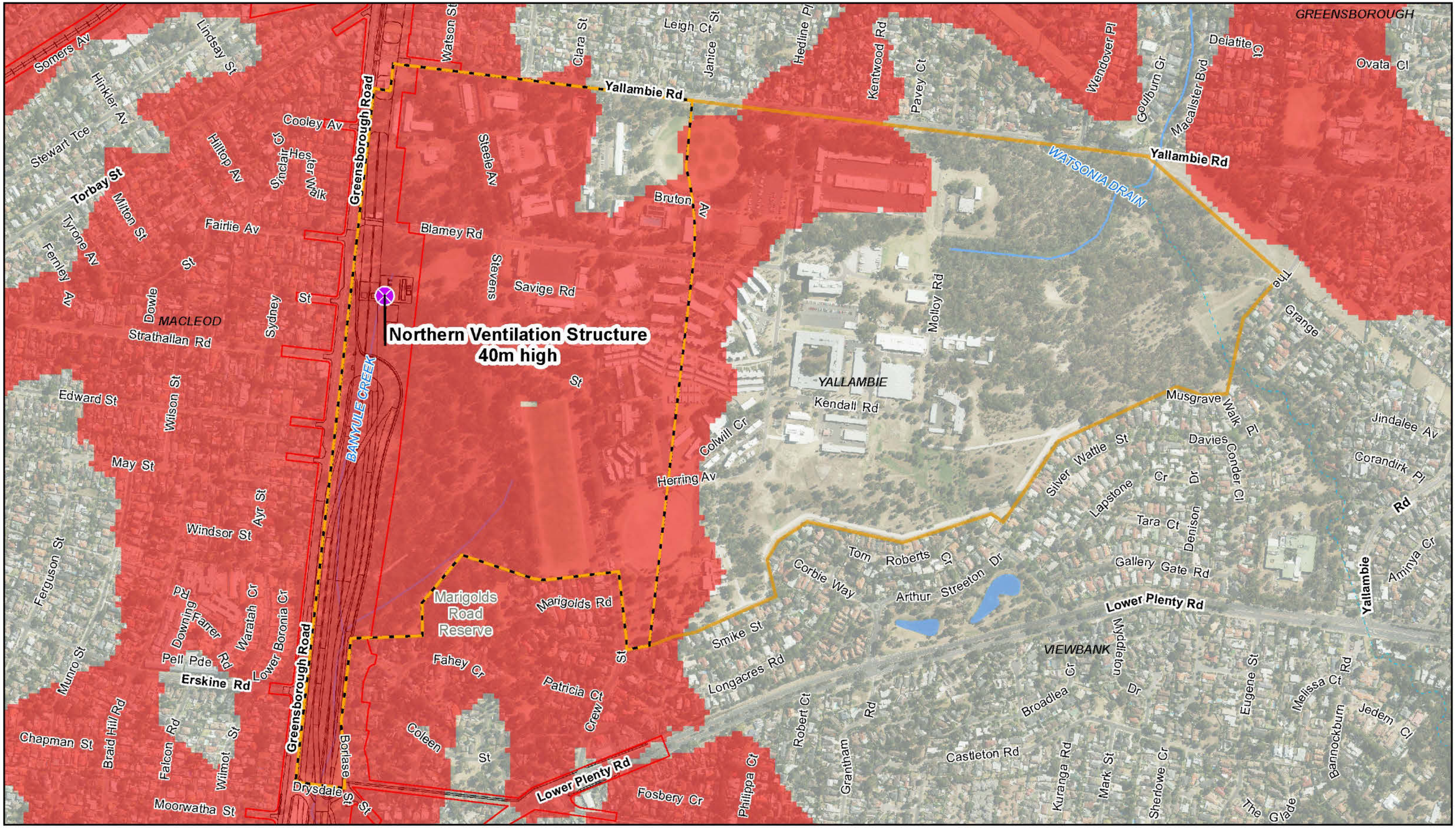
Job Number	31-35006
Revision	C
Date	25/02/2019

Figure 20-4

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives



Paper Size A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- PER 500m buffer
- **Project boundary**
  - Project boundary - surface
  - Commonwealth land
- Proposed reference project
- Railway
- Stream
- Drain/channel/other
- Lake
- Ventilation Structure
- **Zone of Theoretical Visibility**
  - Ventilation structure not visible
  - Ventilation structure visible

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number 31-35006
Revision C
Date 26/02/2019

ZTV for ventilation structure within study area

Figure 20-5

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4L.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

20.4 Relevant impacts and mitigation measures

20.4.1 Visual impacts during construction

Impact description

The main construction impacts would consist of site compounds located within Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks. There would be construction fencing along the boundary of the project boundary.

Viewers located directly adjacent to the construction compounds would have their views to open space interrupted.

Defence personnel within Simpson Barracks are not expected to experience direct views of construction sites and activities due to the densely vegetated buffer between uses within the barracks and project corridor, although they would encounter construction activities entering and leaving the barracks via the Blamey Road entrance.

Indirect impacts would include the potential loss of some vegetation within Simpson Barracks from groundwater drawdown (see Section 5 and Section 24.4.1).

The construction areas would typically be occupied for up to seven years and views would be impacted during this period. The visual impact rating is low for the construction period due to the existing vegetation providing a buffer between the viewers within Simpson Barracks and the construction works.

Proposed avoidance and mitigation measures

Temporary and construction works would need to be designed and carried out in general accordance with the Urban Design Strategy guidance on using design to help manage construction impacts. Areas disturbed by temporary and construction works would be reinstated in consultation with the relevant land manager.

Measures to reduce landscape and visual impact would include, where appropriate:

- Temporary landscaping
- Ensuring that larger features or structures (including viewing portals) are designed, where practicable, to minimise adverse visual impact of construction works and provide visual appeal.

Landscaping enhancement (as part of permanent works) would be implemented where practicable, before construction.

Residual impact

Following implementation of mitigation measures, the residual impacts of any landscape or visual changes on Commonwealth land from the construction of North East Link are not considered to be significant.

20.4.2 Visual impacts during operation

Impact description

Viewpoint –7 – Kay Court, Yallambie

Viewpoint 17 is located along Kay Court in Yallambie. The viewpoint in this location is located approximately 140 metres from the existing Greensborough Road and near the boundary of Simpson Barracks as shown in Figure 20-6.

Figure 20-6 VP17 – Location plan

The current view from this location is of multi-storey residential in the background, established native vegetation in the middle ground and suburban residential street with established street trees in the foreground as shown in Photo 20-1.

Photo 20-1 VP17 – Existing view looking north-west

This is a suburban residential landscape setting where the vegetation is a major element.

The proposed noise wall would be located approximately 80 metres from the viewpoint with a proposed shared use path in front. It has been assumed the existing residential properties in the foreground and vegetation in the background would be removed. The noise wall in this location would be approximately five metres high.

As a result of North East Link, the view would be towards a proposed five-metre high noise wall with landscaping establishing between the noise wall and shared use path.

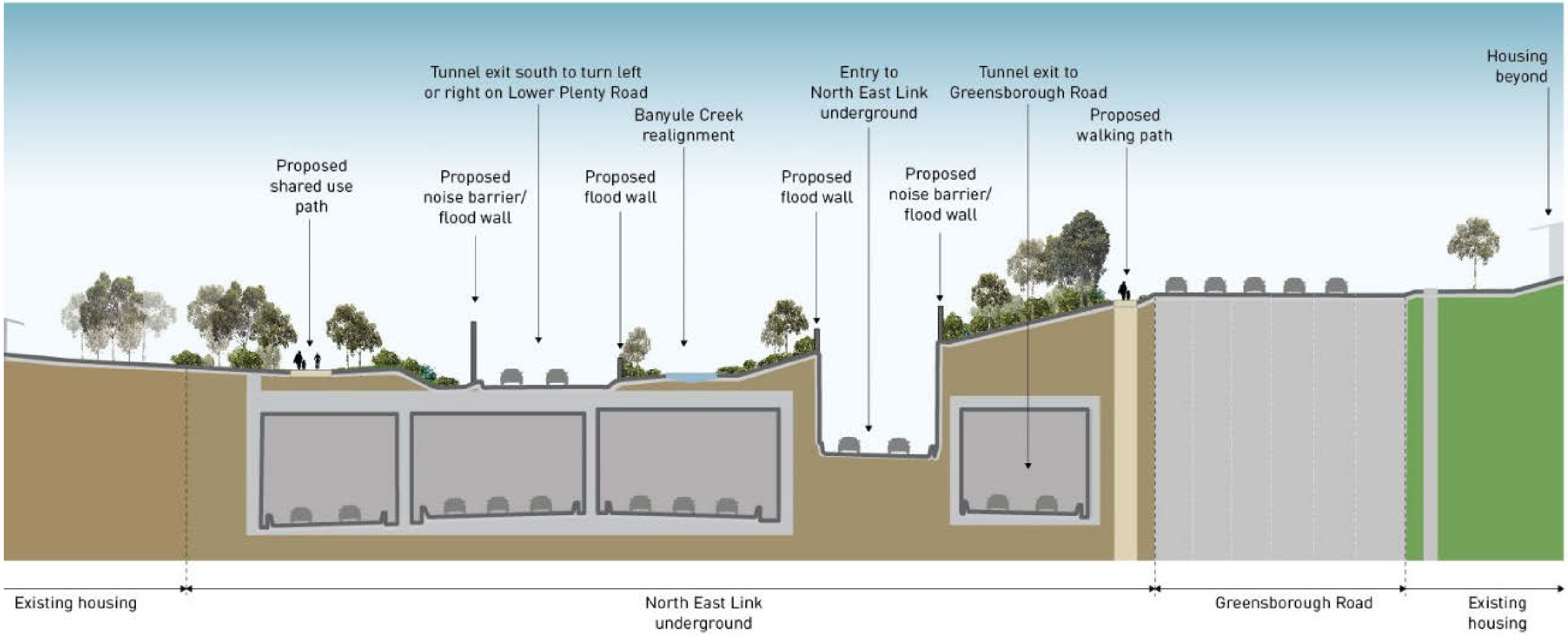


Figure 20-7 VP17 – Landscape treatment section

At this viewpoint, the visual impact is assessed as:

- Year 0 – Low, as the proposed five-metre high noise wall would be visually dominant and there would be a significant visual change in the landscape, but viewer numbers would be low
- Year 10 – Low to negligible, as the landscaping would filter views of the five-metre high noise wall and the landscape setting would be similar to the existing.

The residual impact is assessed as low to negligible, as the landscaping would continue to filter views of the noise wall.

Viewpoint 19 – Simpson Barracks

Viewpoint 19 is located on the footpath at the corner of Savige Road and Stevens Street within Simpson Barracks. This viewpoint is located approximately 274 metres from the existing Greensborough Road edge as shown in Figure 20-8.

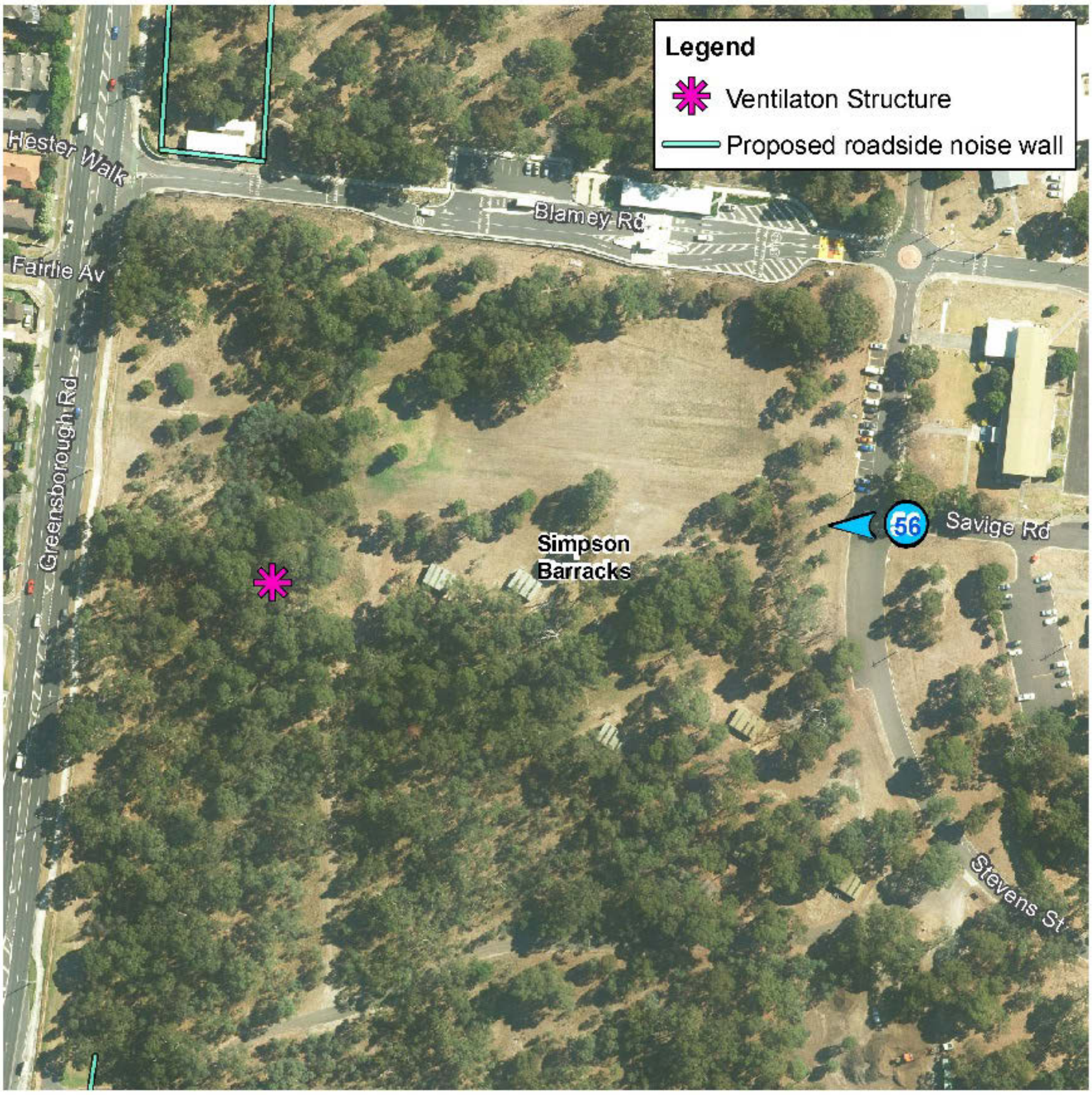


Figure 20-8 VP–9 – Location plan

The current view consists of established native trees on a grassed area sloping down in the background and a t-intersection and overhead power lines in the foreground as shown in Photo 20-2.

Photo 20-2 VP19 – Existing view looking west

This appears as a naturalistic landscape setting in which the existing vegetation is a major element.

The viewpoint is located approximately 160 metres from the proposed ventilation structure and 192 metres from the proposed substation. The existing vegetation and some of the grassed area in the background would be removed. The proposed ventilation structure comprises an eight metre high building and a 40-metre high ventilation structure. The ventilation structure would be a long-term visually dominant element that would directly impact on receptors within Simpson Barracks.

As a result of North East Link, the view would be towards a 40-metre high ventilation structure, eight-metre high associated ventilation building and a substation with existing vegetation retained in the foreground.

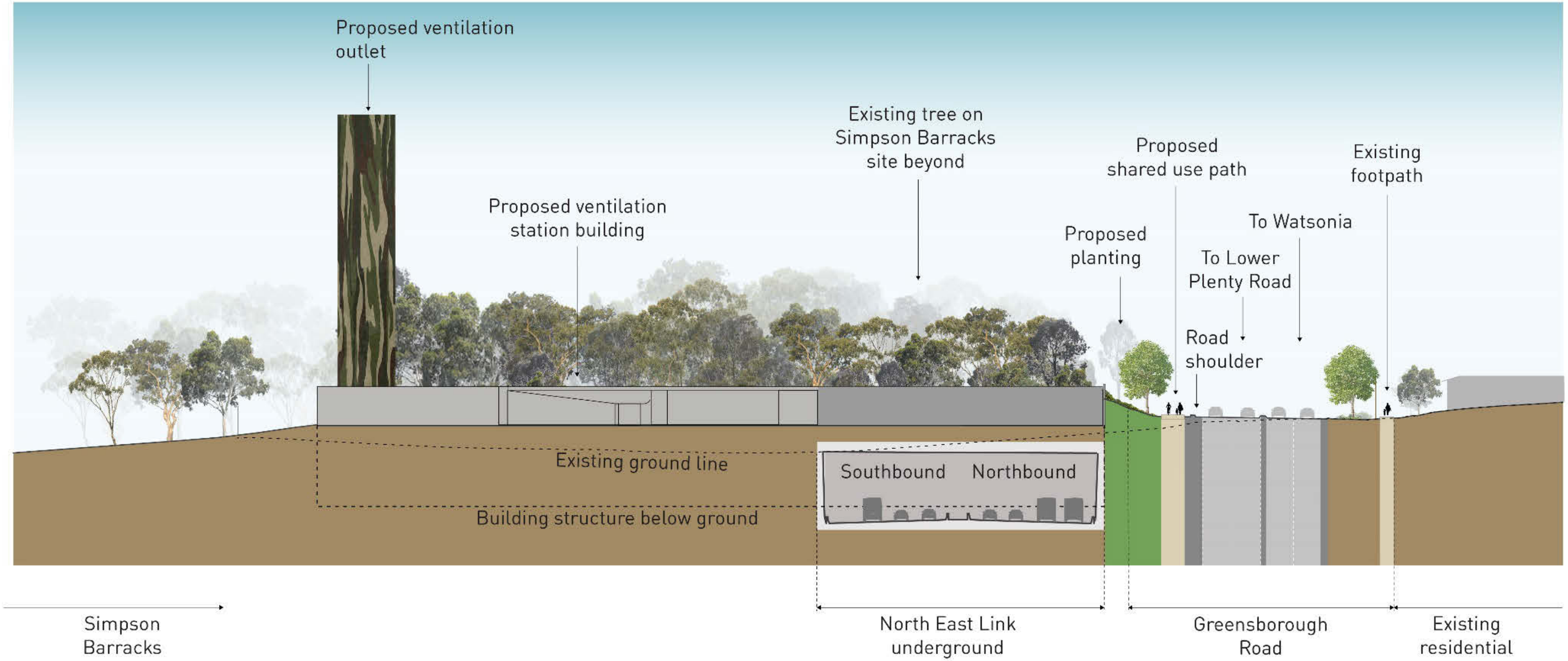


Figure 20-9 VP19 – Landscape treatment section

At this viewpoint, the visual impact is assessed as:

- Year 0 and year 10 – Medium, as the 40-metre high ventilation structure would be visually dominant element and would significantly alter the existing viewpoint, although viewer sensitivity would be medium. The existing vegetation in the foreground would screen the lower half of the ventilation structure and associated ventilation building. If the Urban Design Strategy (UDS) objectives are fulfilled, some viewers may see the ventilation structure as a positive element.

The residual impact is assessed as medium, as the ventilation structure would continue to be a visually dominant element.

Proposed avoidance and mitigation measures

The design of permanent works must avoid or minimise, to the extent practicable, landscape and visual, and overshadowing impacts and be generally in accordance with the project's UDS.

The project's UDS details place-specific requirements that respond to the local context and illustrate how the urban design principles must be addressed at a place-specific level. The place-specific requirements that apply to Simpson Barracks and the immediately adjacent works would help to avoid and minimise any landscape and visual impacts.

Place-specific requirements from the UDS that apply to the study area would help to mitigate any landscape and visual impacts:

- Use screen planting where appropriate to mitigate views to noise walls and road infrastructure
- Improve the landscaping along Greensborough Road by creating an avenue of native shade trees with seating opportunities while maintaining safety for all road users
- Provide additional planting to enhance visual amenity and the existing 'Yallambie-Bundoora Plains' local habitat link
- Maintain and reinforce views from residential areas towards trees where possible; prioritise the retention and enhancement of local views to the Simpson Barracks woodland
- Minimise impacts to Banyule Creek from road infrastructure and enhance and extend the natural values of Banyule Creek to improve appearance, biodiversity, habitat and recreational values.

Residual impact

Following implementation of mitigation measures, the residual impacts of any landscape or visual changes on Commonwealth land from the operation of North East Link are not considered to be significant.

20.4.3 Impacts on the Ridgeline landscape character area

Impact description

The Commonwealth land of Simpson Barracks is within the Ridgeline landscape character area. Simpson Barracks is adjacent to Greensborough Road on the western edge and surrounded by residential areas to the north, east and south.

Construction

Construction of North East Link would require the clearing of 11 hectares of native vegetation along the western edge of Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, which would be replaced by construction compounds surrounded by fencing. This represents approximately 20 per cent of the native vegetation on the Commonwealth land.

Clearance would not involve the complete loss of vegetation on the ridgeline. Banyule Creek would be diverted through culverts on the eastern and western sides of the construction corridor.

Although there is some potential for erosion, this is not considered to have a significant impact on the Ridgeline landscape character area. This is discussed further in Section 23.4.3 and in PER Technical Appendix C – Surface water technical report.

Views from the west would maintain a continual backdrop of native vegetation and views of the construction site from Commonwealth land to the west would be screened or filtered by the vegetation that is retained. The impact on the landscape character would be temporary (up to seven years).

Operation

Although the impacts on the existing landscape take place during construction, at the completion of construction, before planted landscaping has been able to establish, the new infrastructure would be prominent.

However by year 10, planted landscaping would have grown to the point where the above-ground infrastructure (noise walls, ventilation structures) would be screened or softened, and the edges of the vegetated Ridgeline section would have a less abrupt and more natural appearance.

The extent to which the landscape and visual impacts can be reduced would depend on the availability of space for landscaping. Land used for construction on the eastern side of the new carriageway but not required for operation, could be replanted. Any planting on the roof of the cut and cover sections, as well as the proposed land bridges may add up to an additional 8,450 square metres of open space, further reducing the landscape and visual impacts.

Generally post-construction would involve recovery and reinstatement of the existing landscape.

Proposed avoidance and mitigation measures

The place-specific requirements from the Urban Design Strategy (UDS) that apply to the study area are described in Section 20.4.2.

Mitigation related to groundwater drawdown is described in Section 24.4.3.

The UDS includes requirements for the following:

- The design of land bridges and how they would connect visually and physically with adjacent open space. Any barriers on or adjacent to land bridges would need to provide good visual connectivity and minimise obstructing views to the extent practicable.

- The extent of trenches would be minimised and designed to mitigate adverse amenity impacts, with landscape design to reflect local character. Ventilation structures and tunnel portals design would be context sensitive, avoid unnecessary clutter and minimise negative visual impact on the surrounding community. These structures would be sensitively sited and well integrated to minimise negative impact and designed to provide a positive contribution to the local environment.
- Noise walls, flood walls, fences and barriers would be designed to respond to the surrounding areas and integrated with the surrounding environment to minimise visual and physical clutter. Opportunities to use earth embankments and screen planting to mitigate the visual height and bulk of walls are maximised. Transparent barriers would be used to take advantage of existing views, to maximise solar and light access, and to minimise the impacts of reflected coloured light onto private property.

Proposed landscape works would seek to integrate with the existing landscape character. The removal of mature trees and vegetation would be minimised. Landscaping would be used to filter or screen views of road infrastructure and form a visual buffer between the roadway and surrounding areas. Landform would be used to reduce the apparent height of walls, barriers and road infrastructure.

North East Link would be designed generally in accordance with the Urban Design Strategy. Urban Design and Landscape Plans would be developed for permanent above-ground buildings and structures. The design response would, to the extent practicable, minimise landscape and visual impacts and maximise opportunities to enhance public amenity.

Residual impact

Overall the landscape character of the Commonwealth land within the Ridgeline character area would be affected by construction. This landscape and visual impact would reduce during the operation of North East Link as the landscaping matures. There would not be a significant residual impact.

20.4.4 Construction impacts of a northern TBM launch

The proposed alternative northern TBM launch site would occur within the Ridgeline character area. This would add to the construction activity and visual clutter around the Commonwealth land, with adjacent views interrupted by workshops, storage facilities and an acoustic shed for up to seven years. Additionally, the altered construction layout may result in removal of additional vegetation compared with the reference project. However, this would be against a backdrop of a vegetated slope and the additional visual impacts would be minor.

20.5 Residual impacts

Table 20-2 summarises the residual visual impacts.

Table 20-2 Summary of residual visual impacts

Impact	Mitigation	Significance of residual impact
Landscape and visual impacts on receptors that are on Commonwealth during construction	Temporary and construction works would be designed and carried out in general accordance with the UDS guidance on using design to help manage construction impacts. Areas disturbed by temporary and construction works would be reinstated in consultation with the relevant land manager. Measures to reduce landscape and visual impact would include, where appropriate, temporary landscaping and ensuring that larger features or structures (including viewing portals) are designed, where practicable, to minimise adverse visual impact of project works construction works and provide visual appeal. Landscaping enhancement (as part of permanent works) would be implemented, where practicable prior to construction.	Not significant
Ongoing landscape and visual impacts on receptors that are on Commonwealth land from the operation of North East Link	Landscape and visual impacts would be reduced via implementation of the design generally in accordance with the UDS. Permanent works would be designed to avoid or minimise, to the extent practicable, landscape and visual, and overshadowing impacts. Urban Design and Landscape Plans would be developed and implemented for permanent above-ground buildings and structures (excluding preparatory buildings and works) in accordance with the North East Link Project Incorporated Document.	Not significant

21. Ground movement

21.1 Introduction

GHD undertook an assessment of the ground movement impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

21.2 Assessment method

21.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 21-1 summarises the other key policies and guidance relevant to the assessment.

Table 21-1 Key legislation, policy and guidance for ground movement

Policy/guidance	Relevance
Building Response to Tunnelling – case studies from the construction of the Jubilee Line Extension. UK. (Burland, Standing, & Jardine, 2001)	Provides detailed guidance on the staged approach to damage risk assessments for buildings.
Ground Movements and their effects on structures. Surrey University Press. (Attewell PB and Taylor RK, 1984)	Guidance on assessment of buried utilities and pipelines.
Groundwater control design and practice (2nd ed.). Construction Industry Research and Information Association UK (CIRIA) report C750. (Preen, Roberts, & Powrie, 2016)	Guidance on ground movement effects associated with groundwater drawdown.
Guidance on embedded retaining wall design. CIRIA report C760. (Gaba, Hardy, Doughty, Powrie, & Selemetas, 2017)	Guidance on ground movement associated with retaining wall construction.
Building response to excavation induced settlement. (Boscardin & Cording, 1989)	Guidance on estimating settlement effects on face structures.
Australian Standard AS 2870 – 2011 Residential slabs and footings. (Standards Australia, 2011)	Provides guidance on possible foundation details in residential areas. Table C1 provides damage risk category descriptions for walls and Table C2 for concrete floors.
Australian Standard 1726 – Geotechnical Site Investigations. (Standards Australia, 2017)	Australian standard applicable to Geotechnical site investigations. Section 5 of this standard describes the content of a 'geotechnical model' and recommended/typical field investigations.
Australian Standard AS 2566.2 – 2002 Buried Flexible Pipelines (Standards Australia, 2002)	Australian standard applicable to buried flexible utilities. Section 3 provides guidance on 'acceptance criteria' for damage to various pipeline material types.

21.2.2 Relevant assessment criteria

Ground movement impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 22-1 summarises the performance of North East Link against these criteria.

Scope of impacts considered

21.2.3 Assessment scope

Ground movement describes the horizontal or vertical movements due to changes in stress within the ground caused by construction of embankments, excavation for tunnels or excavations for deep cuttings.

Ground movements are not anticipated beyond 500 metres from excavations and so this distance is sufficient to encompass all potential ground movement impacts on Commonwealth land due to the proposed action.

The assessment looked at impacts on integrity and serviceability of structures and utilities on Commonwealth land from construction-related ground movement and, potential consolidation settlement on Commonwealth land caused by construction groundwater drawdown. However, the current geological and hydrogeological data suggests the second mechanism would not be significant in the weathered rock conditions. Thus, the risk of ground movement due to operational groundwater drawdown is considered negligible, and the study focused solely on construction.

Specifically, ground movement impacts were assessed on receptors on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2). Beyond this distance, ground movement impacts would be negligible. This area is further refined by the 'zone of influence', described in Section 21.2.6.

Ground movement impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 22-2.

21.2.4 Description of environment

The existing conditions within the study area were established by a combination of desktop study, geological investigations and field observations. The key aim of the existing conditions review was to provide a baseline assessment of the environment in which receptors potentially sensitive to ground movement are located.

The desktop study included a review of in-house and published geotechnical, geological and hydrogeological information relevant to the study area; a review of inter-disciplinary reports on land usage, heritage places, aerial photography and utilities; and collection of available information relevant on sensitive receptors within the study area. The sources used in this review are presented in Table 21-2.

A field walkover survey was conducted from publicly accessible locations in June 2018 in the publicly accessible Commonwealth land south of Simpson Barracks, although did not enter the restricted area of the barracks. The purpose of the walkover was to classify the typical construction details of the residential housing within the area of interest to inform the ground movement assessments. A specific walkover to examine buildings within the barracks potentially affected by ground movement was undertaken in November 2019.

21.2.5 Information sources

Specific data sources used in the ground movement assessment are presented in Table 21-2.

Table 21-2 Data sources for the ground movement assessment

Source	Type of data
Groundwater data (see Table 21-4)	In-house inter-disciplinary information and research including the results of groundwater drawdown modelling
Victorian Heritage Database and Planning Schemes Online	Heritage places and their relevant listing under the VHR, the VHI or a council Heritage Overlay (HO).
State and council libraries	Historic land use data from council libraries (City of Banyule, web based), historical societies (web based), Land Channel Photo Mosaics Series (Victorian Government)
University of Melbourne's Map Collection	Historical Melbourne aerial photographs from 1945
National Waste Management Database EPA Victoria Publication 1270 (EPA Victoria, 2009) and council reports.	Landfill data
Planning Maps online (Victorian Government, Department of Environment, Land, Water and Planning).	Current land use data
The 'Dial-Before-You-Dig' website, Yarra Valley Water Asset database, Melbourne Water Asset Database and asset owner correspondence.	Utility information
North East Link Project – Geotechnical Factual Report. Draft, Revision B, 19 December 2018.	Factual geotechnical data from NELP investigations. The ongoing geotechnical ground investigations have provided preliminary geotechnical data from boreholes within the footprint to inform the assessment of ground movement.
Vic Roads Geotechnical Assessment North East Link Transport Corridor	Additional geotechnical and geological data was obtained including: • Planning Investigation Department, Report No. MW-91-01-15-01, 25 June 2010 • Vic Roads M80 Ring Road Upgrade Project, Plenty Road to Greensborough Highway, Report No. GR153-05.04.SCI.Rev0, 14 July 2015.

21.2.6 Impact assessment

Specific assessments of structures are undertaken using established engineering principles and methods that consider the particular construction details and condition of the effected structures or utilities.

Sources of ground movement

For the assessment of potential ground movement impacts on the sensitive receptors within the Commonwealth land, two sources of movement were considered:

- Horizontal and (vertical) ground movements occurring behind the trench retaining structures as the excavation proceeds
- Consolidation settlement due to construction dewatering required to enable excavation below the water table.

Other sources of movement such as slope instability, liquefaction, vibration-induced compaction, thermal effects or seasonal ground movement in ‘reactive/expansive’ soils were not considered to present significant risks for North East Link.

For retaining wall structures, such as those proposed within the study area, understanding the nature of the ground to be retained is key to estimating the degree of ground movement that may occur.

In addition, the magnitude of any groundwater pressure present would also play an important part in the magnitude of any wall deflection, which translates to horizontal and vertical movement of the ground behind the wall.

The potential ground movement impacts associated with lowering the water table during de-watering of an excavation are well understood. The current understanding of the ground conditions within the study area suggests the magnitude of any effective stress settlement is very small and so not a significant risk in the study area.

Zone of influence

Having ascertained the expected geometry and ground conditions, calculations were undertaken to determine the magnitude and lateral extent of potential ground movements. These extents can be referred to as the ‘expected zone of influence’.

For practical purposes, a value of five millimetres of settlement (being half the lowest damage category as defined by Rankin in ‘Ground movements resulting from urban tunnelling: predictions and effects (Rankin, 1988) was adopted for the zone of influence. This provided a conservative boundary on which to conduct the assessments and it was found to fall well within the nominal 500-metre radius from the project boundary.

Basis for assessment of ground movement risk

Having assessed the potential extent and magnitude of vertical ground movement in the zone of influence around the proposed works, a staged approach to the assessment of risk to existing structures was adopted in line with international practice.

- **Preliminary assessment** – simplified approach based on the maximum estimated vertical settlement and ground slope (Rankin, 1988). The assessment assumes that surface structures follow the settlement trough shape, with no beneficial interaction effects between the soil and structural foundations.

  For preliminary assessment, those structures that are anticipated to experience less than 10 millimetres of settlement and/or a ground slope of 1:500 are considered by Rankin to be at little risk of damage. Those that exceed these limits (that is, fall with a 'slight' damage risk category or greater) are taken forward to the second stage assessment.

  Rankin's classification also provides some guidance with regards to the risk of damage to buried utilities and services, but reference is also made to recommended criteria proposed by (O'Rouke & Trautmann, 1982).

- **Second stage assessment** – the specific influence of the geometry (section properties) and the Young's Modulus to Shear Modulus ratio of the structure are considered at this stage. Construction sequence may also be taken into account. For buildings, the criteria described in Table 21-3 are used to determine if further assessment is required. Typically, structures falling within the 'Slight' category or less are considered to be at little risk of damage. For utilities and buried structures, an assessment of the tolerable joint rotations, bending and extensional strains, is undertaken case-by-case.

- **Detailed evaluation** – this level of assessment is undertaken if the structure falls within the 'moderate' risk category or greater after second stage assessment.

  Detailed evaluation considers additional factors that would have a bearing on the risk (or consequence) classification. This may include specific details of the building construction, structural condition, the relative stiffness of the structure and the ground, the 3D position of the structure relative to the settlement profile, self-weight of the structure and the development of settlement and strains with construction sequence.

  Where a moderate risk or greater remains after this stage, consideration of specific risk mitigation measures are required.

Figure 21-1 illustrates the phased approach adopted for the assessment of ground movement impacts. The six categories of damage risk for masonry buildings are shown in Table 21-3.

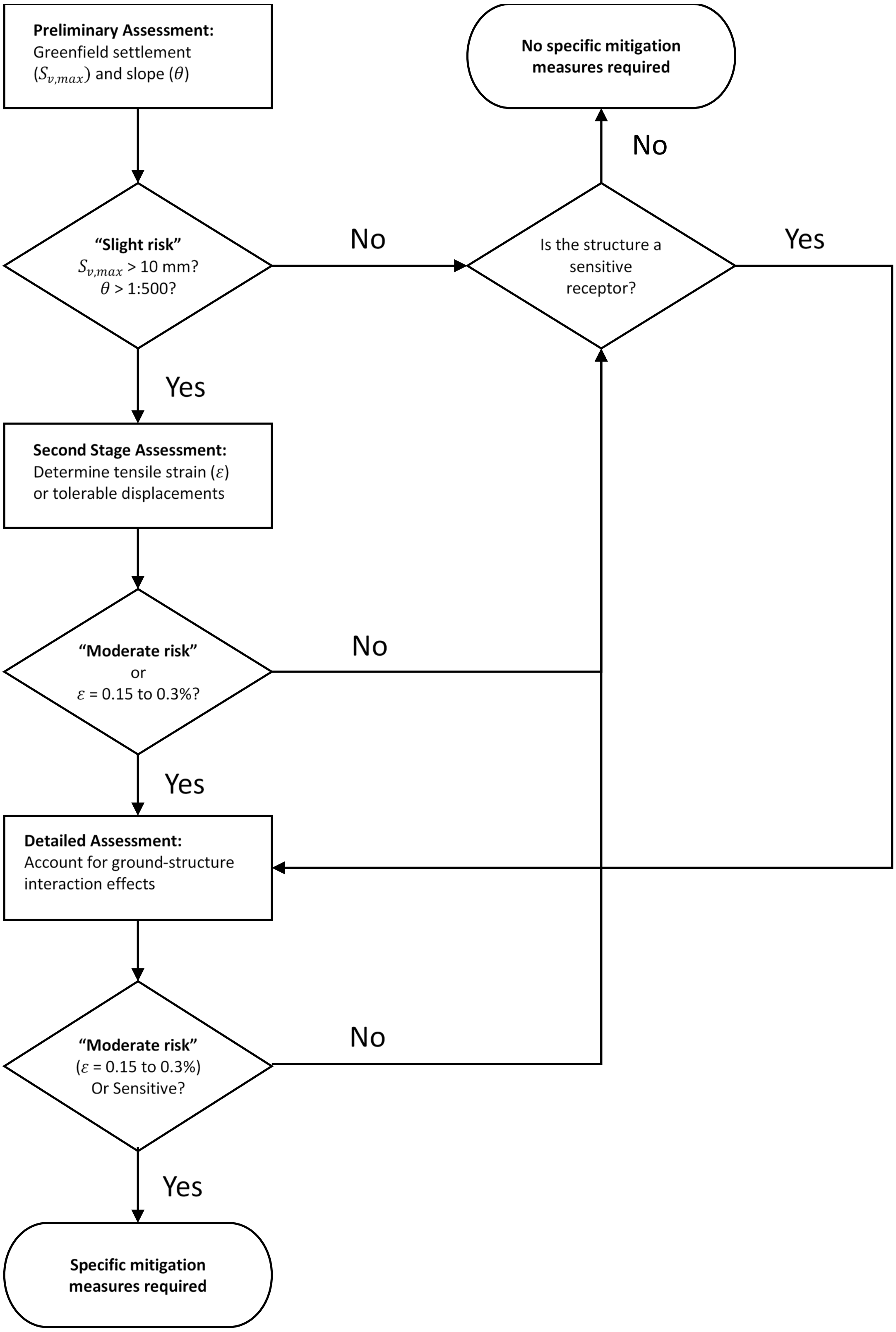


Figure 21-1 Ground movement assessment process

Table 21-3 Damage risk (and consequence) classification as applied to buildings (based on AS 2870 – 2011)

Building damage classification (limiting tensile strain)				
Risk category	Normal degree of severity	Description of typical and likely forms of repair for typical masonry buildings	Approx. crack width (mm)	Limiting tensile strain εlim(%)
0	Negligible	Hairline cracks	< 0.1	< 0.05
1	Very slight	Fine cracks easily treated during normal redecoration. Close inspection may reveal some cracks in external brickwork or masonry.	0–1 – 1.0	0.–5 – 0.075
2	Slight	Cracks easily filled. Redecoration probably required. Some repointing may be required to ensure water-tightness. Doors and windows may stick slightly –1 – 5	0.0–5 – 0.15	
3	Moderate	Cracks may require out and patching. Re-pointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weather tightness often impaired – 5 – 15 or several > 3 mm	0.–5 – 0.3	
4	Severe	Extensive repair involving removal and replacement of sections of walls especially over door and windows. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some loss of bearing in beams. Service pipes disrupted.	–5 – 25 depends on number of cracks	> 0.3
5	Very severe	Major repair required involving partial or complete reconstruction. Beams lose bearing, walls lean badly and required shoring. Windows broken by distortion. Danger of instability.	> 25 depends on number of cracks	> 0.3

21.2.7 Assumptions

The ground movement assessment has been progressed on the findings of the desktop study, ongoing geological investigations and field observations. The following limitations and assumptions are identified:

- Historical aerial photography has identified a former landfill site located outside the south-western boundary of the un-fenced commonwealth land associated with the Simpson Barracks property. There is some uncertainty as to the extents of the landfill area, however from the historical records it is considered unlikely that it extends into the barracks to the north (refer to Section 28 – Contaminated land).
- The ongoing nature of the ground investigation campaign, to support the design of North East Link required that the in-situ ground conditions be estimated based on a potentially incomplete or partial dataset. However, together with the geological data from the rest of the North East Link ground investigation activities, the understanding of the prevailing ground conditions within the study area is considered suitable to determine the potential for significant impacts.
- Access to the Simpson Barracks buildings that fall within the influence zone of ground movement was gained in November 2018 to inspect the buildings closest to the trench excavations and within the zone of influence of ground movement. A request for the construction details of these buildings has been made to the DoD, but a response has not been received to date. As such a number of assumptions have been made in order to undertake the damage risk assessment.

21.2.8 Linked sections

Table 21-4 lists other technical assessments from which information has been drawn for this study.

Table 21-4 Linkages to other assessment

Reference	Topic	Link
PER Technical Appendix B – Groundwater technical report and Section 24	Groundwater	Provides an assessment of North East Link's impacts on groundwater levels, which in turn may contribute to overall ground movement in some circumstances.
Section 18	Historic heritage	Identifies the location of cultural heritage sites that may be affected by ground movement.

21.2.9 Stakeholder consultation

Stakeholders and the community were consulted to support the preparation of the North East Link EES and PER and to inform the development of North East Link and an understanding of potential impacts.

Table 21-5 lists specific engagement activities relating to ground movement, with more general engagement activities occurring at all stages of North East Link.

Table 21-5 Stakeholder engagement undertaken for ground movement

Activity	When	Matters discussed	Outcome
Consultation with Melbourne Water	June 2018	Details of utilities along the project boundary	Details adequate for a preliminary assessment obtained.
DoD	September 2018	Request for construction details of the Simpson Barracks buildings	DoD responded that records for buildings of this vintage are not always available. DoD is commissioning an engineering report of Building 1 (L shape building).
Site walkover of Simpson Barracks	November 2018	Visual inspection of the Simpson Barracks buildings with barracks staff	Confirmation of construction details relevant to the impact assessment.

21.3 Description of the environment

21.3.1 Geology

The anticipated geological conditions within the study area comprise predominantly extremely weathered to highly weathered Silurian bedrock with minor alluvial sediment in the course of Banyule Creek. The Silurian rocks comprise rhythmically interbedded siltstone and fine sandstone. They have been folded on a north to north-east trending axis, faulted and intruded by dykes over geological time (see PER Technical Appendix B – Groundwater technical report).

21.3.2 Hydrogeology

A comprehensive description of the specific hydrogeology of the North East Link alignment is provided in PER Technical Appendix B – Groundwater technical report.

The groundwater quality is saline and varies in depth from five metres to over 10 metres below ground level.

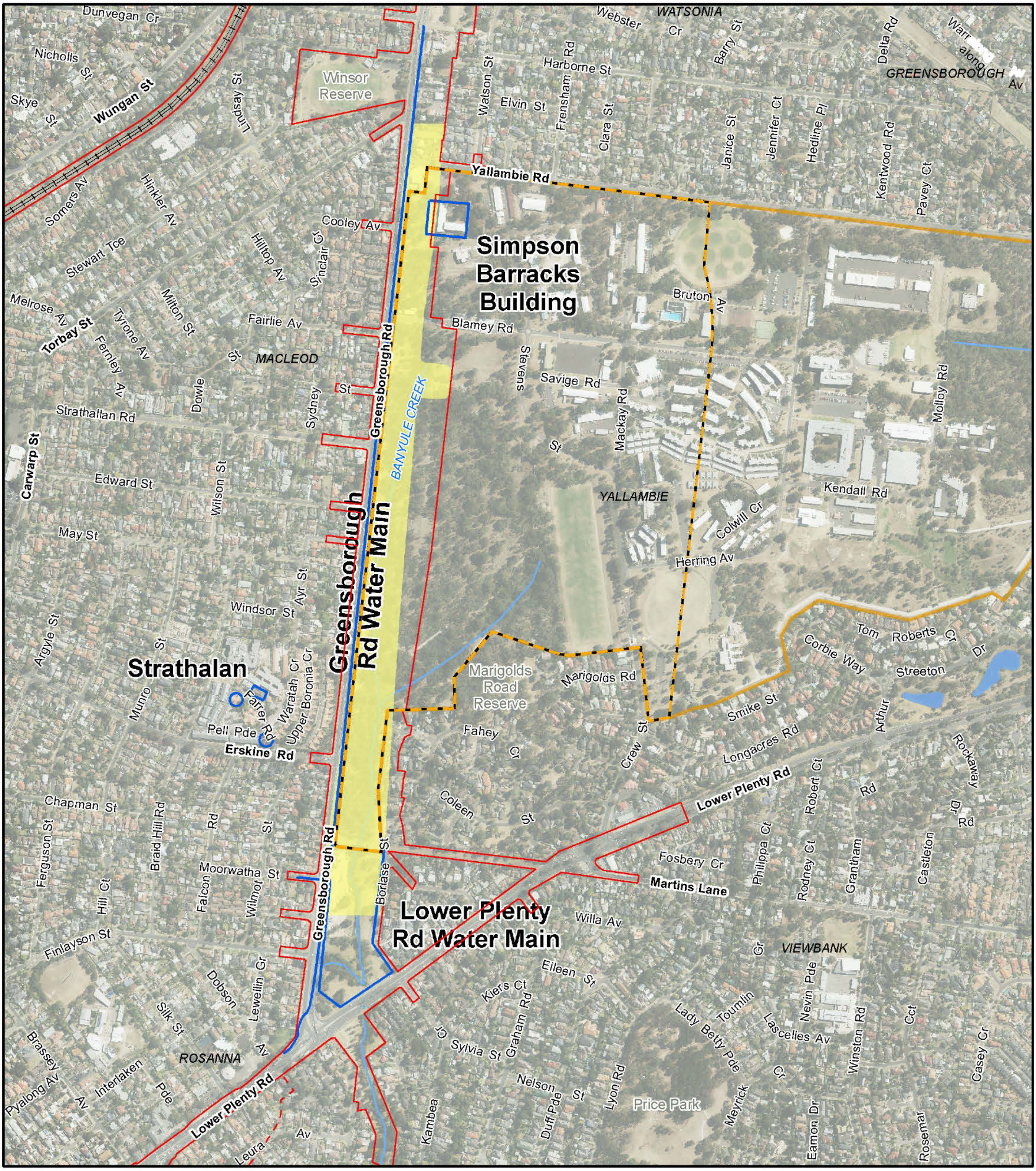
21.3.3 Receptors

Minor utilities

A large number of minor (small diameter) utilities exist within the study area. These utilities typically comprise small local distribution networks of power, water, sewerage, gas and telecommunications lines that service the residential properties within the study area.

Simpson Barracks buildings

The Simpson Barracks (shown as Commonwealth land in Figure 21-2) is located on the eastern side of Greensborough Road, extending from Yallambie Street to Drysdale Street. An L-shaped building and nearby outbuilding are located near the open cut section of the alignment and have the potential to experience adverse impacts as a result of trench excavation works; the outbuilding would experience a higher level of ground movement, being closer to the trench excavation.



Legend

- PER 500m buffer
- **Project boundary**
- Reference Project boundary - sub-surface
- Reference Project boundary - surface
- Commonwealth land
- Railway
- Stream
- Drain/channel/other
- Lake
- Ground Receptors in PER Study Area
- Zone of Influence

Paper Size A4

0 65 130 260

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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North East Link Project
Public Environment Report

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Revision	D
Date	03/04/2019

Ground receptors within the PER Study Area

Figure 21-2

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Datasets - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: bkaemmerling

21.4 Relevant impacts and mitigation measures

21.4.1 Potential impacts from construction related ground movement

Impact description

Within the study area the maximum depth of excavation is approximately 12 metres, with a potential ground movement zone of influence of up to approximately 30 metres from the edge of the excavation. Due to the increasing depth of excavation, the extent of the zone of influence where there is potential for direct impacts on receptors is greatest towards the south of the study area at the publicly accessible Commonwealth land south of Simpson Barracks.

Minor utilities

A number of minor utilities located within the study area transect the zone of influence of ground movement. Utilities such as small diameter sub-surface power or telecommunications services are typically at low risk from settlement damage in all but the most extreme cases of movement, given the relative flexibility of their construction. The same applies to piped utilities such as water, gas and sewerage where the pipe diameter is generally less than 400 millimetres, and where the material used for construction is relatively flexible such as HDPE (High Density Poly-Ethylene, a tough, flexible plastic) or has flexible joints. On this basis, no significant impacts are expected for minor utilities within the study area.

Simpson Barracks buildings

Within Simpson Barracks a main building and nearby outbuilding (understood to be a vehicle workshop) are within the zone of influence (see Figure 21-2). Preliminary assessment of the main building suggests a negligible risk of damage so further assessment of this structure is not warranted. The outbuilding is closer to the cut and cover excavations and so may be directly impacted as it is subject to a higher settlement of 19 millimetres and a ground slope of 1:400, indicating a 'slight' risk of damage.

A visual inspection of the outbuilding structure showed it was a corrugated galvanised sheet clad, steel (portal) frame, with a partially cantilevered roof. The floor of the structure comprised flexible asphalt paving, with the vertical columns assumed to be founded on circular concrete piers. Connections between the columns and the rafter beams are bolted, with web stiffeners located within the rafter beams.

The bolted portal frame structure is considered to be tolerant to ground movement, because it is a relatively flexible structure and the potential for damage can be readily mitigated.
However, the critical section of the building is located at the base of a storage room sited approximately in the centre of the outbuilding. The storage room portal frame is founded on a concrete wall approximately 750 millimetres high. Because as-built construction details are not available, the base has been assumed to comprise a 200-millimetre thick reinforced concrete wall founded on strip footings at a depth of 600 millimetres.

The second stage assessment indicated the wall is within the 'moderate' category of damage risk, suggesting that some repairable cracking may occur within the reinforced concrete structure.

Proposed avoidance and mitigation measures

To minimise the potential for adverse impacts to these structures, a geotechnical model and Ground Movement Plan (GMP) would be prepared and implemented for each structure, including ground movement acceptability criteria and mitigation measures to be implemented in case the criteria are not met. For the Simpson Barracks outbuilding, a pre- and post-construction condition survey is also recommended, subject to obtaining the necessary permissions for access. The GMP would:

- Address the location of structures/assets which may be susceptible to damage by ground movement
- Identify baseline ground movement monitoring before construction
- Identify ground movement impact acceptability criteria
- Identify mitigation measures should the geotechnical model, predictive groundwater model, or subsequent monitoring program indicate acceptability criteria may not be met
- Establish ground movement monitoring requirements for the area surrounding the project boundary to measure ground movement consistency with the anticipated ground movement in the predictive model.

Residual impact

In practical terms, the estimated 19-millimetre settlement and 1:400 ground slope represent movements at the lower end of Rankins ‘slight’ risk of damage category. That is, Rankin proposes that the risk of ‘slight’ damage occurs within a range of 10 to 50 millimetres and 1:500 to 1:200 ground slope. However, on account of the particular geometry of the wall and its position within the settlement profile, the second stage assessment according to Burland, places the wall in a higher damage risk category. However, that assessment does not take into account beneficial impacts of the axial stiffness of the wall or self-weight or the structure, which would significantly mitigate the risk of damage.

It is envisaged that condition surveys and monitoring of actual movements against pre-determined acceptability criteria (‘trigger levels’) would substantially reduce the likelihood the wall would suffer significant damage. In addition, to achieve long-term serviceability, simple remedial measures can be applied (such as re-pointing or resin injection of any visible cracks). Thus, following mitigation measures the residual impact of ground movement on the Simpson Barracks buildings and minor utilities are predicted not to be significant.

21.4.2 Changes to groundwater levels during construction leading to consolidation settlement

Impact description

Excavation and construction of the trenched and cut and cover structures on Commonwealth land would change groundwater levels due to dewatering requirements during construction (see Section 24 and PER Technical Appendix B – Groundwater technical report). Lowering the groundwater level has the potential to result in the ‘effective stress’ settlement of any soft or compressible soil layers within the study area. This settlement could then lead to long-term damage to structures and utilities within the study area.

The current geological information for the study area does not indicate significant soft or compressible soil layers that are at risk of consolidation settlement impacts due to groundwater drawdown. Therefore, as discussed in Section 21, no further assessment was considered to be required.

Proposed avoidance and mitigation measures

No specific mitigation is proposed.

Residual impact

The impacts of changes to groundwater levels during construction leading to consolidation of Commonwealth land are not predicted to be significant (see Section 24).

21.4.3 Construction impacts of a northern TBM launch

The potential ground movement impacts of the alternative TBM launch site have been reviewed. Considering that the alternative launch site does not involve substantial changes to the excavated geometry and so does not change the estimated extents of ground movement, the same recommended mitigation would be effective at minimising ground movement impacts.

21.5 Residual impacts

Table 21-6 summarises the residual impacts on ground movement.

Table 21-6 Summary of residual ground movement impacts

Impact	Mitigation	Significance of residual impact
Potential impacts to utilities and buildings on Commonwealth land from construction related ground movement	A geotechnical model and Ground Movement Plan (GMP) would be prepared and implemented for each structure, including ground movement acceptability criteria and mitigation measures to be implemented in case the criteria are not met. For the Simpson Barracks outbuilding, a pre- and post-construction condition survey is warranted.	Not significant.
Changes to groundwater levels during construction leading to consolidation settlement on Commonwealth land	Current understanding of the geology indicates there is no risk of consolidation settlement, so no specific mitigation measures are proposed.	Not significant

22. Relevant impacts on landscape and soil

22.1 Simpson Barracks

Table 22-1 summarises the performance of North East Link on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks) on landscape and soils against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 22-1 Relevant impacts on landscape and soil – Simpson Barracks

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Substantially alter natural landscape features	The action on Simpson Barracks would disturb and remove what appears as natural landscape features. The landscape and visual assessment looks at the impacts of the action on the landscape of Commonwealth land, which falls within the 'Ridgelines' landscape character area. The wooded western edge of Simpson Barracks which continues southwards into the publicly accessible Commonwealth land south of Simpson Barracks, although classified as native vegetation, is regrowth on a site that in the 1940s was almost entirely cleared of vegetation (see PER Technical Appendix A – Flora and fauna technical report). The vegetation would not be entirely cleared and post construction planting would reduce or minimise the landscape and visual impacts. Banyule Creek, the ephemeral headwaters of which run southwards close to the barracks western boundary, is fed by overland flows and piped and formed surface drains. It is a heavily altered open drain, is steeply graded with erosion control and check dams showing damage with evidence of outflanking. The temporary diversion during construction would use two culverts, but in the long term the channel would be replaced by a well-engineered open flowpath that removes existing erosion problems (see Section 23.4.3 and PER Technical Appendix C – Surface water technical report). In summary, landscape features on the Simpson Barracks would be altered by North East Link but these impacts would be mitigated by landscape and drainage design. However, while natural in appearance the nature and history of the site is such that it is not truly a natural landscape features and North East Link would not have a significant impact on natural landscape features.

Assessment criteria	Impact
Cause subsidence, instability or substantial erosion, or	**Settlement** Excavation of the trench on Simpson Barracks may result in direct settlement within 30 metres of the edge of the excavation. Settlement would potentially affect minor utilities, on which no significant impact is expected, and a single outbuilding on Simpson Barracks which may experience settlement of up to 19 millimetres and have a slight to moderate risk of damage. Following mitigation measures the residual impact of ground movement on the Simpson Barracks buildings and minor utilities is predicted to not be significant. **Erosion** Land clearance and alterations to drainage patters during construction can result in soil erosion and subsequent impacts on water quality. Management of drainage would be a key part of the environmental management of construction activities and would include preventing erosion at source and providing suitable storage and outlet controls to attenuate downstream peak flows. The culverting of Banyule Creek during construction and the improvements to the engineering of the drain during operation would reduce the potential for the erosion that is currently taking place on the upper reaches of Banyule Creek.
Involve medium or large-scale excavation of soil or minerals?	At Simpson Barracks, North East Link would involve excavating a trench approximately 40 metre wide and, at its deepest, approximately 12 metres deep. The excavation is not for mineral extraction and the soil layer is relatively thin (1 to 3 metres) above the weathered bedrock. The material excavated from within Simpson Barracks is a small proportion of the approximately 6.3 million m^3 of spoil that would be generated by North East Link. As discussed in Section 28.4.1, a Spoil Management Plan (SMP) would be developed that would provide guidance for spoil management and disposal during construction to mitigate potential human health and environmental risks. The SMP is based on a waste management hierarchy where landfill disposal is the least favoured option.

22.2 War Services easement

Table 22-2 summarises the performance of North East Link on Commonwealth land at the War Services easement) on landscape and soils against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 22-2 Relevant impacts on landscape and soil – War Services easement

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Substantially alter natural landscape features	The War Services easement is a modified landscape and not considered to be natural. The War Services easement and Frensham SEC Reserve would be occupied for the duration of North East Link's construction, meaning no users of the easement would experience changes to landscape features. Any visual impacts would be temporary and mitigated with temporary landscaping where practicable. At completion of construction, there would be significant visual changes to the War Services easement, as relocated electricity transmission towers, new noise walls and a new shared use overpass would be visually prominent. This impact should be considered in the context of the existing landscape which is dominated by existing electricity transmission towers. The long-term impact is considered to be medium as landscaping would provide some partial screening. It is expected that visual changes would have no impact on the functionality of the War Services easement and Frensham SEC Reserve.
Cause subsidence, instability or substantial erosion, or	**Subsidence and instability** An assessment of ground movement due to North East Link did not identify any impacts on the War Services easement. **Erosion** Removal of vegetation from the War Services easement could result in localised soil erosion and subsequent impacts on water quality. Management of erosion and sedimentation would be a key part of the environmental management of construction activities.
Involve medium or large-scale excavation of soil or minerals?	On the War Services easement, North East Link would involve some minimal excavation associated with the construction of permanent infrastructure. The material excavated from the War Services easement would be negligible in the context of the approximately 6.3 million m^3 of spoil that would be generated by construction of North East Link. A Spoil Management Plan (SMP) would be implemented for spoil management and disposal during construction to mitigate potential human health and environmental risks. The SMP is based on a waste management hierarchy where landfill disposal is the least favoured option.

Part F Water resources

23. Surface water

23.1 Introduction

GHD undertook an assessment of the surface water impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

This section summarises the impacts on surface water on Commonwealth land and provides an assessment against the relevant criteria for water resources from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b) in Table 25-1.

This study also relates to the conclusions presented in Table 30-1 related to the potential impacts of North East Link related to pollutants, chemicals and toxic substances.

As well as impacts on Commonwealth land, the PER Guidelines require *'an assessment of water related impacts and the associated impacts on listed threatened species and ecological communities, and migratory species (or their habitat) dependent on these water resources'.*

PER Technical Appendix C – Surface water technical report provides a more detailed assessment of impacts on Commonwealth land and a broader assessment of water resources in relation to impacts on MNES within the overall EPBC boundary.

23.2 Assessment method

On Simpson Barracks, North East Link may result in impacts beyond Commonwealth land (such as changes to hydrology from works in Simpson Barracks that may impact waterways (Banyule Creek).

Full details of the assessment methodology are provided in PER Technical Appendix C – Surface water technical report.

23.2.1 Assessment scope

Study area

The assessment looked specifically at surface water impacts on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2).

To describe the existing environment, the section describes information about the catchment area of Banyule Creek (in which the impacts would occur).

Surface water impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 25-2.

Scope of impacts considered

There are three main aspects relating to surface water considered in this surface water assessment:

- Flooding
- Water quality
- Geomorphology.

23.2.2 Flooding assessment

Hydrologic and hydraulic modelling was been undertaken for Banyule Creek to identify and map the natural and constructed surface water drainage system. This was developed using RORB (a hydrologic modelling package) and TUFLOW (a two-dimensional hydraulic modelling package), in general accordance with the Melbourne Water guidelines for flood studies.

23.2.3 Water quality monitoring data

Water quality monitoring data has been collected and collated for Banyule Creek, based on water quality data from Melbourne Water, EPA Victoria and Waterwatch.

23.2.4 Geomorphology assessment

Existing geomorphic conditions for Banyule Creek were established by reviewing previous geomorphic assessments and site inspections undertaken on 17 July 2017 and 7 May 2018. Information from these sources was used to determine existing geomorphic conditions with respect to waterway stability for Banyule Creek.

23.3 Description of environment

23.3.1 Water courses

Banyule Creek is an ephemeral stream with a length of approximately four kilometres and serves a catchment of four square kilometres. The creek begins in Simpson Barracks, flows south through the Banyule Swamp area, and discharges into the Yarra River. The majority of the catchment is urbanised with the exception of Simpson Barracks.

Banyule Creek is fed by overland flows and piped and formed surface drains. It is a heavily altered open drain, is steeply graded with erosion control and check dams showing damage with evidence of outflanking. The temporary diversion during construction would use two culverts, but in the long term the channel would be replaced by a well-engineered open flowpath that removes existing erosion problems

23.3.2 Flooding

Detailed hydraulic modelling has been undertaken for Banyule Creek to understand the behaviour of the current flooding. Figure 23-1 provides an overview of the Banyule Creek catchment.

Within Simpson Barracks, the depth of existing flooding is generally less than 0.5 metres, aside from some isolated locations which are estimated to have depths up to one metre in a 1% annual exceedance probability (AEP) event. The elevation of Greensborough Road is higher than the surrounding properties, which results in stormwater flowing south along the western side of the road. In the publicly accessible Commonwealth land south of Simpson Barracks, flood depths greater than two metres are estimated in a 1% AEP event and would extend over Borlase Street into private property. Figure 23-2 shows the 1% AEP peak flood depth for Banyule Creek.

From Drysdale Street to Lower Plenty Road the 1% AEP flood extent is confined to Borlase Reserve. The creek then flows beneath Lower Plenty Road in two 1.6-metre diameter culverts. Downstream of Lower Plenty Road, the estimated flow is mainly confined to the creek reserve with depths of up to two metres.

The timing of the peak flow and water level influences the nature of the flooding within a catchment. Due to the short reach lengths and steep nature of the catchment flash flooding occurs within Banyule Creek, with the peak flow and or water level typically occurring within one to two hours of the rain starting.

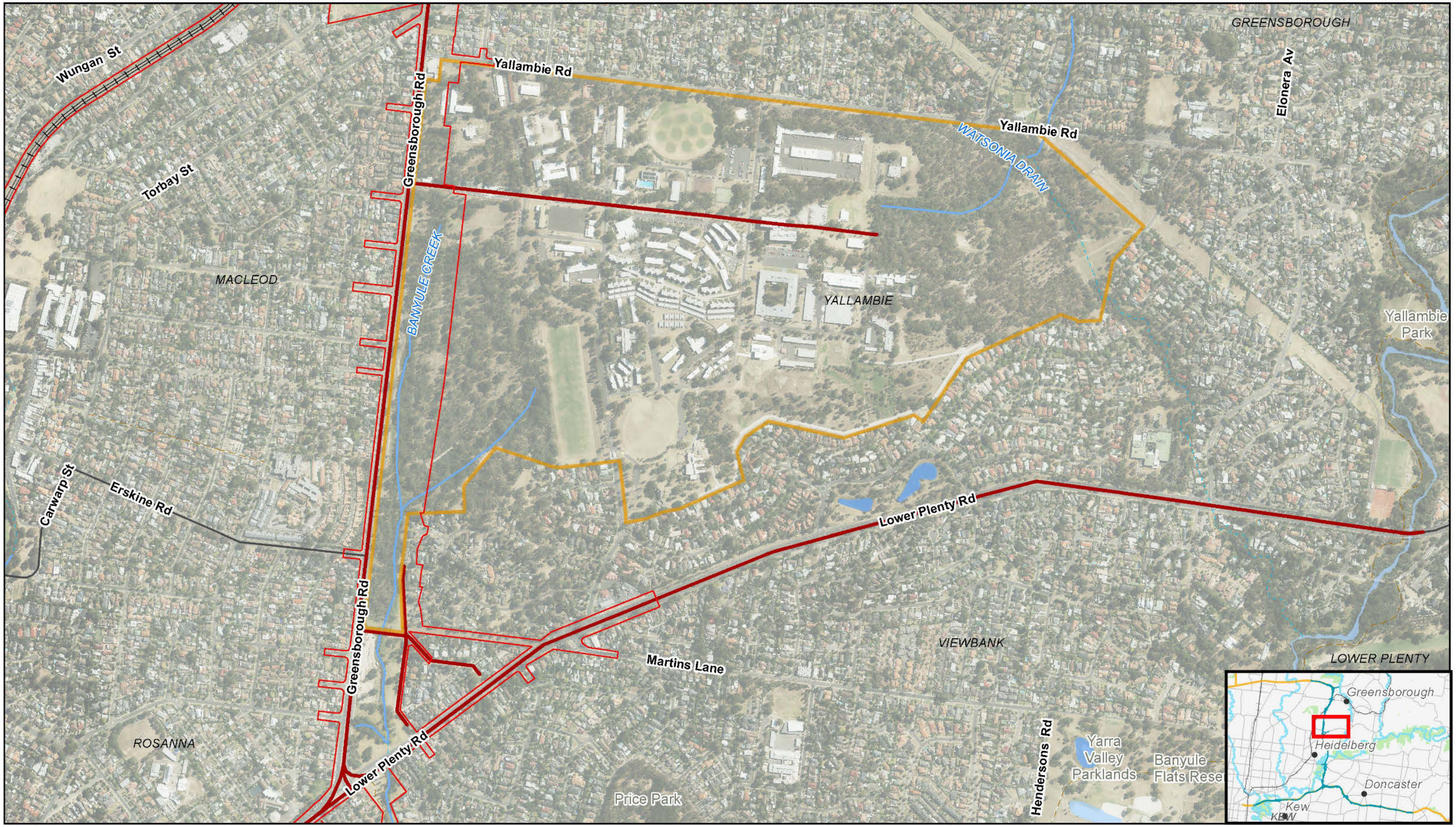
23.3.3 Water quality

Water quality at Banyule Creek was assessed using data from three monitoring stations. Results show dissolved oxygen, pH and turbidity exceeded SEPP (Waters of Victoria) objectives.

23.3.4 Geomorphology

The existing geomorphic conditions for river waterway stability within Banyule Creek have been appraised through observations made during site visits. Within Simpson Barracks, Banyule Creek is described as small incision within the confined floodplain before changing into a more defined creek channel at the site boundary. From the site boundary the channel becomes heavily choked with cumbungi reeds. Immediately downstream of Drysdale Road, the creek becomes more uniform and straightened. From Lower Plenty Road the channel becomes further incised through the residential surrounds.

Further details about Banyule Creek are provided in PER Technical Appendix C – Surface water technical report.



Paper Size A4

0 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Roads of Interest
- Project boundary -sub-surface
- Project boundary -surface
- Commonwealth land

Roads

- Highway
- Major road
- Walking or cycling path
- Railway
- Stream
- Drain/channel/other
- Watercourse
- Lake

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Job Number	31-35006
Revision	B
Date	03/04/2019

Banyule Creek overview

Figure 23-1

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | GW Model Layers - GHD - 2018 Created by: bkaemmerling

Paper Size A4

0 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Project boundary - surface
- Commonwealth land

Peak Flood Depth (m)

- <0.05
- 0.05 - 0.10
- 0.11 - 0.15
- 0.16 - 0.20
- 0.21 - 0.25
- 0.26 - 0.30
- 0.31 - 0.50
- 0.51 - 1.20
- 1.21 - 2.00
- Railway
- Stream
- Drain/channel/other
- Lake

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1% AEP peak flood depth for Banyule Creek

Figure 23-2

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | GW Model Layers - GHD - 2018 Created by: bkaemmerling

23.4 Relevant impacts and mitigation measures

23.4.1 Construction stormwater runoff volume and flooding

Impact description

This section considers the potential for flooding impacts on people, community, infrastructure and assets.

There is potential for increased runoff volumes due to reductions in the rate of infiltration in the catchment during construction. For instance, the temporary removal of vegetation may locally increase runoff volumes. This type of change could be mitigated with rainwater tanks with sufficient event storage. These may potentially provide some opportunity for stormwater reuse.

Construction works would divert both the existing open drain on the east side of Greensborough Bypass and some of the ephemeral flow paths within Simpson Barracks. This has the potential to reduce flow attenuation leading to increases to peak flows.

With such a solution, larger peak flows may extend at least a short distance downstream of the Commonwealth land. Adverse flooding impacts on either Commonwealth land or downstream would be avoided by providing sufficient conveyance to offset any potential increase in peak flows.

The temporary diversion would likely comprise a pipe to the east and to the west of the proposed northern portal to pick up the east and west catchments respectively. It is likely that inlet capacity would be reliant at least in part on the ponding within storages and that inlets would be designed to minimise their potential for blockage. The potential impacts of inlet blockage during a flood event include increased flood levels, velocities and consequently the potential for scour and safety concerns. Although performance of the existing drainage system can be impacted by inlet blockage, the piped diversion is potentially more susceptible to inlet blockage and the design would need to mitigate this risk.

Proposed avoidance and mitigation measures

Mitigation for increased peak flows could involve providing suitable storages and outlet controls designed to attenuate downstream peak flows. Additional storage would be provided and designed to minimise changes to the frequency and magnitude of downstream flows. It is likely that at least some of this mitigation would be provided downstream of the Commonwealth land to the north of Lower Plenty Road.

Potential mitigation measures for inlet blockage may include large inlet grill capacity with downstream orifice to regulate outlet capacity and or design and management of overland bypasses.

Connections with upstream tributary streams and drains would need to be suitably designed to avoid increased tail water which might lead to flooding or reduced tail water levels which without appropriate management may lead to headward and or gully erosion.

Specific requirements that relate to the design development of North East Link include the requirement to mitigate flood impacts during construction (and operation) by:

- Assessing overall flood risk by modelling the design of permanent and temporary works to demonstrate the resultant flood levels and risk profile in accordance with Standards for Infrastructure in Flood-Prone Areas (2019)
- Modelling a range of flood events with varying probabilities and a range of scenarios (such as inlet blockage)

- If significant increases in flood risk are predicted for any events analysed, an overall assessment of flood risk together with proposed mitigation measures would be presented to the relevant drainage authority or asset owner for acceptance, prior to commencement of construction for the relevant section of the works. If there are significant design changes during construction, the model must continue to be updated, as appropriate to represent these changes. Other relevant authorities (such as Simpson Barracks) would be consulted where required.

With these requirements, the design of any pipes or diversions to accommodate surface water flow during construction would need to be sized by the contractor to manage any modelled flooding.

Although likely to be limited by available space, there is sometimes potential for over compensation with respect to providing additional storage and water quality treatment. Given the urban nature of the downstream waterway, a reduction in flooding, particularly overbank flooding may be seen as beneficial. However, in many flood plains there are environmental benefits of overbank flooding, such as the downstream reaches of Banyule Creek where flood flows may occasionally contribute water to Banyule Swamp within Banyule Flats. Although primarily fed from other sources and well over a kilometre downstream, these areas are an example of why mitigation should be thoroughly contemplated and not used to fix existing flooding issues without careful consideration.

Residual impact

With appropriate design and construction management for surface flow, no significant residual impacts on runoff volumes or peak flows are expected on or downstream of the Commonwealth land. With careful design and construction management, the potential impacts of blockage on the performance of the proposed stormwater system would be substantially controlled and remain comparable with those of the existing stormwater system.

23.4.2 Construction stormwater runoff quality and spills

Impact description

This section considers the potential for spills, and mobilisation of pollutants or sediment leading to a reduction in water quality.

In the absence of appropriate best practice controls, construction particularly along or adjacent to waterways or drains increases the risk of spills and the exposure and mobilising sediment and other pollutants in stormwater runoff. While this site is no exception, the diversion of the existing open drain would replace an asset which is actively eroding. The replacement of this actively eroding drain in itself is likely to improve water quality.

Proposed avoidance and mitigation measures

Standard construction measures and approaches for works of this type would be implemented through a Construction Environmental Management Plan (CEMP) and Surface Water Management Plan (SWMP), and would potentially include:

- Hazard prevention (such as offsite servicing to reduce potential for spills)
- Wash down areas
- Bunds around stockpiles
- Sedimentation and or holding ponds

- Construction scheduling
- Careful location and protection of access roads, stockpiles, plant and sheds in combination with detailed construction management plans.

North East Link requirements, the CEMP and SWMP would require ongoing monitoring of upstream and downstream indicators and as necessary refinement of methodologies and approaches to effectively minimise the potential for impacts due to spills or pollution of stormwater runoff. The selection of monitoring methodologies and locations would consider construction methodologies, locations and risks and be developed in consultation with EPA Victoria and the asset owner/manager.

It is possible that some water quality treatment measures to manage potential water quality impacts originating on or contributed by works on Commonwealth land would be located downstream of the Commonwealth land so that unmitigated impacts would likely extend at least a short distance downstream of the Commonwealth land.

Residual impact

With appropriate design, construction methodologies and risk management, no significant adverse residual impacts are expected on Commonwealth land during construction and some improvement in water quality is possible even during construction.

23.4.3 Erosion impacts on waterway stability, habitat and water quality

Impact description

Changes to surface drainage create the potential for erosion to bed or banks resulting in the undermining of assets, with potential to impact on habitat and water quality. The most significant erosion is currently occurring in the drain on the east side of the Greensborough Bypass. Minor erosion elsewhere has less potential to destabilise assets.

Construction works which divert the eroding open drain are expected to replace it with a properly engineered solution significantly improving waterway stability. Although the duration of construction would likely be seven years, for the majority of this time the diversions, bunding and other 'temporary' features would be in place and operating effectively to minimise any adverse impacts.

The greatest risks in terms of waterway stability and water quality would be over a relatively short period while the diversions are being initially constructed and brought into service. There is a potential for perceived impacts on Banyule Creek due to existing bank erosion, particularly a section of bank just downstream of Lower Plenty Road.

Proposed avoidance and mitigation measures

Mitigation for erosion is described in Section 23.4.1.

Residual impact

With appropriate mitigation measures in place to control flooding related impacts it is expected there would be no significant change in the residual erosion potential to the waterways downstream of the Commonwealth land. Stability of waterways on Commonwealth land would likely improve.

23.4.4 Operational stormwater runoff volume and flooding

Impact description

Changes to surface drainage create the potential for flooding impacts on people, community, infrastructure and assets. There is minimal potential for permanent increased runoff volumes due to reductions in the perviousness of the catchment during operation. If there were significant changes to runoff volumes, these could be mitigated with rainwater tanks with sufficient event storage and would potentially provide some opportunity as a source of stormwater for reuse.

Proposed avoidance and mitigation measures

Taking into account the design requirements discussed in Section 23.4.1, the design of any pipes or diversions to accommodate surface water flow during operation would need to be sized by the contractor to manage flood flows and risks.

Residual impact

During operation, the constructed flow paths, which would include flood barriers and storages, would be required to perform in accordance with North East Link and drainage authority requirements and so are predicted to have a negligible impact on flooding.

23.4.5 Operational stormwater runoff quality and spills

Impact description

There is potential for impacts on surface water quality from spills, and mobilisation of pollutants or sediment leading to a reduction in water quality. Increased paved surfaces from new roads and infrastructure would increase surface water run-off, with a higher pollutant load which can impact water quality. In addition, North East Link would be located in a metropolitan area where there is limited land available for retarding basins, wetlands and other drainage features to treat additional surface water run-off.

Proposed avoidance and mitigation measures

During operation, a number of controls including emergency response plans and spill containment facilities in accordance with AustRoads requirements would be provided to reduce the potential for adverse water quality impacts from spills.

During operation, pollutants from vehicles mobilised by stormwater would pass through treatment trains before discharging to the receiving waterways.

Residual impact

The combination of active management, physical spill capture and treatment trains provides a high level of protection, which modelling indicates would be effective in achieving best practice objectives, and an improvement on the performance of the current infrastructure.

23.4.6 Operational erosion impacts on waterway stability, habitat and water quality

Impact description

Changes to surface drainage create the potential for erosion to bed or banks resulting in the undermining of assets, with potential to impact habitat and water quality.

Under existing conditions, the most significant erosion is currently occurring in the drain on the east side of the Greensborough Bypass. Minor erosion elsewhere has less potential to destabilise assets.

Proposed avoidance and mitigation measures

Once construction is complete and North East Link was operating, the actively eroding drain would be replaced by a well-engineered flowpath. Replacement of this problematic eroding drain in combination with the storages and treatment trains would increase waterway stability, the security of adjacent structures, habitat and improve downstream water quality by reducing sediment loads.

Residual impact

During operation, it is anticipated that bank erosion downstream of Lower Plenty Road would continue until works are undertaken to stabilise this existing issue. It is expected the operation of North East Link would not adversely affect waterway stability along any of the major waterways, including Banyule Creek and the Yarra River.

23.4.7 Construction impacts of a northern TBM launch

The potential surface water impacts of the alternative TBM launch site have been reviewed. While no long-term operational impacts are anticipated, there is potential for the alternative TBM launch site to result in impacts during construction, particularly with respect to flood flows along Banyule Creek to the north of Lower Plenty Road.

To minimise potential flood impacts, the Construction Environmental Management Plan (CEMP) would include requirements to maintain flow characteristics to prevent flood impacts. Modelling the proposed layout of compounds before construction would allow for identification of issues and associated contingency measures to satisfy the requirements of the relevant drainage authority. Furthermore, waterway modifications would have to be designed to mitigate the impacts of changes to flow.

The limited space at this location and operations within an ephemeral flood plain would be carefully considered, planned and implemented to minimise impacts and manage the potential construction risks. Consideration of the modelling results and a range of design concepts indicates there is a feasible surface water solution for the northern alternative TMB launch site although it would require careful planning, analysis, detailing and implementation to maintain an acceptable surface water outcome throughout construction and may result in more severe constraints on stockpile configurations.

Modelling of the area within the project boundary indicates that although it may be feasible to construct diversion pipes of sufficient capacity, it would be challenging to capture and attenuate these flows. Although both of these challenges can be addressed, space is very limited at this location and the viability of a solution would rely on a very tight integration of the drainage and other civil requirements.

Further development and integration of the design solution in consultation with the relevant drainage authority would be required during detailed design.

23.5 Residual impacts

Table 23-1 summarises the residual surface water impacts.

Table 23-1 Summary of residual surface water impacts

Impact	Mitigation	Significance of residual impact
Construction stormwater runoff volume and flooding increase due to construction work and stream diversion	Flood storage and outlet controls, suitably large inlet grill capacity, design and management of overland bypasses.	No significant residual impacts
Construction stormwater runoff quality and spills	Standard preventative measures and monitoring set out in relevant CEMPs and SWMPs.	No significant residual impacts
Construction erosion impacts on waterway stability, habitat and water quality	As for flooding	No significant residual impacts
Operational stormwater runoff volume and flooding	Constructed flow paths including barriers and storages to provide project and authority performance requirements.	No significant residual impacts
Operational stormwater runoff quality and spills	Emergency response plans and spill containment facilities in accordance with AustRoads requirements	No significant residual impacts
Operational erosion impacts on waterway stability, habitat and water quality	Replacement of actively eroding drain with a well-engineered flow path in combination with flood storage and treatment trains to reduce erosion.	No significant residual impacts

24. Groundwater

24.1 Introduction

GHD undertook an assessment of the groundwater impacts of the action on Commonwealth land.

This section also relates to the conclusions presented in Table 30-1 related to potential impacts of North East Link relating to pollutants, chemicals, and toxic substances.

24.2 Assessment method

24.2.1 Assessment scope

Study area

The assessment looked specifically at groundwater impacts on Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks.

Groundwater processes occur over a range of the scales, so it was necessary to extend the study area beyond the area within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2). The extent of impacts on Commonwealth land is defined by the drawdown modelling presented in Section 24.4.1.

Groundwater impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 25-2.

Scope of impacts considered

The scope of impacts considered in this assessment is described in PER Technical Appendix B – Groundwater technical report.

24.2.2 Methodology

Full details of the groundwater assessment methodology are provided in PER Technical Appendix B – Groundwater technical report.

A combination of desk study information and field data collected during these investigations was used to provide site specific hydrogeological information and enable improved characterisation of the existing conditions compared with that determined from the desktop literature review.

The geotechnical program comprised multiple investigation phases, including:

- Core drilling and lithological sampling and core photography
- Geophysical assessment: natural gamma, imaging (ultrasonic, optical)
- Groundwater monitoring bore construction and development
- Aquifer and slug testing
- Pumping test investigations and groundwater level gauging
- Groundwater sampling and laboratory analysis.

The geotechnical investigations undertaken on Commonwealth land have targeted the far western portion of Simpson Barracks, and are generally within 100 metres of Greensborough Highway. Geotechnical boreholes were placed at approximate 100-metre intervals along the reference project alignment.

Since the numerical groundwater modelling was undertaken for the preparation of the draft PER that was published under Section 98 of the EPBC Act, additional numerical groundwater modelling has been undertaken. As part of the finalising the PER, the findings presented in this section and the PER Technical Appendix B – Groundwater have been revised, as appropriate, to reflect the results of the further groundwater modelling.

24.3 Description of environment

This description of the groundwater environment relates to that potentially affected by North East Link on Commonwealth land at Simpson Barracks. Full description of the properties, uses, quality and behaviour of the affected aquifers is provided in PER Technical Appendix B – Groundwater technical report, which also provides the broader assessment of potential impacts on groundwater environment required within the EPBC boundary.

24.3.1 Geology

The regional geological around Simpson Barracks setting can be broadly described as comprising a basement of folded and faulted Palaeozoic marine sedimentary rocks comprising mudstones and sandstones. These rocks were subsequently uplifted and eroded over time into a system of river valleys. Simpson Barracks is principally situated upon indurated Silurian sediments (Melbourne Formation). These rocks have a thin cover of residual soils, and can be extensively weathered.

24.3.2 Topography

The Palaeozoic bedrock within the project boundary forms undulating, rolling hills, which have been dissected by the Yarra River and its floodplain. The topography is highest around the M80 Ring Road to northern portal element, extending to over 100 metres above sea level.
The topography results in drainage towards the Yarra River floodplain, which generally lies 10 to 20 metres above sea level.

24.3.3 Aquifers

The main relevant aquifers systems are the Fractured Rock Aquifers (or Bedrock Aquifer) which include Silurian Devonian indurated sediments and Basalts of the Newer (Quaternary/Upper Tertiary) and Older (lower Tertiary) Volcanics. Within these aquifers, groundwater is (mostly) transmitted by secondary flow mechanisms in these rocks such as fractures, joints and other discontinuities within the rock mass. This aquifer is identified across the whole North East Link study area.

24.3.4 Groundwater levels

Groundwater monitoring of North East Link bore network indicates that groundwater depth between the M80 Ring Road and Lower Plenty Road is at depths of greater than 10 metres below ground surface with the exemption of lower lying areas such as the Plenty River floodplain, north of Grimshaw Street and along the Hurstbridge rail corridor.

24.3.5 Groundwater quality and use

Sampling by North East Link indicates that much of the bedrock aquifer is saline, particularly north of Lower Plenty Road and remote from the Yarra River floodplain. In general the groundwater in the alluvial sediments is less saline than the bedrock aquifer, thought to be because of greater interaction with fresh surface water.

Groundwater abstraction in the area is limited due to the largely residential setting, where piped potable water is readily available. Due to the brackish to saline quality of groundwater available in the area, its use is limited. Two groundwater bores (monitoring bores) were identified on the Commonwealth land based on a site inspection undertaken on the western part of the land parcel only. These monitoring bores are not registered publicly.

24.3.6 Acid sulfate soils

Preliminary field investigations undertaken to date indicated the Silurian siltstone materials are unlikely to contain potential acid sulfate soil (PASS) material, though some samples from deep (20 metres) in a borehole (BH057) approximately 500 metres south of Simpson Barracks were tested and found to be potentially acid forming. The location of BH057 is shown in Figure 24-1.

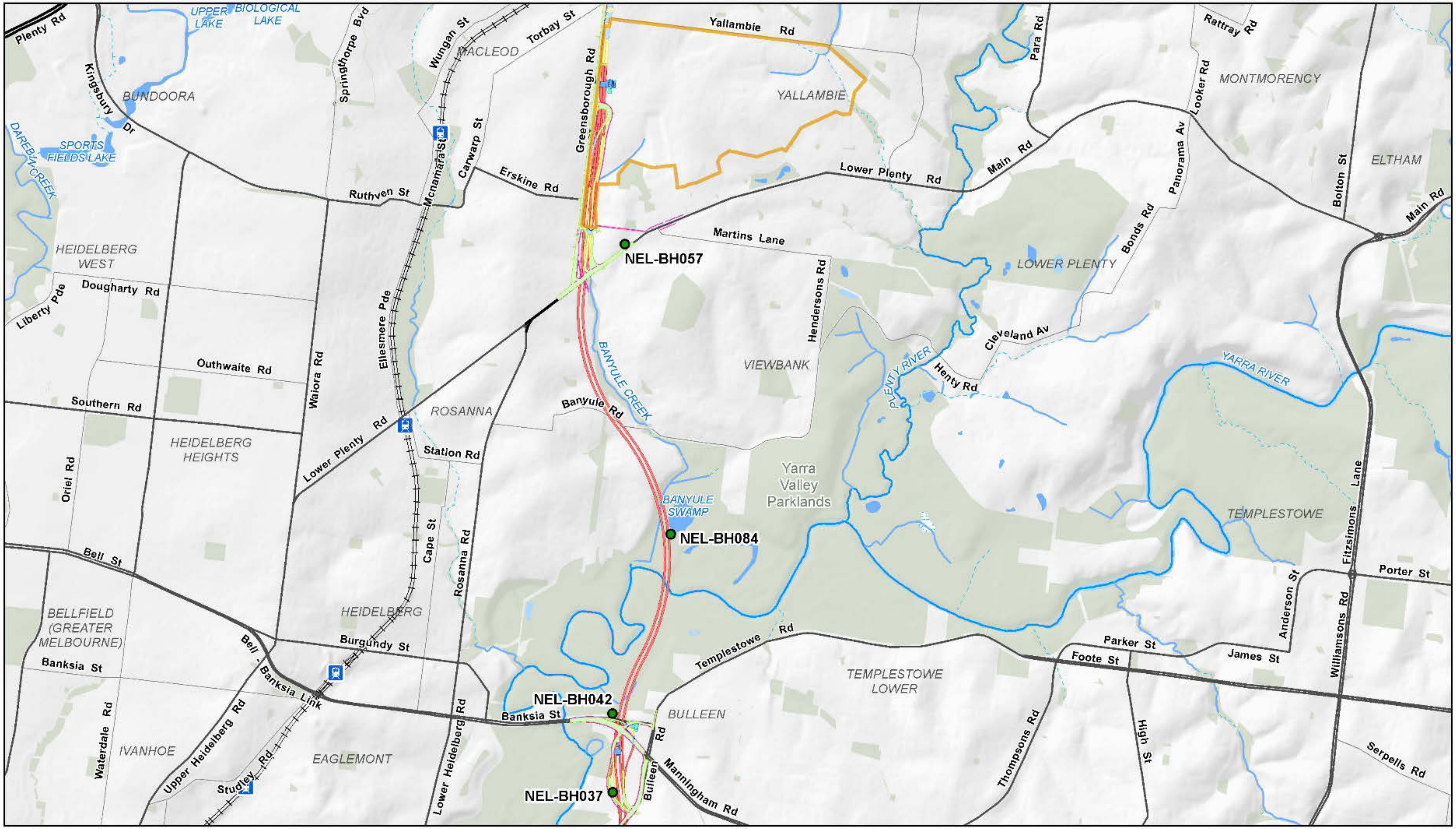
However, given the preliminary nature of the sampling and the presence of Acid Sulfate Rock (ASR) along other parts of the alignment, its presence cannot be totally discounted, particularly at depth where fresher rock is encountered.

Based on preliminary 2D geological interpretation, undertaken by the geotechnical investigation team, it is estimated that earthworks associated with the trench section between Elder Street and the cut and cover tunnels section would not encounter PASS.

24.3.7 Groundwater dependant ecosystems

Groundwater dependent ecosystems (GDEs) are often complex, dynamic systems relying on groundwater for some or all of their water requirements, either permanently or intermittently. The geographic area in the vicinity of the northern tunnel portal, including Simpson Barracks and Banyule Creek, include GDEs at the Banyule Creek and Plains Grassy Woodland (EVC 55) within Simpson Barracks.

Further details of the existing groundwater conditions are provided in PER Technical Appendix B – Groundwater. Ecological impacts to GDEs are assessed as relevant in Section 5.4.1 and PER Technical Appendix A – Flora and Fauna technical report.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Legend

- Commonwealth land
- NEL Bores

Proposed reference project

- Ventilation system
- Proposed area for substation
- Shared use path overpass
- Shared use path
- Shared use path underpass
- Surface road
- Elevated road, ramp or structure
- Road in trench
- Underground tunnel

Roads

- Highway
- Major road
- Local road
- Railway

- Train station

Watercourses

- River
- Stream
- Drain/channel/other

Waterbodies

- Lake
- Swamp
- Watercourse
- Parks & reserves

NORTH EAST LINK PROJECT

North East Link Project Public Environment Report

Job Number	31-35006
Revision	D
Date	16/01/2019

PASS Locations near Commonwealth land

Figure 24-1

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Data source: CIP Imagery - DELWP - 2018 | NELP Data - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

24.4 Relevant impacts and mitigation measures

24.4.1 Modelled changes to groundwater levels

Modelling approach

Numerical groundwater modelling has been undertaken to estimate the extent of drawdown from the construction of North East Link. Details of the approach to modelling are presented in PER Technical Appendix B – Groundwater technical report.

The initial modelling undertaken for the draft PER has incorporated an uncertainty analysis to address model non-uniqueness issues. This has resulted in the reporting of water level changes as 95th and 5th confidence intervals. The 95th percentile is relevant to areas of drawdown and denotes the drawdown extent where 95 per cent of the calibrated model results are predicted. The 5th percentile, which is relevant to water table mounding, presents an area where 95 per cent of calibrated model results predicted within the indicated extent of mounding.

Further numerical groundwater modelling was undertaken following the publication of the draft PER. The purpose of the further modelling was to incorporate additional groundwater data collected over a period of approximately 12 months to enable transient calibration to seasonal variations in groundwater levels and to assess whether or not the additional calibration efforts result in changes to the assessment of project-induced groundwater impacts. The performance of the additional modelling improved and the overall findings were generally similar to the initial numerical groundwater modelling.

The design and construction assumptions on which the both models were based, as well as calculations to estimate the amount of inflow to below ground structures during construction and operation, are provided in PER Technical Appendix B – Groundwater technical report.

Construction

A change in groundwater levels due to North East Link could result from the following sources:

- Dewatering of excavations to enable construction below the water table
- Seepage into structures during the operation phase, limited by the water tightness of the completed structures
- Use of groundwater by the construction contractor as water supply to service construction requirements, as an alternative to using potable drinking water supplies.

The predicted extent of drawdowns towards the close of the construction period, based on the initial modelling, are shown in Figure 24-2 and Figure 24-3 for the 95th and 5th percentiles respectively. The uncertainty analysis completed as part of the initial numerical modelling shows the contours of drawdown percentiles based on over 200 models of equivalent calibration.

The further modelling has resulted in improved calibration and predicted drawdowns (or impressed heads) have reduced in size and magnitude. Figure 24-4 shows the predicted impacts on groundwater levels based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted as part of the initial numerical groundwater modelling. As such, Figure 24-4 is not directly comparable to Figure 24-2 or Figure 24-3.

During construction, drawdowns are predicted to extend beneath Commonwealth land. Greatest drawdowns would occur nearest the excavation faces and the drawdown decreases with distance from the tunnel or excavation, and expands in size while pumping occurs until steady state conditions are reached. Based on the understanding of groundwater levels in relation to the grade line, as the trench structure dives from Watsonia railway station towards the south and Lower Plenty Road, it is likely to intersect the water table to the south of Blamey Road (Commonwealth land). The greatest magnitude of dewatering occurs at the northern portal (near Greensborough and Lower Plenty Road intersection) where the structure is at its deepest below the water table.

The further modelling predicted less drawdown in this area and greater inflows, which is a result of assigning increased recharge to the bedrock aquifer in this area.

Drawdowns beneath the TBM tunnel, between Lower Plenty Road and the Manningham Road interchange are not predicted as the permanent lining is installed as part of the construction activities.

Seasonal water level fluctuations of 0.5 to one metre are possible, with potentially a greater fluctuation during decadal influences such as droughts. While Southern Rural Water typically applies a 10 to 20 per cent loss in available drawdown in a production bore as being a significant impact, this is based on the bores having an abstractive use.

Operation

Predicted drawdowns during operation of North East Link, based on initial modelling, are shown in Figure 24-5 and Figure 24-6 for the 95th percentile (drawdown) and 5th percentile (mounding) respectively. The uncertainty analysis completed as part of the initial numerical modelling shows the contours of drawdown percentiles based on over 200 models of equivalent calibration.

As noted for construction, the additional modelling resulted in improved calibration and prediction drawdowns (or impressedheads) have reduced in size and magnitude. Figure 24-7 shows the predicted impacts to groundwater levels based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted for the initial numerical modelling. As such, Figure 24-7 is not directly comparable to Figure 24-5 or Figure 24-6.

A worst case arises when drawdowns are imposed upon a decadal-type water level response, such as during a severe drought.

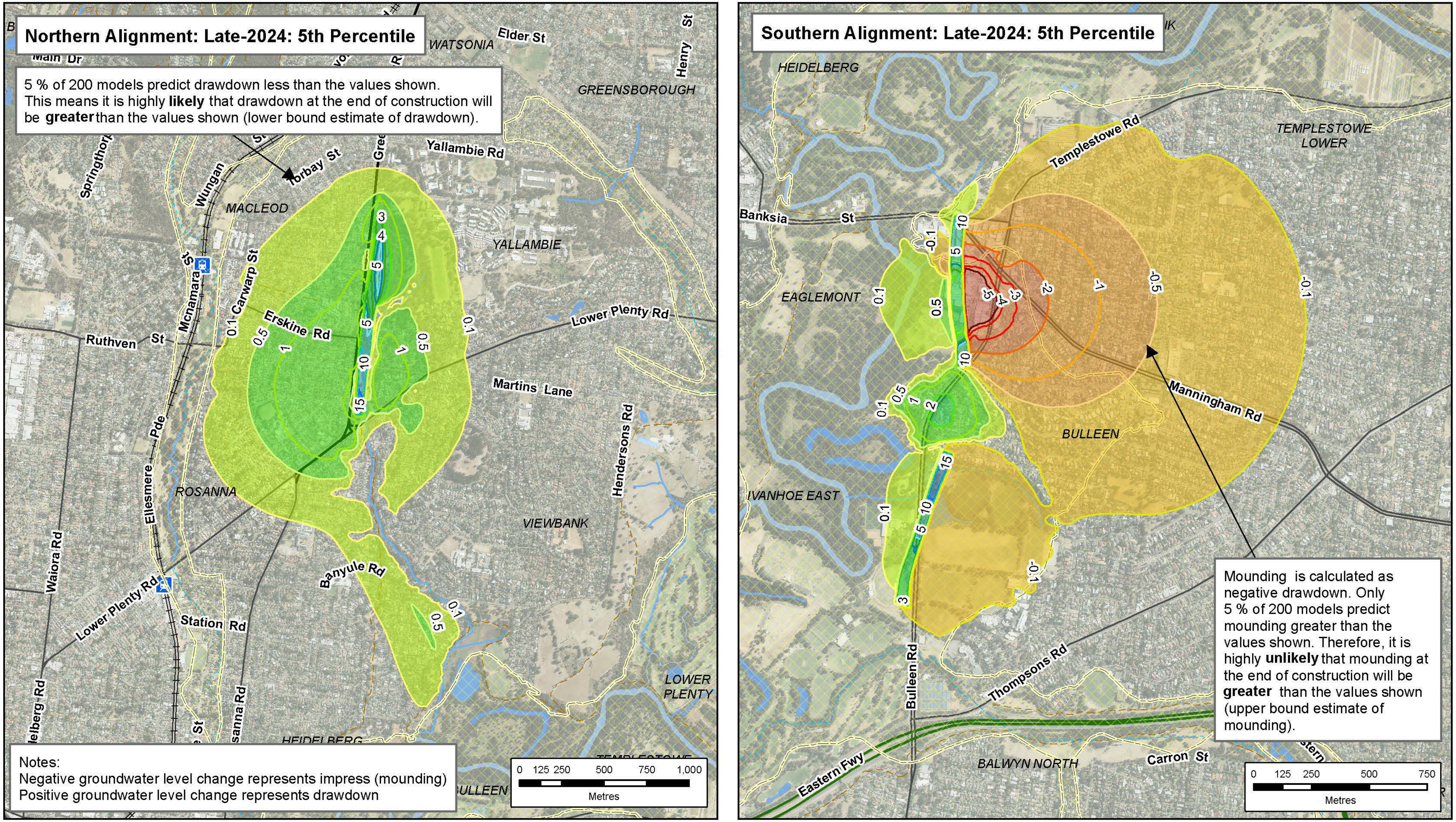
In some areas, particularly those nearest the excavation, full recovery of water levels would occur following construction. In other areas, water levels would only partially recover to pre-construction conditions.

Drawdown during operation would be larger in extent compared with that modelled for the construction, although the magnitude of drawdown would be less.

Following construction, the depressed water tables would begin to recover and, after 2075, the water levels would approach a steady state condition with the rate of seepage matched by the rate of groundwater recharge.

The large extent of drawdown shown in Figure 24-4 and Figure 24-5, is influenced by tanking (water-tightening of below ground structures) which extends for 600 metres north of the portal structure lining systems and would allow very little seepage, the slow rate of groundwater recharge, and a conservative assumption about the level of seepage predicted in the model (a maximum of Haack 3 classification).

Seasonal water level fluctuations of one to two metres could be reasonably expected and the predicted drawdown is within the magnitude of drawdown change experienced during the Millennium Drought (see PER Technical Appendix B – Groundwater technical report).



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Modelled GWL Change (m)

- -5
- -4
- -3
- -2
- -1
- -0.5
- -0.1
- 0.1
- 0.5
- 1
- 2
- 3
- 4
- 5
- 10
- 15
- 20

Modelled GWL Change (m)

- < -5
- -4.99 - -2
- -1.99 - -0.5
- -0.49 - -0.1
- -0.09 - 0.1
- 0.11 - 0.5
- 0.51 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20
- Alluvium

NORTH EAST LINK PROJECT

North East Link Project
Environment Effects Statement (EES)

Predicted drawdowns:
5th Percentile
(construction, initial modelling)

Job Number 31-35006
Revision F
Date 22 Aug 2019

Figure 24-2

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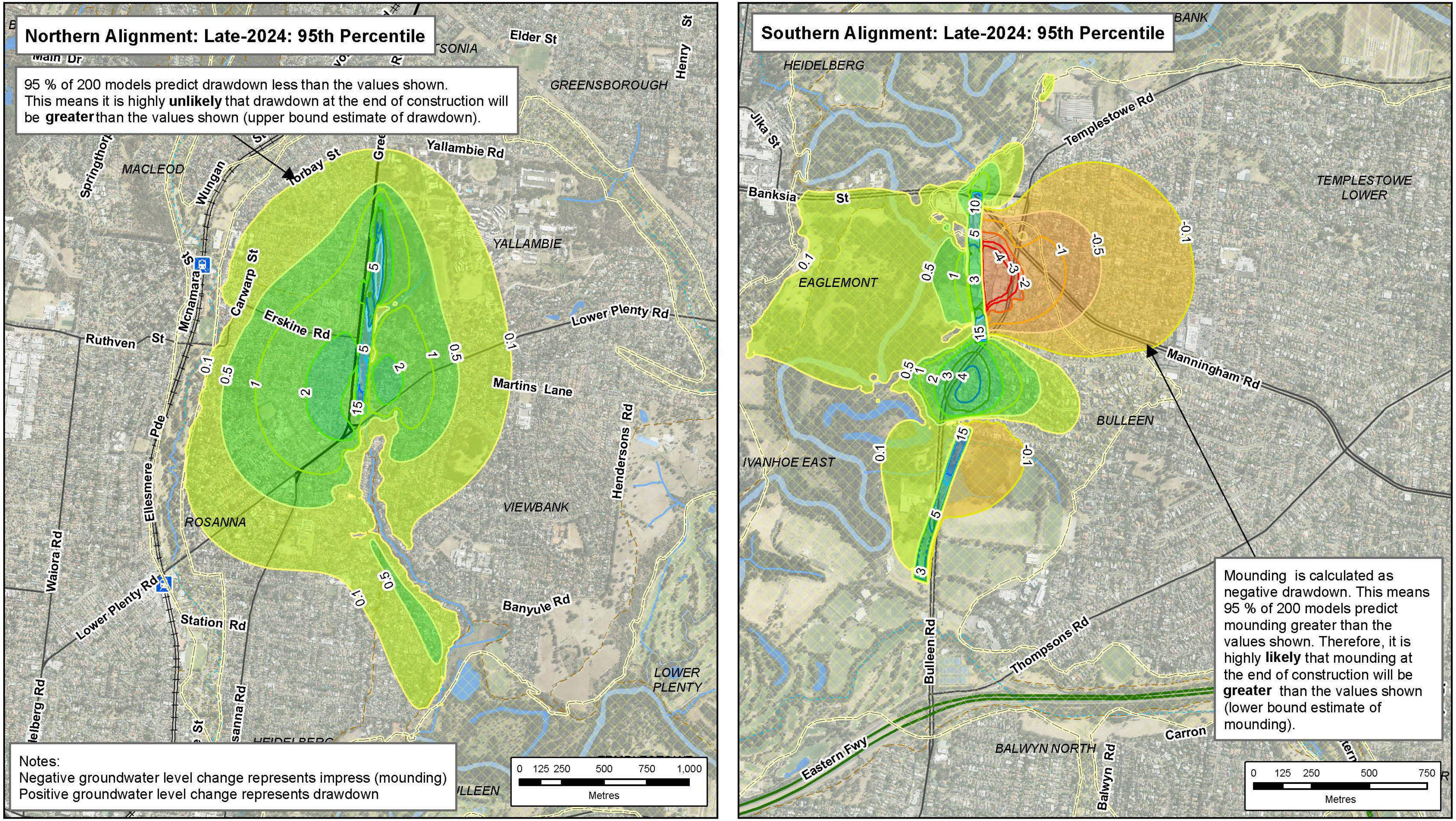
Data source: Aerial, CIP, 2018. BaseMaps, VicMaps, 2018; GW Model Layers, GHD, 2018. Created by:sacevedo



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Modelled GWL Change (m)

- -5
- -4
- -3
- -2
- -1
- -0.5
- -0.1
- 0.1
- 0.5
- 1
- 2
- 3
- 4
- 5
- 10
- 15
- 20

Modelled GWL Change (m)

- < -5
- -4.99 - -2
- -1.99 - -0.5
- -0.49 - -0.1
- -0.09 - 0.1
- 0.11 - 0.5
- 0.51 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20
- Alluvium

North East Link Project
Environment Effects Statement (EES)

Job Number 31-35006
Revision F
Date 22 Aug 2019

Predicted drawdowns:
95th Percentile
(construction, initial modelling)

Figure 24-3

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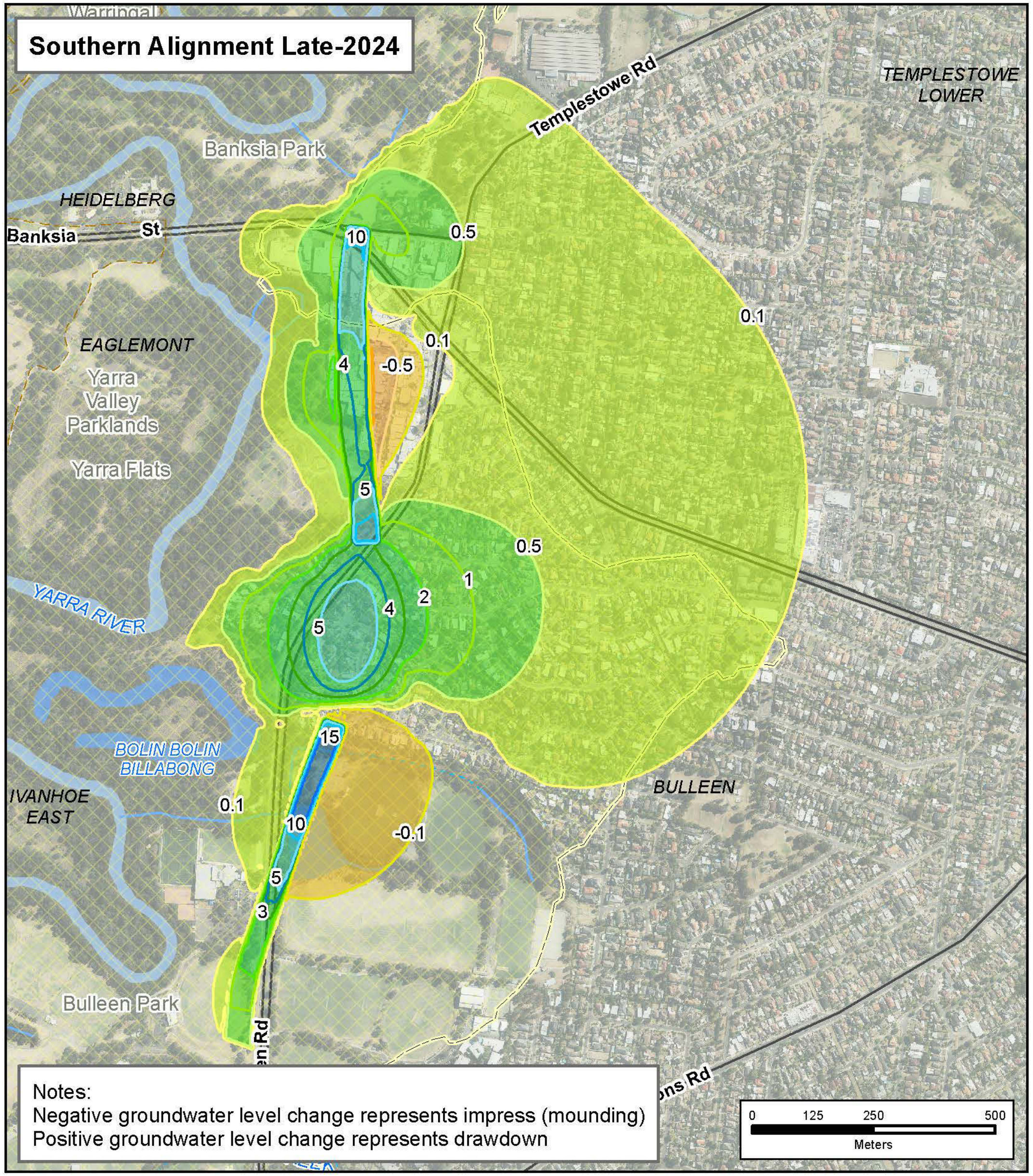

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Grid: GDA 1994 MGA Zone 55

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Modelled GWL Change (m)

-5
-4
-3
-2
-1
-0.5
-0.1
0.1
0.5
1
2
3
4
5
10
15
20

Modelled GWL Change (m)

-0.49 - -0.1
0.11 - 0.5
0.51 - 2
2.01 - 5
5.01 - 10
10.01 - 15
15.01 - 20
Alluvium

North East Link Project

Job Number	31-35006
Revision	B
Date	22 Aug 2019

NORTH EAST LINK PROJECT

Predicted groundwater level changes (construction, further modelling)

Figure 24-4

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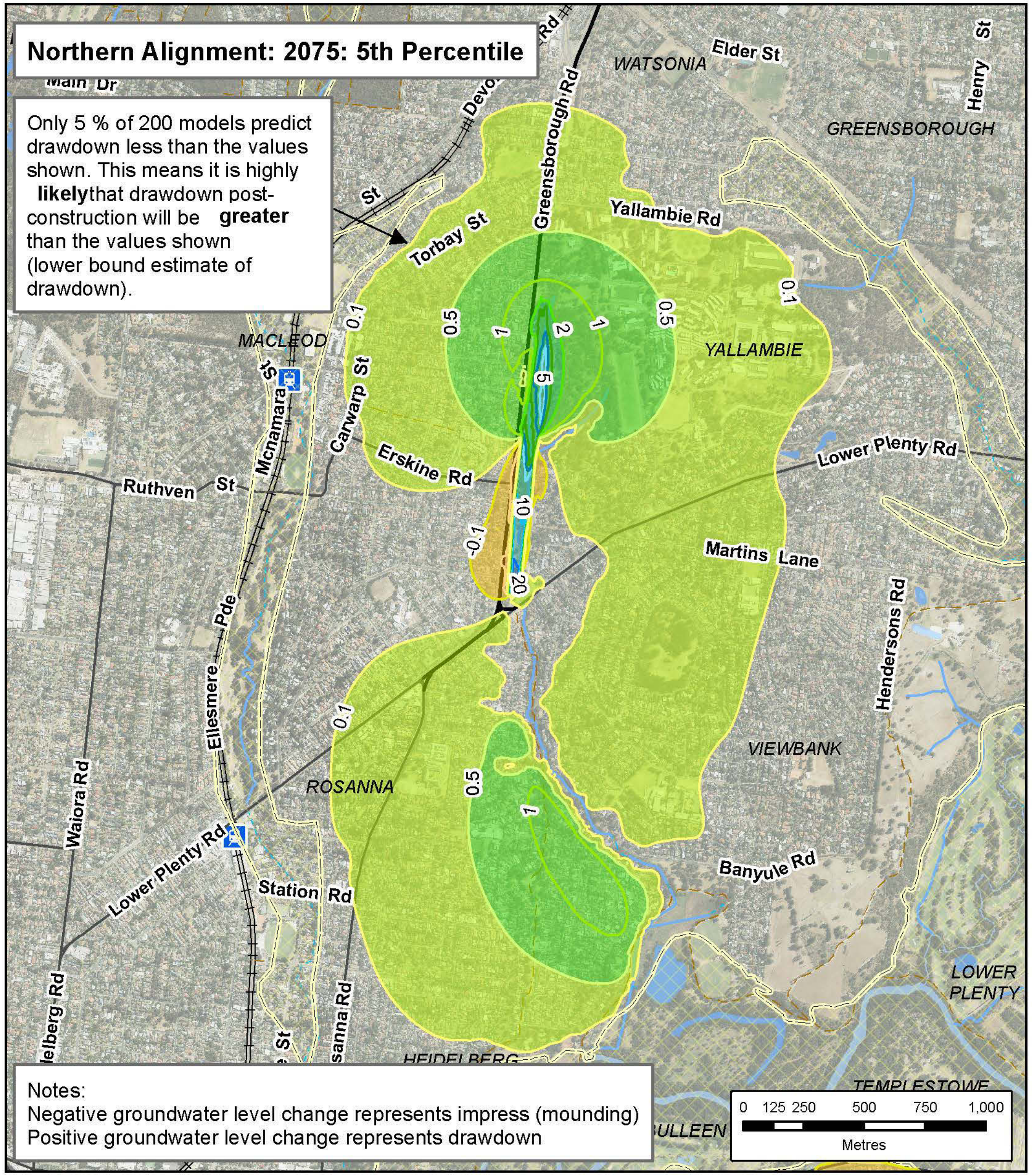
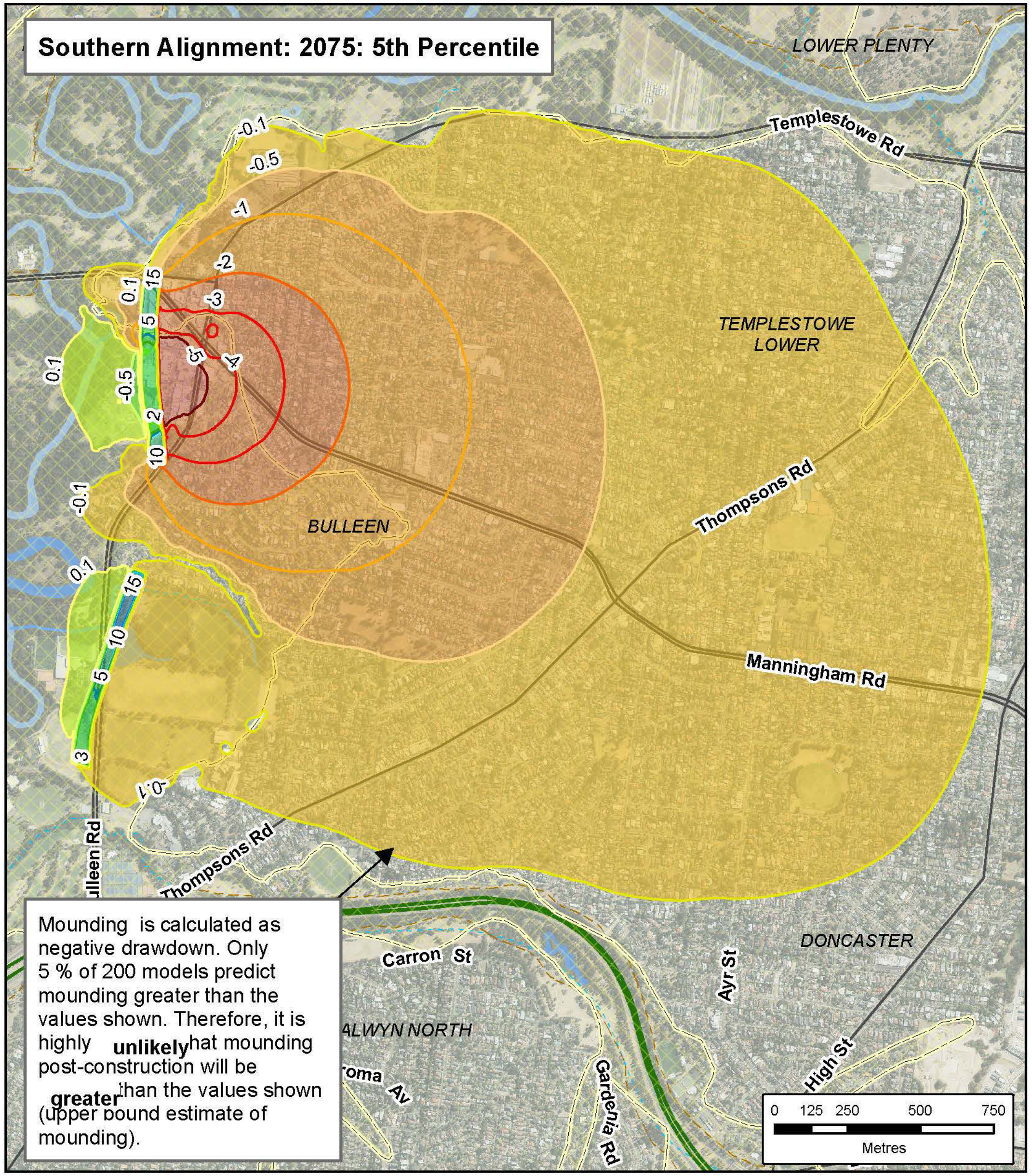
Data source: Aerial, CIP, 2018. BaseMaps, VicMaps, 2018; GW Model Layers, GHD, 2018. Created by:sacevedo





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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Modelled GWL Change (m)

- -5
- -4
- -3
- -2
- -1
- -0.5
- -0.1
- 0.1
- 0.5
- 1
- 2
- 3
- 4
- 5
- 10
- 15
- 20

Modelled GWL Change (m)

- < -5
- -4.99 - -2
- -1.99 - -0.5
- -0.49 - -0.1
- -0.09 - 0.1
- 0.11 - 0.5
- 0.51 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20
- Alluvium

North East Link Project
Environment Effects Statement (EES)

Job Number 31-35006
Revision G
Date 22 Aug 2019

Predicted drawdowns:
5th Percentile
(operation, initial modelling)

Figure 24-5

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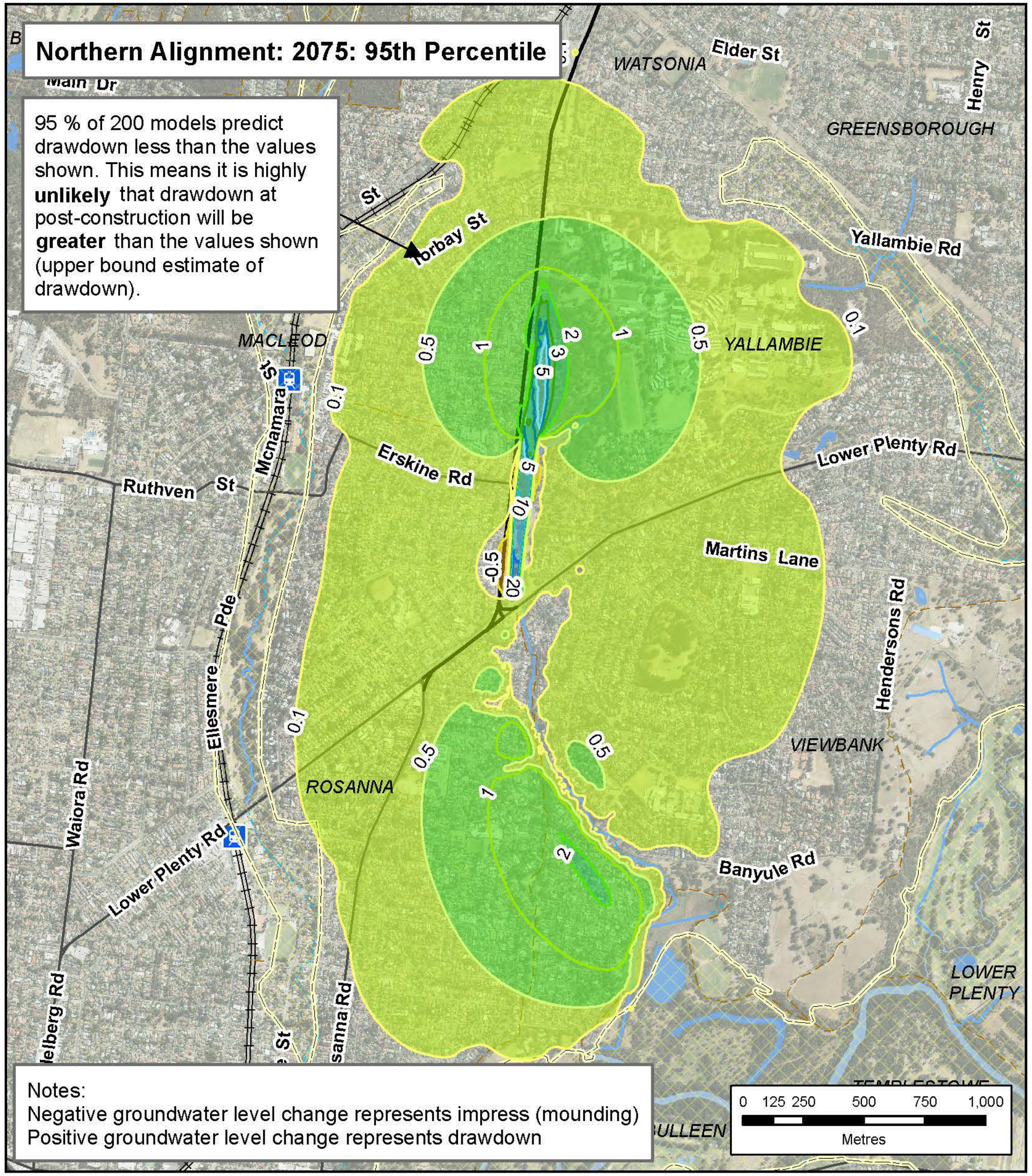
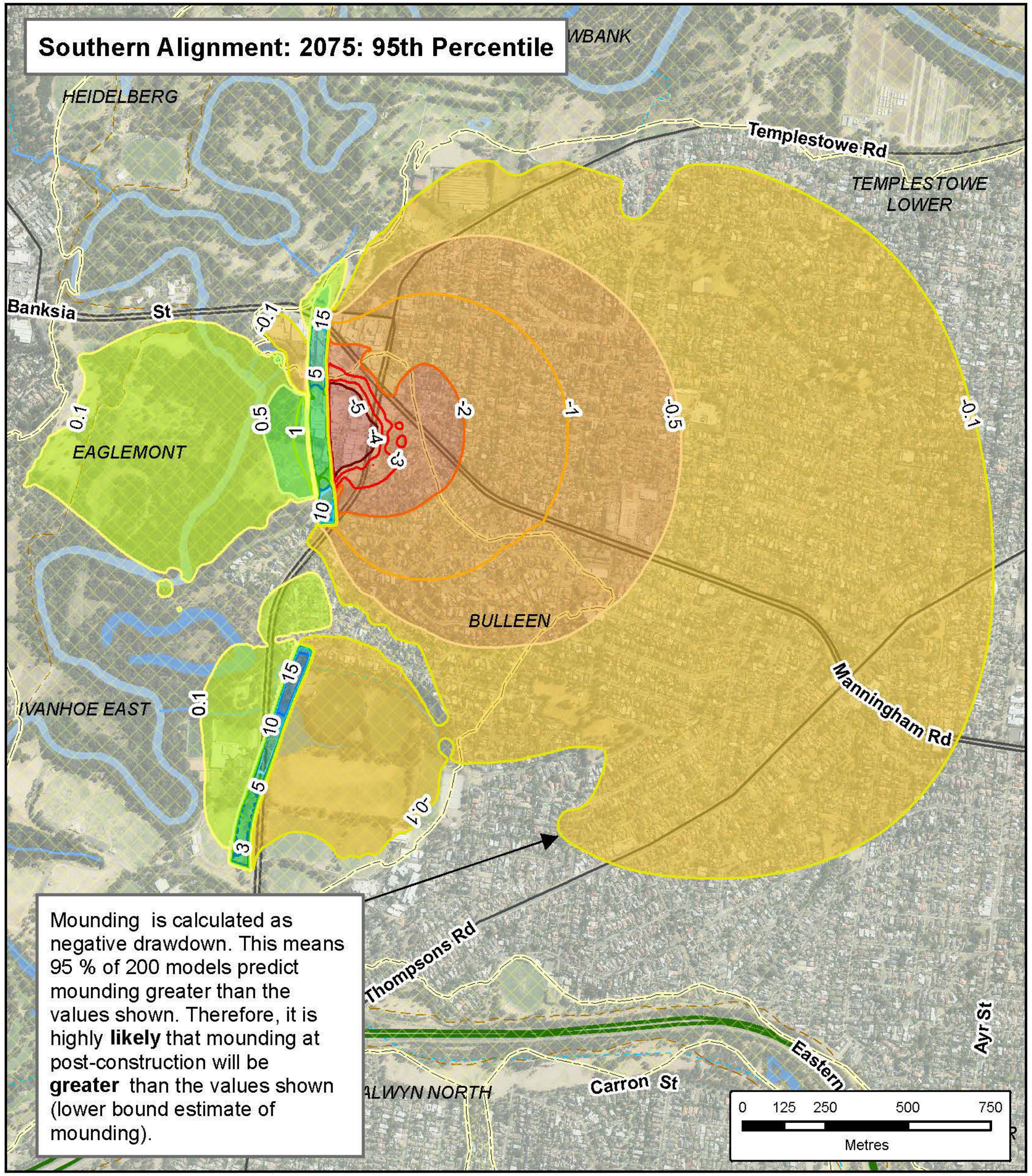
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: Aerial, CIP, 2018. BaseMaps, VicMaps, 2018; GW Model Layers, GHD, 2018. Created by:sacevedo





Paper Size A4

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Modelled GWL Change (m)
- -5
- -4
- -3
- -2
- -1
- -0.5
- -0.1
- 0.1
- 0.5
- 1
- 2
- 3
- 4
- 5
- 10
- 15
- 20

Modelled GWL Change (m)
- < -5
- -4.99 - -2
- -1.99 - -0.5
- -0.49 - -0.1
- -0.09 - 0.1
- 0.11 - 0.5
- 0.51 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20
- Alluvium

NORTH EAST LINK PROJECT

North East Link Project
Environment Effects Statement (EES)

Job Number | 31-35006
Revision | G
Date | 22 Aug 2019

Predicted drawdowns:
95th Percentile
(operation, initial modelling)

Figure 24-6

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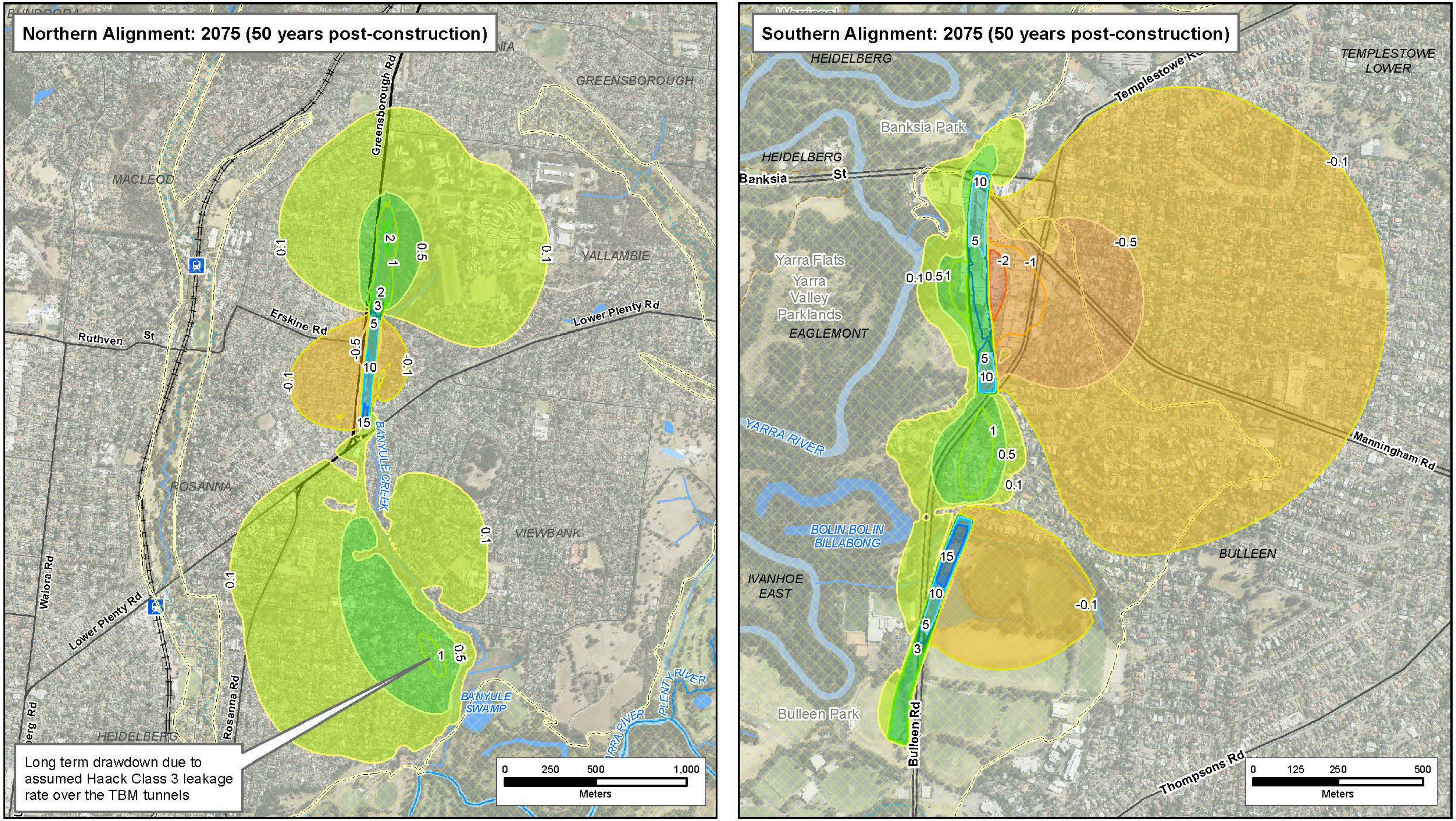
Data source: Aerial, CIP, 2017. BaseMaps, VicMaps, 2018; GW Model Layers, GHD, 2018. Created by:sacevedo



Paper Size A4

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Modelled GWL Change (m)

-5, -4, -3, -2, -1, -0.5, -0.1, 0.1, 0.5, 1, 2, 3, 4, 5, 10, 15, 20

Modelled GWL Change (m)

< -5.81 - -5, -4.99 - -2, -1.99 - -0.5, -0.49 - -0.1, -0.09 - 0.1, 0.11 - 0.5, 0.51 - 2, 2.01 - 5, 5.01 - 10, 10.01 - 15, 15.01 - 20, 20.01 - 24

Alluvium

North East Link Project

Job Number	31-35006
Revision	B
Date	22 Aug 2019

Predicted groundwater level changes (operation, further modelling)

Figure 24-7

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180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: Aerial, CIP, 2018. BaseMaps, VicMaps, 2018; GW Model Layers, GHD, 2018. Created by:sacevedo

24.4.2 Impact to groundwater quality

Impact description

Potential groundwater quality changes may arise during construction of North East Link from:

- Spillage, improper handling, storage and application of hazardous materials
- Disposal of fluids or waste to groundwater
- Incompatibilities with construction materials, such as leaching from imported backfill, chemical additives to grouts and sealing resins
- Fluids used during artificial recharge activities.

Construction activities may result in localised groundwater quality impacts from spillage or improper handling and application of hazardous materials, such as the refuelling and maintenance of construction plant and equipment.

The likelihood of these environment incidents is low because the construction would be required to implement controls to manage chemicals, fuels and hazardous materials to manage the risks (see below). Furthermore, with suitable incident procedures in place any spilled pollutants would have insufficient time to migrate downwards to through the soil profile to the water table before the source was removed, avoiding the potential for significant pollution

Artificial recharge to dispose of surplus waters flowing into excavations or to impart hydraulic controls to mitigate the migration of contaminated groundwater or water level changes could also introduce contaminants if inappropriate quality water was used.

The extent of any effect mostly dependent upon the size and resilience of the aquifer. Most water quality changes would likely be highly localised.

Proposed avoidance and mitigation measures

Implementation of management measures through a Construction Environmental Management Plan (CEMP) during construction is the primary means of avoidance and mitigation to control this impact and is assumed in the impact evaluation above. These avoidance and mitigation measures would include:

- Where appropriate, reinjection of groundwater to mitigate the impacts of construction dewatering (regulatory control under Victoria's *Water Act 1989*)
- Establishment of baseline condition to characterise the groundwater environment pre-construction
- Ongoing groundwater monitoring during construction.

Aquifer reinjection is a licensable act under the Water Act so the water quality of the injection fluids would need to be consistent with the SEPP (Waters). Water quality would need to be of a standard that makes recharge technically achievable and practicable (minimises mechanical, biological or chemical clogging) and is compatible with native groundwater quality. As part of the licensing process, the licensing authority, which is Southern Rural Water in this part of the State, may seek an assessment of the proposed impacts to groundwater from the proponent seeking the reinjection licence, and may use EPA Victoria as a referral agency.

Residual impact

With the proposed control measures, the residual impact significant is considered low, and not significant.

24.4.3 Impact to existing groundwater users from water level decline during construction

Impact description

Water level changes can effect groundwater users; that is, bores used for stock and domestic, irrigation, commercial and industrial purposes. Certain ecosystems may also rely upon groundwater. Notably drawdown of the water table can reduce the amount of water available at existing abstraction bores.

Impacts on groundwater dependent ecosystems (GDEs) are addressed in Section 5 of PER Technical Appendix A – Flora and fauna technical report.

No abstractive groundwater development has been identified on Commonwealth land probably due to the saline groundwater quality and low bore yields. No evidence of groundwater pumping has been identified in the water level responses of North East Link groundwater monitoring bores. Elevated groundwater salinity suggests that future groundwater development, either on, or adjacent to Commonwealth land would be unlikely.

Groundwater investigation (and monitoring) bores have been identified, but these are typically used for the measurement of groundwater level and groundwater quality and not used as a water resource. The initial modelling predicted these would experience drawdown during construction of 0.5 to two metre. The further modelling predicted these bores would experience 0.1 to 0.5 metres drawdown. Both these changes in water level would be unlikely to significantly affect the operation of these monitoring bores.

Proposed avoidance and mitigation measures

The primary control for minimising groundwater drawdowns relating to construction dewatering is the design philosophy. Adopting structures that have tanked lining systems would minimise the change in groundwater levels during construction after installation is complete.

Mitigation can also be applied to the receptors themselves, for example:

- Lowering pumps within bores
- Drilling deeper bores
- Provision of alternative supplies during construction
- Implementing recharge (between the structure and receptors) to impart controls on water level change.

The numerical groundwater model has not been applied to assess the extraction of groundwater for a construction water supply, nor the use of recharge bores to mitigate against drawdowns. These may be required to support licensing of a production bore, or the design of a recharge scheme.

Any groundwater bores installed for construction water supply or permanent water supply would need to be licensed by Southern Rural Water in accordance with Victoria's *Water Act 1989,* and would be subject to its licensing determinations. As part of any licensing determination, a proponent would be required to complete a technical hydrogeological assessment to support the groundwater licensing. This would include an assessment of impact to existing users, surface water flows and water availability. A groundwater supply would not be licensed unless the risks of extraction on groundwater (other users, the environment) are deemed acceptable by Southern Rural Water, the relevant water authority in this part of the State.

Residual impact

With the proposed mitigation measures, residual impact significance is predicted to be low.

In some cases, contractors do not specifically install groundwater bores, but rather harvest groundwater seepage intersected during excavation activities occurring below the groundwater table. Reuse of groundwater, provided its quality is suitable for the intended use, can be an appropriate means of managing groundwater inflows.

24.4.4 Impact from drawdowns on acid sulfate geological materials

Impact description

Conceptualisation

Changes to water levels which result in the generation of acidic groundwater can impact surface waters receiving groundwater, GDEs or buried structures, or structures with foundations, or basements that are below the water table. As discussed in Section 24.4.3, no abstractive groundwater use has been identified on Commonwealth land.

As shown schematically in Figure 24-8, reduced water levels may exposed potential acid sulfate soils (PASS) materials and generate acid plumes. PASS materials below the water table are saturated. During construction (or during operation if a drained structure), PASS materials could oxidise with a reduction in water level, and a leached plume would subsequently migrate under the prevailing hydraulic gradient. This plume can adversely affect foundations in contact with groundwater, other buried structures that are hydraulically down-gradient of the plume, ecological receptors and groundwater receiving environments.

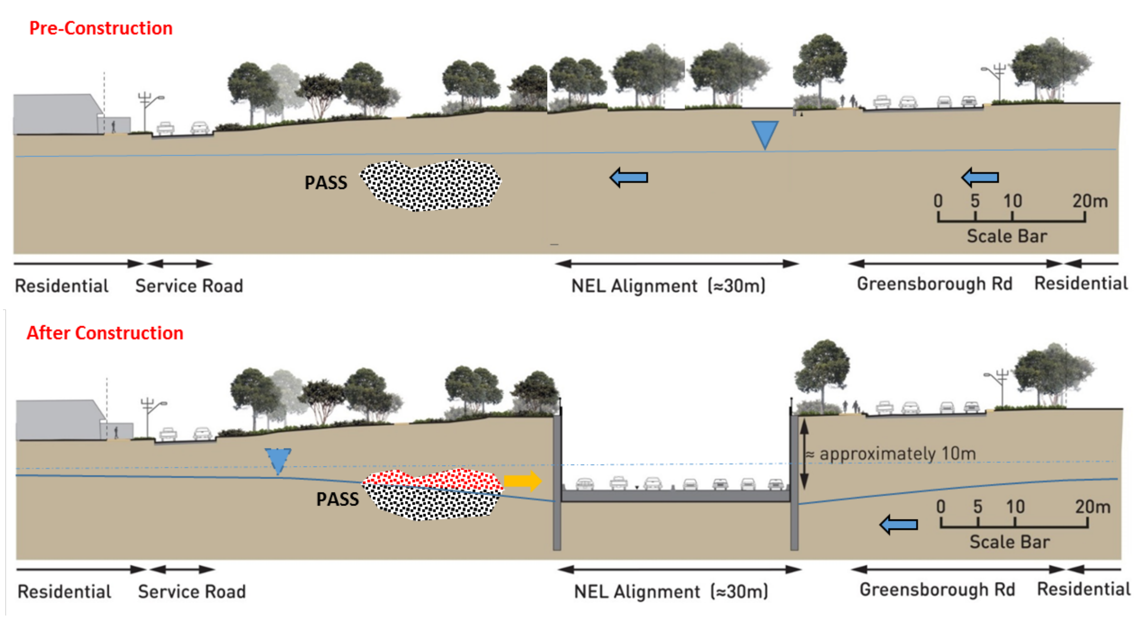


Figure 24-8 Groundwater changes and PASS oxidation

PASS presence

Sampling undertaken during the geotechnical investigation program identified parts of the Palaeozoic bedrock as being potential PASS; that is Acid Sulfate Rock (ASR) (see PER Technical Appendix B – Groundwater technical report).

Laboratory analysis of over 80 rock samples identified only four samples that were PASS and no confirmed acid-generating soil or rock materials were identified. The four samples that were identified as PASS, were identified at depths greater than 20 metre below the surface in fresh bedrock. None of the PASS samples were on Commonwealth land but further evidence of PASS materials may be identified with additional geotechnical investigations required to support the detailed design.

The PASS materials are generally associated with the deeper, fresher bedrock, and occur at depths greater than 20 metres below the surface. Therefore dewatering extents (and magnitudes) must coincide with such depths.

If acid-generating materials are present within the excavation these would be removed. Some drawdown may occur outside the cut-off walls (noting that some seepage can be transmitted laterally through the cut-off depending upon the water tightness achieved).

Drawdown extent

The predicted extent of drawdowns towards the close of the construction period are shown in Figure 24-2 and Figure 24-3 for the 95th (drawdown) and 5th (mounding) percentiles respectively. Dewatering would occur on Commonwealth land, but the magnitude of dewatering would not likely expose fresh bedrock. After construction, some water level recovery is expected.

With increasing distance from the northern at Lower Plenty Road, the drawdowns decline towards 0.1 to one metre. These drawdowns are within the range of seasonal fluctuation and so PASS geological materials are likely to have already been oxidised, or drawdowns would be too small to result in the unsaturation and oxidation of fresh bedrock.

Based on the depth to water on Commonwealth land, and a resulting gradient from drawdowns towards the west and away from Commonwealth land, adverse impact to buildings is considered unlikely. Impact to this receptor is not discussed further.

North East Link's construction would likely take seven years, providing limited opportunity for rainfall recharge to infiltrate and generate a flux of leaching water, which has to then migrate to a receptor (or seepage face).

Contamination hazards

Contamination hazards arise when naturally occurring metals are leached from aquifer geological materials due to the low pH conditions. Groundwater can have a natural capacity (alkalinity) to buffer against pH changes and provide protection against acidification. Based on groundwater sampling undertaken throughout the North East Link monitoring network, the geometric mean groundwater alkalinity of 520 mg/L (alluvial sediments) and 514 mg/L (bedrock aquifer) and pH >6.5 for both aquifer systems was determined. These waters are designated as being of very high alkalinity and considered by (Shand, 2018) to be adequate to maintain acceptable pH level in the future.

Proposed avoidance and mitigation measures

The primary control for minimising groundwater drawdowns relating to construction dewatering is the design philosophy. Adopting structures that have tanked lining systems would minimise the change in groundwater levels during construction. Designers would also need to consider the water chemistry and potentially aggressive nature of groundwater on foundation materials.

Notwithstanding the unlikely nature of the impact, a monitoring program would be implemented to determine the magnitude of change in groundwater levels and assess the reliability of the predicted drawdown estimates. A Spoil Management Plan (SMP) would be developed and implemented that includes measures to manage spoil recovered from excavations that could contain PASS materials and contingency actions if monitoring indicated pH changes in groundwater.

PASS materials inside the excavation extents would be removed, removing a potential source of acid generating materials.

Residual impact

With the proposed mitigation the significance of residual impact for the trenched section is predicted to be low.

24.4.5 Impact from drawdowns on contaminated groundwater plumes

Impact description

Conceptualisation

Changes to water levels can dislocate contaminated groundwater plumes, or cause native groundwaters of differing quality to mix (saline intrusion). This can impact surface waters receiving groundwater, GDEs or buried structures, or structures with foundations, or basements below the water table. They could also generate vapour hazards for overlying residential properties overlying the plume. No abstractive groundwater use has been identified on Commonwealth land (see Section 24.4.3).

Figure 24-9 illustrates a hypothetical contaminated groundwater plume from a contaminated site migrating in the direction of regional groundwater flow. During construction (or operation if a drained structure), the plume would migrate under the prevailing hydraulic gradient, which could be different to that existing pre-construction.

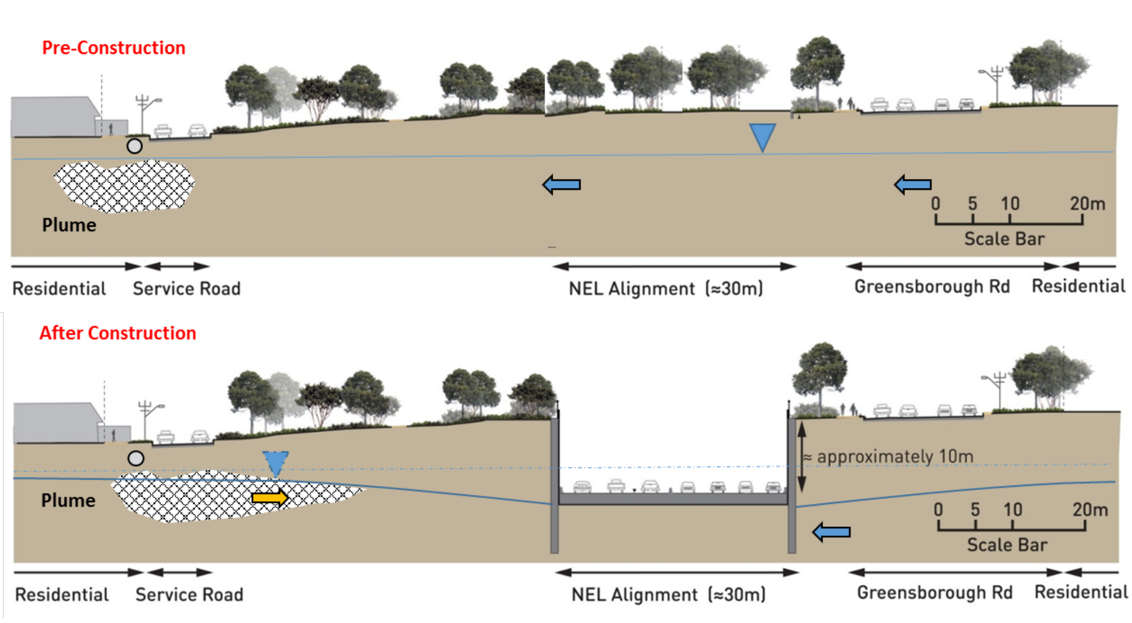


Figure 24-9 Groundwater and contaminated groundwater movement

Presence of contamination

The geotechnical investigation program included a groundwater sampling program with the objective of characterising groundwater quality from a project-wide perspective.
This subsequently identified potential risk areas, but delineating the extent of groundwater plumes was outside the scope of the investigation program.

Table 28-6 summarises the potential sources of contamination whose migration would affect Commonwealth land.

Contaminated groundwater plumes tend to be localised, but groundwater recovery can be short to long term (or not be fully restored). This assessment refers to the initial groundwater modelling only, as the minor changes from the further modelling, which reflects an improved model calibration, do not significantly add to the quantitative understanding of the impact.

Drawdown extent and potential migration

For an impact to occur to groundwater receptors via this pathway, a plume needs to be present and its migration influenced by changes in the hydraulic gradient. The predicted extent and magnitude of changes to groundwater levels are discussed in Section 24.4.1.

While there are a number of potentially contaminating land uses nearby, groundwater sampling undertaken as part of the geotechnical investigation program has generally not identified clear evidence of contaminant where water levels changes are predicted, with the following exceptions:

- The fuel service station (within the project boundary) and Simpson Barracks are nearest to the proposed areas requiring construction dewatering. Recent findings from the geotechnical investigation have identified hydrocarbons in bore NEL-ENV-BH022 which is south of the service station on the intersection of Yallambie and Greensborough Roads. This is located on Commonwealth land
- Near Lower Plenty Road, the northern portal trench would intersect sediments of the Borlase Reserve landfill. Construction of the northern portal itself would also result in the intersection and removal of filling materials. This are is located within 500 metres of Commonwealth land
- There remains a small possibility of unknown buried contamination elsewhere on Commonwealth land from which contaminants could migrate due to groundwater drawdown.

Proposed avoidance and mitigation measures

The primary control for minimising groundwater drawdowns relating to construction dewatering is the design philosophy. Adopting structures that have tanked lining systems would minimise the change in groundwater levels during construction. Additional controls are required to those areas where contaminated groundwater has been identified to prevent adverse health risks to construction works and the public and to prevent displacing, mobilising or spreading the existing contamination.

Managing the migration of contaminants would be achieved by:

- Ongoing groundwater monitoring during construction
- Measures to minimise changes to groundwater levels through tunnel construction methods
- Implementing contingency measures and/or controls as required to manage, mitigate and minimise to the extent practicable any movement of contamination that is identified, (source removal, clean-up or hydraulic controls)

- A Groundwater Management Plan (GMP) would be developed and implemented to protect groundwater quality and manage interception of groundwater. In addition the Spoil Management Plan (SMP) would contain measures to manage contaminated spoil, and monitor and manage intrusive vapour including potentially flammable or explosive conditions in enclosed spaces or other potential impacts on human health and the environment. The SMP would address vapour risks associated with soil, groundwater and landfill conditions as well as measures to manage odour
- Contaminated groundwater that is captured by the project would be appropriately managed and disposed.

Residual impact

With the implementation of the mitigation measures described above, the residual impact is predicted to be low and not significant.

24.4.6 Operational impact to groundwater quality

Impact description

During operation of North East Link, groundwater quality could be affected by:

- Spillage of hazardous materials from traffic accidents as would be the case elsewhere on the road network. Vehicle accidents are generally localised and an emergency services response would likely be rapid reducing the potential for migration of contaminants from the surface to the underlying groundwater system.
- Stormwater run-off which, as with any road, would contain oils, greases, heavy metals and other potential contaminants. The potential impacts of these contaminants on surface water are discussed in Section 23.4.5. Significant quantities of impacted run-off would need to pond and then soak into to the water table, before it evaporated or was taken up (transpired) by roadside vegetation.

Proposed avoidance and mitigation measures

Mitigation measures would include:

- Prepare and implement an Operational Environmental Management Plan (OEMP) for the management, monitoring, reuse and disposal of groundwater inflows during operation in accordance with relevant legislation and guidelines, specifically SEPP (Waters).
- Water sensitive urban design (WSUD) principles would be applied to the stormwater management regime and landscaping. This could result in features such as grass swales being incorporated into the North East Link design to naturally treat run-off or stormwater from the local stormwater drainage system. In addition, soils within the proposed alignment may have appreciable fine fractions, such as clays, silts, or carbonaceous material.

  The low permeability of these soils would retard the vertical migration of contaminated waters, but also naturally attenuate some contaminants, such as heavy metals, through adsorption. These WSUD features could include wetlands, bioretention ponds and storage dams which range from approximately 45 to 3,000 square metres in size. Drainage design and stormwater management is discussed further in PER Technical Appendix C – Surface water technical report.
- To minimise the potential of spilled liquids ending up in waterways, North East Link would include spill containment features on freeway pavements (including ramps) designed in accordance with AustRoads requirements.

A post-construction groundwater quality monitoring program would monitor during the first two years of operation. Long-term groundwater monitoring post construction (beyond two years) is not proposed provided that a review of groundwater condition at the completion of North East Link confirmed that no adverse impacts have occurred. If changes in groundwater condition were identified during construction, monitoring may be extended in these areas post construction to verify acceptable restoration of the groundwater environment.

Residual impact

With the application of avoidance and mitigation measures, the residual significance of impact remains low and not significant.

24.4.7 Operational impact to existing users and depletion of groundwater resources

Impact description

The operational impacts on other groundwater users are similar to those described in Section 24.4.3.

Predicted drawdowns during the operation period, based on the initial modelling, are shown in Figure 24-4 and Figure 24-5 for the 95th percentile (drawdown) and 5th percentile (mounding) respectively. Figure 24-7 shows the predicted impacts on groundwater levels during operation, based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted as part of the initial numerical groundwater modelling. Refer to Section 24.4.1 for more information about the additional groundwater modelling undertaken.

The further modelling undertaken indicates the groundwater drawdowns are less than that initially predicted. The initial modelling predicted the known bores on Commonwealth land would experience drawdown during operation of one to 1.5 metres. The further modelling predicted these bores would experience 0.1 to 0.5 metres drawdown. The initial predictions are shown as they incorporate the uncertainty analysis, and show the contours of drawdown percentiles based on over 200 models of equivalent calibration.

The bores on Commonwealth land are monitoring bores and changes in water level would not likely significantly affect their operation. Seasonal water level fluctuations of one to two metres could be reasonably expected and the predicted drawdown is within the magnitude of drawdown change experienced during the Millennium Drought.

It is acknowledged that bores may exist that are not identified on the DELWP Water Measurement Information System (WMIS), such as older bores drilled pre-1969, or unregistered bores.

Proposed avoidance and mitigation measures

The avoidance and mitigation measures are the same as those proposed during construction. During construction, water supply to identified groundwater users would be maintained, and so these controls should have been implemented before the completion of construction.

Ongoing monitoring of water levels would be required to confirm the adequacy of applied measures as identified in the Groundwater Management Plan (GMP). Private bores installed after the completion of construction would be expected to have been constructed to accommodate any longer-term water level changes.

Residual impact

The residual impact is predicted to be low and not significant.

24.4.8 Operational impact from drawdowns on acid sulfate geological materials

Impact description

The operational impacts from disturbance of acid sulfate materials are similar to those described in described in Section 24.4.3.

Predicted water level changes during operation of North East Link, based on the initial modelling, are shown in Figure 24-4 and Figure 24-5 for the 95th percentile (drawdown) and 5th percentile (mounding) respectively. Figure 24-7 shows the predicted impacts on groundwater levels based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted for the initial numerical groundwater modelling. Refer to Section 24.4.1 for more information about the additional groundwater modelling undertaken.

Groundwater monitoring would be used to determine if PASS materials have oxidised and generated acidic groundwater conditions during construction. Close to the excavations, water level drawdowns experienced during construction would recover during operation. Although the areal extent of drawdown is greater, the magnitude of drawdown is within seasonal variations and so would unlikely expose fresh bedrock.

Proposed avoidance and mitigation measures

Mitigation measures proposed as part of the design and construction also apply to operation. The primary control is the tanking and water tightness of proposed structures. Water level drawdowns are expected to be at the maximum towards the end of construction, Partial, and in some areas, full recovery of water levels is predicted to occur after construction is complete.

A key requirement is the monitoring of water levels and quality during construction. Further sampling for acid generating materials is expected to be undertaken as part of detailed design Where the oxidation of acid sulfate soils has been identified, as being a high risk (either from detailed design investigations, or from further numerical modelling), contingency measures in the Groundwater Management Plan would be implemented to protect groundwater quality. Monitoring of groundwater would continue into operation for two years or until the groundwater quality has been acceptably restored.

Residual impact

With the proposed mitigation, residual impact significance is predicted to be low and not significant.

24.4.9 Operational impact from drawdowns on contaminated groundwater plumes

Impact description

The operational impacts from disturbance of acid sulfate materials are similar to those in described in Section 24.4.9.

Under operating conditions, the magnitude of drawdown relative to construction is much less, although the extent of drawdown could be greater. The further modelling indicates reduced extents of operational drawdown compared to that of the initial numerical groundwater modelling, however, the former did not include the uncertainty analysis.

Although the operational drawdown would be greater in area, the magnitudes are typically within the seasonal water table fluctuation ranges. Therefore changes in water levels, and the resulting implications on contaminated groundwater plumes, are potentially localised.

Groundwater monitoring bores have been identified on Commonwealth land. Groundwater quality information was requested from the DoD but none was made available.

Predicted drawdowns during operation of North East Link, based on the initial modelling, are shown in Figure 24-4 and Figure 24-5for the 95th percentile (drawdown) and 5th percentile (mounding) respectively. Figure 24-7 shows the predicted impacts on groundwater levels based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted for the initial numerical groundwater modelling. Refer to Section 24.4.1 for more information about the additional groundwater modelling undertaken.

The long-term drawdowns are predicted to extend beneath the fuel service station at the intersection of Yallambie Road and Greensborough Road (Commonwealth land), and the former Borlase Reserve landfill. Groundwater contamination has been identified in the north-west corner of the Commonwealth land.

Proposed avoidance and mitigation measures

Mitigation measures proposed as part of the design and construction also apply to the operation of North East Link. The primary control is the tanking and water tightness of proposed structures. Water level drawdowns are expected to be at the maximum towards the end of construction. Partial, and in some areas, full recovery of water levels is predicted.

Further investigations would be completed during the design phase to delineate the groundwater quality in these areas. Where the contaminated groundwater has been identified, contingency measures as per the Groundwater Management Plan would be implemented to manage the plume during construction. This would include monitoring of water levels and quality during construction.

Additional measures implemented during construction could include source removal, clean-up and/or hydraulic control of the plume. During operation, it is assumed the management of the plume would no longer be required, or at least management regimes could be adapted to the new groundwater conditions post construction.

Monitoring of groundwater would extend into operation to confirm that groundwater quality has been acceptably restored.

Residual impact

With the proposed mitigation, residual impact significance is predicted to be low and not significant.

24.4.10 Operation impact of project representing a barrier to regional groundwater flow

Impact description

The presence of a tunnel or cut and cover structure, whether it is drained or tanked, can impede regional groundwater flow. This would most likely occur when the impediment is aligned perpendicular or oblique to the regional groundwater flow direction.

Predicted drawdowns during operation, based on the initial modelling, are shown in Figure 24-4 and Figure 24-5 for the 95th percentile (drawdown) and 5th percentile (mounding) respectively. Figure 24-7 shows the predicted impacts on groundwater levels based on the further groundwater modelling, noting this data does not include an uncertainty analysis as conducted for the initial numerical groundwater modelling. Refer to Section 24.4.1 for more information about the additional groundwater modelling.

The long-term drawdown impacts predicted by both numerical groundwater models do not indicate the presence of impediments to regional flow. In this area, groundwater flow is southward towards the northern portal/Yarra River and aligned or parallel with North East Link. The effect of structures being a barrier to regional flow is predicted to be negligible on Commonwealth land.

Proposed avoidance and mitigation measures

The construction of a watertight structure provides the benefit of minimising a number of potential impacts to groundwater by reducing groundwater drawdown. The disadvantage of this is the formation of a barrier to regional hydraulic flow.

Analysis has indicated that mounding would unlikely result in shallow water tables and groundwater logging and impacts to Commonwealth land. Monitoring is required to verify the predicted changes in groundwater level. Ongoing monitoring during operation is undesirable and it is proposed that monitoring be undertaken over a duration that verifies the predictive numerical groundwater model.

Residual impact

No residual impacts are anticipated.

24.4.11 Operational impact to streamflows

Impact description

Receptors affected are waterways and associated dependent ecosystems that are fed by groundwater discharge. Assessment of impacts to ecological receptors is documented in PER Technical Appendix A – Flora and fauna technical report.

On Commonwealth land, Banyule Creek is ephemeral in the upper parts of its catchment and not considered to be significantly linked to groundwater.

Proposed avoidance and mitigation measures

Mitigation aimed at preventing impacts to stream flow from groundwater fluctuations is not relevant to impacts on Commonwealth land.

Residual impacts

No residual impacts are anticipated.

24.4.12 Construction impacts of a northern TBM launch

The potential groundwater impacts of the alternative TBM launch site have been reviewed. Generally, the TBM results in the permanent, tanked tunnel lining being placed during construction. Therefore, over the TBM tunnel sections of North East Link, there would not likely be any change to the impact assessment based on tunnel drive direction. On the assumption that the portal structures (TBM launch and retrieval) remain a similar size, some variation in the drawdown during construction may occur.

This is because the portal construction timings (durations) may be altered; that is, a drawdown at the northern portals may occur earlier than predicted by the numerical groundwater model. At the close of construction, the magnitude of drawdowns should be similar.

The change in launch direction does not alter the conclusions of the impact assessment and the mitigation that have been developed are equally applicable.

24.5 Residual impacts

Table 24-1 summarises the residual groundwater impacts.

Table 24-1 Summary of residual groundwater impacts

Impact	Mitigation	Significance of residual impact
Impact to groundwater quality from discharges during construction	Standard preventative measures and monitoring set out in relevant CEMPs and Groundwater Management Plans.	No significant residual impacts
Construction impact to existing groundwater users from water level decline	• Construction methods to minimise changes to groundwater levels (such as tanked lining, vertical cut off walls to minimise lateral ground water flows) • Aquifer recharge where appropriate • Altered depth, location or supply for affected water resources	No significant residual impacts
Construction impact from drawdowns on acid sulfate geological materials	• Minimising drawdowns (see above) • Assess vulnerability of foundation materials • Monitoring of groundwater levels and quality	No significant residual impacts
Construction impact from drawdowns on contaminated groundwater plumes	• Minimising drawdowns (see above) • Monitoring of groundwater levels and quality • Measures to control migration of contaminants as described in Section 28	No significant residual impacts
Operational impact to groundwater quality through spillage or runoff.	• Implement an OEMP • Apply WSUD principles to the stormwater management regime • Provide spill containment facilities in accordance with AustRoads requirements.	No significant residual impacts
Operational impact to existing users and depletion of groundwater resources	Mitigation for construction impacts would also apply during operation.	No significant residual impacts

Impact	Mitigation	Significance of residual impact
Operational impact from drawdowns on acid sulfate geological materials	Mitigation for construction impacts would also apply during operation.	No significant residual impacts
Operational impact from drawdowns on contaminated groundwater plumes	Mitigation for construction impacts would also apply during operation.	No significant residual impacts
Operation impact of project representing a barrier to regional groundwater flow	No specific mitigation proposed. Monitoring to verify predictive modelling.	No significant residual impacts
Operational impact to streamflows	No specific mitigation proposed.	No significant residual impacts

25. Relevant impacts on water resources

25.1 Simpson Barracks

Table 25-1 summarises the performance of the action on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks) on water resources against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 25-1 Relevant impacts on water resources – Simpson Barracks

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Measurably reduce the quantity, quality or availability of surface or ground water	**Groundwater** A combination of dewatering in excavations, seepage into new below ground structures and use of groundwater by the construction contractor would likely cause drawdown of ground water below Simpson Barracks. Close to the edge of the trench structure this could be up to three metres, although the majority of the land affected on Simpson Barracks would experience groundwater level changes of less than one metre. This situation remains post construction although the area of zero to one metre drawdown extends eastwards in the decades following the end of construction. Initial modelling of two monitoring bores at Simpson Barracks (of unknown depth) predicted drawdowns of 0.5 to one metre during construction and 0.1 to 1.1 metres during operation, although these are not extractive. Further modelling predicted the two monitoring bores to experience drawdowns of 0.1 to 0.5 metres during construction and operation Measures would be employed to minimise groundwater drawdown (including tanked lining of permanent below water table structures) and careful management of construction activities through a Groundwater Management Plan including ongoing monitoring and modelling of groundwater behaviour. A construction contractor would tailor the Groundwater Management Plan to the specific requirements of North East Link, consult with EPA Victoria (and any other relevant authorities) in preparing the plan and develop the plan and requirements to a level that satisfies the independent environmental auditor. No known human uses of groundwater on Simpson Barracks would be affected although some mature trees near the eastern EPBC boundary at Simpson Barracks may lose access to groundwater in drought conditions. This is discussed in Section 5. There are several means by which groundwater quality could be affected: • Accidental introduction of liquid contaminants as part of construction activities (such as from spills, fluid waste disposal, leaching from fill or use of contaminated fluid for artificial recharge). These would be managed by standard preventative measures and monitoring set out in relevant CEMPs. • Creation of acid plumes due to exposure of existing potentially acid sulfate soils by lowered groundwater levels. However, the risk of this is low as the magnitude of dewatering on Simpson Barracks would not likely expose fresh bedrock. • Creation of plumes of contaminants migrating from existing sources of in-ground contamination. With additional surveys, treatment and preventative measures during construction (see Section 28) the risks are considered low.

Assessment criteria	Impact
	Surface water Alterations to Banyule Creek and catchment may increase peak flows with potential for flooding. North East Link would be designed to not increase flood risk, in accordance with the requirements of the relevant drainage authority, and in consultation with other relevant authorities. This could include measures such as flood storage and outlet controls, suitably large inlet grill capacity, design and management of overland bypasses. During construction risks of spills, mobilisation of pollutants or sediment erosion reducing water quality would be managed using standard preventative measures and monitoring set out in relevant CEMPs and SWMPs. Operational runoff quality would be managed by adopting WSUD and integrated water management principles in the stormwater treatment design.
Channelise, divert or impound rivers or creeks or substantially alter drainage patterns, or	Construction of North East Link requires diversion of Banyule Creek on Simpson Barracks away from construction activities and the infrastructure during operation (and particularly the tunnel portal). During construction a temporary diversion is likely to comprise pipes either side of the proposed northern portal to pick up the east and west catchments respectively. The diversions, bunding and other 'temporary' features would be in place and operating effectively minimise any adverse impacts. On completion, Banyule Creek would be replaced a properly engineered solution in combination with flood storage and treatment trains significantly improving waterway stability. Large inlet grill capacity with downstream orifice to regulate outlet capacity and or design and management of overland bypasses may be required to manage inlet blockage during construction. Connections with upstream tributary streams and drains would need to be suitably designed to avoid increased tail water which might lead to flooding or reduced tail water levels which without appropriate management may lead to headward and or gully erosion. Impact on the aquatic habitat of the diverted section of Banyule Creek are described in Part B.
Measurably alter water table levels?	North East Link is predicted to measurably change ground water levels, as discussed above. However, in the long term, these changes are comparable to the range of current seasonal fluctuations and are not expected to have a significant impact on sensitive receptors, with the possible exception of tall trees on the western edge of Simpson Barracks. Impacts on these are discussed in Section 5.

25.2 War Services easement

Table 25-2 summarises the performance of the action on Commonwealth land at the War Services easement on water resources against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts relating to Commonwealth land (DSEWPAC, 2013b).

Table 25-2 Relevant impacts on water resources – War Services easement

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Measurably reduce the quantity, quality or availability of surface or ground water	**Groundwater** Works within or near the War Services easement would have limited interaction with the groundwater environment and risks to groundwater in this area are low. The potential for a spill of hazardous material on the War Services easement during construction impacting groundwater would be managed through appropriate controls to manage risks from chemicals, fuels and hazardous materials. Any accident would likely be localised and an emergency services response likely to be rapid, reducing the potential for contamination of groundwater. **Surface water** There are no surface water bodies in the War Services easement and no significant changes to nearby drainage or flood levels are anticipated from North East Link. During operation of North East Link, the potential for pollutants to end up in waterways and groundwater has been minimised by the inclusion of water treatment features along the alignment. One of these features is a water treatment bioretention pond to be located partly on the War Services easement that would filter and treat the stormwater captured by new road surfaces.
Channelise, divert or impound rivers or creeks or substantially alter drainage patterns, or	There are no surface water bodies in the War Services easement. North East Link would not substantially alter drainage patterns on the War Services easement.
Measurably alter water table levels?	Works within or near the War Services easement would have limited interaction with the groundwater environment. North East Link works on the War Services easement would not measurably alter water table levels.

Part G Pollutants, chemicals, and toxic substances

26. Water quality

Pollutants, chemicals, and toxic substances include those that enter the environment through emissions to water or through disturbance of contaminants in the existing environment by the action. A separate discussion of water-related impacts and a description of pollutants emitted to water is discussed in Part F (as well as PER Technical Appendix B – Groundwater technical report and PER Technical Appendix C – Surface water technical report). However, Table 30-1 takes account of water pollutants in summarising the overall residual impacts for pollutants, chemicals, and toxic substances.

27. Air quality

Pollutants, chemicals, and toxic substances include those that enter the environment through emissions to air. In the context of an urban transport project, the principal receptors of impacts from these emissions are people and communities. Consequently, the description of pollutants emitted to air is discussed in Part C. However, Table 30-1 takes account of air pollutants in summarising the overall residual impacts for pollutants, chemicals, and toxic substances.

28. Contaminated land

28.1 Introduction

GHD undertook an assessment of the contaminated land impacts of North East Link on Commonwealth land. This section summarises the assessment's findings.

28.2 Assessment method

28.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 28-1 summarises the other key policies and guidance relevant to the assessment.

Table 28-1 Key legislation, policy and guidance for contamination

Policy/guidance	Relevance
National Environmental Protection (Assessment of Site Contamination) Measure 1999, as amended in 2013 (ASC NEPM).	The main guidance document for the assessment of land contamination. The ASC NEPM provides a national approach to the assessment of potentially contaminated sites to ensure effective management by the community and provide adequate protection of human health and the environment where known contamination has occurred.
Environment Protection Act 1970 (VIC)	The Act: • Makes provisions with respect to the powers, duties, and functions of EPA Victoria and the protection of the environment • Regulates the discharge or emission of waste to water (including groundwater), land or air • Enables EPA Victoria to require investigation and clean-up of identified impacts • Provides the basis for the various State Environment Protection Policies (SEPPs).
SEPPs	Subordinate legislation made under the provisions of the Environment Protection Act, and sets policies to define environmental quality objectives, and establish beneficial uses and values to be protected in different segments of the environment.
Environment Protection (Industrial waste resource) regulations 2009	These regulations assist industry to implement the principles of waste hierarchy, prescribe requirements for assessing and classifying industrial waste, and encourage industry to use industrial waste as a resource and prescribed requirements for the transport and management of industrial waste.

28.2.2 Relevant assessment criteria

Contaminated land impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2. Table 30-1 summarises the performance of North East Link against these criteria.

Specific contamination assessment guidelines are derived from industry publications including:

- ASC NEPM (see above)
- Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000)
- Industrial waste resource guideline (IWRG) Soil Hazard Categorisation and Management (EPA Victoria, 2009)
- National Health and Medical Research Council 2011, Australian Drinking Water Guidelines (NHMRC, 2011)
- National Health and Medical Research Council (NHMRC) 2008, Guidelines for Managing Risks in Recreational Waters (NHMRC, 2008)
- PFAS National Environmental Management Plan (HEPA, 2018).

28.2.3 Assessment scope

Study area

The assessment looked specifically at impacts related to contamination on receptors within Commonwealth land at Simpson Barracks and the publicly accessible Commonwealth land south of Simpson Barracks, within 500 metres of the project boundary (see Section 3.1) as described in the PER Guidelines (see Section 4.2.2).

Contamination impacts on the War Services easement located at the rear of properties on Elder Street, Watsonia are discussed in Table 30-2.

Scope of impacts

The assessment looks specifically at contaminated land impacts on Commonwealth land, including:

- Impacts on human health and the environment (via direct contact and vapour inhalation) from excavation, stockpiling, transport and treatment/disposal of contaminated soil
- Impacts on human health and the environment (via direct contact and dust inhalation) from excavation, stockpiling, transport and treatment/disposal of acid sulfate soil and rock
- Impacts on human health and the environment from disturbance of former landfill(s) and/or uncontrolled fill site(s) (known or unknown)
- Impacts on human health and amenity from offensive odour released by disturbed contaminated material
- Impact to public safety, human health and the environment from works causing migration of hazardous vapours, ground gases and/or dissolved methane.

A key means by which contamination in the ground can migrate and cause impacts is via groundwater. Changes to groundwater flows and how these can affect contaminants are discussed in Section 24 and in PER Technical Appendix B – Groundwater technical report.

The potential for spills and leaks from construction equipment to cause contamination of soil leading to impacts to public health and the environment is discussed in Sections 23 and 24.

28.2.4 Description of environment

The assessment of existing conditions was conducted in general accordance with the ASC NEPM. The ASC NEPM recommends a staged approach to site contamination assessment, with each stage informing subsequent stages. The broad scope items included:

- A desktop review of in-house and published information sources to assess the current and former land uses and potential contaminating practices and contaminants of concern
- Request for details of any known contamination on site from representatives of the Simpson Barracks management
- Preliminary intrusive sampling program to obtain some quantitative data on contamination status.

28.2.5 Preliminary field investigations

As of 11 October 2018, the field program to assess presence of contamination within Commonwealth land included:

- Drilling and sampling of 14 soil bores for contaminants of concern and acid sulfate soil/rock
- Analysis of 24 samples from 12 soil bores for contaminants of concern
- Sampling of six rock samples from three bores specifically to assess for the potential of encountering actual or potential acid sulfate soil/rock during construction; samples were collected from between five and 15 metres below ground level (mbgl)
- Conversion of four soil bores into groundwater monitoring wells and sampling of five groundwater monitoring wells (see Section 28.3.4).

All samples were collected with reference to the following guidelines and protocols:

- ASC NEPM
- AS 4482.1 – 2005 Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds. (Standards Australia, 2005)
- AS 4482.2 – 2005 Guide to the investigation and sampling of sites with potentially contaminated soil. Part 2: Volatile Substances. (Standards Australia, 2005)
- EPA Publication 669.1 Groundwater sampling guidelines, 2000. (EPA Victoria, 2000).

28.2.6 Information sources

Data sources used in the contaminated land assessment are presented in Table 28-2.

Table 28-2 Data sources for the contaminated land assessment

Source	Type of data
Search engines	General history of the study area and search for selected sites where historic land use could not be ascertained.
EPA Landfills Register	Lists all current and known closed landfills in Victoria.
Historical aerial photographs	Comparison of 1945 and current aerial photographs to identify likely industrial commercial sites and quarries or landfills. This was followed by a more detailed review of a series of historical aerial photos at locations identified as being of potential interest for further assessment.
Historical certificates of title	Historical certificate of titles from sites identified as being of potential interest for further assessment (that is, not the full alignment).
Historical Melway maps, EPA Victoria records	Potential for current/historic landfills in the study area based on review of historical Melway maps, EPA Victoria records.
VicRoads and local council data	Review of data held by VicRoads and local council (landfill data, where available).
DoD, Management of Simpson Barracks	Information provided by DoD upon request and from DoD's website.
Atlas of Australian Acid Sulfate Soils,	Assess the potential for acid sulfate soil/rock conditions, by review of the Atlas of Australian Acid Sulfate Soils, a web-based hazard assessment tool. The tool is available on the Australian Soil Resource Information System (AIRIS), which provides information about the distribution and properties of coastal and inland acid sulfate soils across Australia.
Groundwater Quality Restricted Use Zones (GQRUZ)	Review of Groundwater Quality Restricted Use Zones (GQRUZ) located within the study area, as declared by the Victorian EPA.
EPA Victoria list of issued Certificates and Statements of Audit	Review of the EPA Victoria list of issued Certificates and Statements of Audit. This was initially undertaken to identify the distribution of Environmental Audits undertaken in the study area. Environmental Audits identify specific areas of land on which a Statutory Environmental Audit was conducted. These audits are conducted in response to the identification of contamination that might create a risk to human health or the environment or might affect the uses of that land. It was necessary to review these areas to assess their potential impacts on activities associated with North East Link.
EPA Victoria Priority Sites Register	Review of the EPA Victoria Priority Sites Register to identify the number of potentially contaminated sites in the study area.

28.2.7 Impact assessment

Section 4 discusses the general approach to describing and evaluating impacts on Commonwealth land. The specific approaches to contaminated land impacts during construction and operation are listed in Table 28-3.

The assessment of risk involves consideration of sources, pathways and receptors and potential impacts to those receptors. Guidance on this approach is provided in ASC NEPM.

The risk assessment has been used as a screening tool to prioritise the focus of the impact assessments and development of mitigation measures. The risk pathways link action activities (causes) to their potential impacts on the environmental assets, values or uses that are considered in more detail in the impact assessment. Risks were assessed for the construction and operation of North East Link.

Risks were considered with respect to impact on human health and the environment, excluding risks to construction workers, which would be managed under health and safety requirements specific to North East Link.

Table 28-3 Contaminated land assessment method

Phase	Approach
Construction	• Summarising existing conditions with respect to potentially contaminated land (including landfills), acid sulfate soils and groundwater, including specific information on potential sources of contamination. • Identifying potential impacts of North East Link during construction and operation, including disturbance of contaminated soil (including landfills) and acid sulfate soils and rocks, treatment and disposal options, spills or leaks, and release of vapours or ground gases. • Identification of potential receptors of contamination exposed or released to the environment thorough construction and operation activities. These include human and ecological receptors including local residents and surface water receiving bodies. • Identification of the migration pathways and exposure routes by which contamination exposed or released by construction or operation activities enters human and ecological receptors. Possible exposure routes for humans and terrestrial and aquatic organisms are ingestion, inhalation and/or dermal sorption. Each are dependent of the chemical involved and its properties. • Identification of approaches to manage any other wastes encountered or generated during construction of North East Link.
Operation	Once construction is complete, any contamination left in the ground is assumed to have been stabilised and ongoing impacts are not considered, apart from those related to ongoing groundwater migration described in PER Technical Appendix B – Groundwater technical report (see Section 24).

28.2.8 Assumptions

The contamination assessment has been progressed on the findings of the desktop study, ongoing geological investigations and field observations. The following limitations, uncertainties and assumptions are identified:

- The desktop assessment was limited to publicly and readily available information and is based on conditions that existed at the time the assessment was completed and only limited information was provided by DoD. Specific information about the barracks was obtained from the DoD website. Its findings and conclusions may be affected by the passage of time, by anthropogenic events (such as construction on or adjacent to the referred EPBC boundary) and by new releases of contaminants into the environment.
- Historic land use information presented herein is generally limited to information obtained from local council reports and aerial photographs taken during the late 1940s through to current Google Earth images.
- The compiled data does not necessarily include all landfill sites. As acknowledged by EPA Victoria, there is a lack of consolidated data on past Victorian landfills. Landfill sites in and around Melbourne are predominantly former quarry sites (clay pits, sand pits and other large voids) and have tended to ultimately being converted to parks or reserves (Taylor, 2013). However, the likelihood of encountering additional landfills along the alignment, other than those discussed in this section, is considered low.
- Although the information obtained from Atlas of Australian Acid Sulfate Soils map classified the study area as low and extremely low probability of acid sulfate Soil occurrence, CSIRO also noted the classification to be provisional, as analytical data was not available when the plan was prepared. Further assessment of acid sulfate conditions may be required.
- The Priority Sites Register (based on EPA Victoria data dated 31 March 2018) does not list all known contaminated sites in Victoria and a site should not be presumed to be free of contamination, just because it does not appear on the register.
- The assessment of commercial and industrial sites operational at the time of the investigation was limited to the results of a brief internet search and did not involve a site visit or detailed review. No interviews with site owners or operators were undertaken.
- Properties that appeared to be used for residential purposes in 1945 and currently were generally assumed to have a low potential for contamination of soil and groundwater.
- Contractors appointed to construct North East Link would be required to carry out detailed investigations in accordance with relevant industry standards as part of the detailed design and construction to supplement the information contained in this section.
- Investigation locations for assessing land contamination were based on opportunistic sampling associated with geotechnical drilling and some targeted locations based on the preliminary desktop review and field investigations.
- Interpretation of subsurface conditions and the nature and extent of contamination on Commonwealth land was based on limited sampling and is considered indicative only. It was based on field observations and laboratory analytical data from widely spaced sampling locations originally designed as part of the wider assessment of the entire North East Link alignment and not specifically to the Commonwealth land. Therefore, the investigation was not conducted at a frequency that meets minimum standards for site assessments. Further investigations to achieve at least minimum industry standards, would be undertaken during detailed design.

- This section details the findings of a desktop study and preliminary sampling program. It is recognised this represents a relatively early stage in North East Link's life. As with all projects of this size, further information would need to be obtained to reduce the level of uncertainty and limitations associated with this phase, particularly in relation to the volume of contaminated waste categories.
- Historical aerial photography has identified a former landfill site located outside the south-western boundary of the un-fenced Commonwealth land associated with the Simpson Barracks property. There is some uncertainty as to the extents of the landfill area, but from the historical records it is considered unlikely that it extends into the barracks to the north.
- The assessment does not include an assessment of the loss of a resource from removal of soil.

28.2.9 Linked sections

Table 28-4 lists other technical assessments from which information has been drawn for this study.

Table 28-4 Linkages to other assessment

Reference	Topic	Link
Section 5 and PER Technical Appendix C – Surface water technical report	Flora and fauna	Provides an assessment of North East Link's impacts on aquatic and groundwater dependent ecosystems and communities in surface water bodies along the alignment. Specific to contamination, the ecology helps define the protected beneficial uses of surface water and the levels of protection from contamination. The potential for contamination to impact aquatic and terrestrial habitats is discussed in Section 5.
Section 14	Air quality	Provides an assessment of North East Link's impacts on air quality. This is relevant to spoil management, notably for the protection of any stockpiled soil and generation of dust during construction works which might liberate contamination. The potential for contamination to impact air quality during excavation and transport is discussed in Section 14.
Section 15	Human health	Provides an assessment of the action's impacts on human health. Contamination in soil can occur at concentrations in excess of guidelines protective of human health. Understanding these concentrations is important in developing management plans and mitigation measures to limit possible exposures during construction and transport of soil through the community. Section 15 assesses the potential health risks associated with exposing and transporting contaminated soil.
Section 23 and PER Technical Appendix A – Flora and fauna technical report	Surface water	Provides an assessment of the action's impacts on surface water bodies along the alignment. Specific to contamination, the action may create runoff of soil and sediments to the surface water that may be contaminated and thereby affect water quality. The potential for contamination to impact surface water bodies is discussed in Section 23.

Reference	Topic	Link
Section 24 and PER Technical Appendix B Groundwater technical report	*Ground-water*	Assesses North East Link's impacts on groundwater. The presence of contaminated soil can act as a source of contamination to groundwater through rainwater leaching. Dewatering during construction may lead to the mobilisation of contaminants towards extraction points, which would require management. The potential for contamination in groundwater to be discharged into surface waters are discussed in Section 24. Drawdown from construction dewatering or abstraction causes movement of groundwater which can lead to plumes of contaminants migrating from existing sources.

28.2.10 Stakeholder consultation

Stakeholders and the community were consulted to support the preparation of the North East Link EES and PER and to inform the development of North East Link and an understanding of potential impacts.

Table 28-5 lists specific engagement activities specific to Commonwealth land related to contaminated land, with more general engagement activities occurring at all stages of North East Link.

Table 28-5 Stakeholder engagement undertaken for contamination

Stakeholder	When	Matters discussed	Outcome
Simpson Barracks, Commonwealth DoD	August to October 2018	Requests were made for information relating to contamination at the barracks.	A response was received on 29 October 2018 stating there are two known underground storage tanks on the site and there may also be other contamination resulting from the past 40 years of operation.
Communication with Banyule City Council	4 April 2018	Sought information on former landfills located at AK Lines Reserve, Watsonia and Borlase Reserve, Yallambie.	Received the municipality's contaminated land register, which identified AK Lines Reserve as former landfill.
Communication with VicRoads	2017 to 2018	Geotechnical data was requested.	Provision of geotechnical reports which included information on contaminated sites and former landfills.
Communication with United Energy petroleum	5 April 2018	Sought historical groundwater monitoring data and/or access to site to sample existing groundwater monitoring wells in relation to the fuel service station on Yallambie Road and Greensborough Road.	Advised no groundwater monitoring wells on-site.

28.3 Description of environment

28.3.1 Topography drainage and ground conditions

Topography, drainage, soils, geology and groundwater conditions are important factors in relation to contaminated land. These are discussed in Section 24.

28.3.2 Existing and historic land uses

Review of publicly available information and selected aerial photographs from the 1940s onwards indicated that existing land uses of Simpson Barracks included:

- Agricultural land
- Military base and associated activities.

Simpson Barracks was established in the 1940s and occupies approximately 22 hectares of land. Potential or known contaminating activities include:

- Bulk fuel storage and distribution
- Former sewage treatment plant
- Battery stores
- Several landfills that have been used to dispose waste from defence operations (DoD, 2016).

According to the website, the only known contamination issue relates to buried ACM which has been identified '*in many locations across the property*'.

A service station located at the north-west corner of Simpson Barracks (shown in Figure 28-2) was considered an 'area of interest' for North East Link with respect to a source of contamination, since contaminants (hydrocarbons leaked from underground tanks) have already migrated across the boundary into the rocks underlying the Commonwealth land.

28.3.3 Potential sources of contamination

A summary of the potential sources of contamination, contaminants of concern, and how pathways from these could be created, is presented in Table 28-6. Locations of known contamination are shown in Figure 28-1.

Table 28-6 Potential source of contamination

Potential source of contamination	Location	Potential impact pathway	Potential contaminants of concern
Active fuel service station – loss of fuels from the fuel delivery system including the underground and above ground tanks, and fuels/oils/solvents from possible workshop use on-site.	Yallambie Rd, within the North East Link EPBC boundary.	Excavation of soil/rock, vapour inhalation and abstraction of groundwater.	• Total petroleum hydrocarbons (TPHs) • BTEX • PAHs • phenol • chlorofluorocarbons • acids • alkalis • asbestos from brake replacement activities • Antifreeze (ethyl-alcohol, ethylene glycol, isopropyl alcohol, methyl alcohol). • Light non-aqueous phase liquid (LNAPL) • Solvents (including chlorinated hydrocarbons) • Metals (such as copper, chromium, lead, zinc) • ACMs
Simpson Barracks Defence information from the DoD's website confirmed that the property contains several historic landfills, containing waste from defence operations and potentially ACM. Potential for underground storage tanks (USTs); storing diesel, petroleum and waste oil Storage/use explosive ordnance	Simpson Barracks	Excavation of soil and abstraction of groundwater, vapour migration.	Potential asbestos, metals, TPHs, BTEX, PAHs, MAHs, UXO
Borlase Reserve, Yallambie	Former landfill (filling occurred during the early to mid-1960s of solid inert waste and possible putrescible waste). The reported edge of the landfill is approximately 170 m south of the Commonwealth land (see Figure 28-1).	Disturbance of waste, abstraction of groundwater, gas migration.	NEL geotechnical investigations identified minor amounts of construction and demolition wastes, at depths generally less than 3 m, (that is, above the groundwater table). Potential contaminants of concern are: landfill gases (methane, carbon dioxide, hydrogen sulphide and carbon monoxide), ACM, heavy metals, nutrients (ammonia, nitrate, phosphorous), TPHs, BTEX, PAHs, MAHs.

28.3.4 Preliminary field investigations

Preliminary field investigations (the scope of which is listed in Section 28.2.5) were undertaken to provide better understanding of the quality of soil and groundwater, landfills/fill sites and the presence of acid sulfate soil and rock within the study area. Sample locations were both targeted at potential contamination sources identified in the desktop study and opportunist (using geotechnical boreholes). Sample locations are shown in Figure 28-2.

Soil contamination investigation

The result of the soil sampling is summarised below. Full details are provided in Appendix A.

A total of 24 primary soil samples were analysed to assess the potential requirements for offsite treatment and disposal with the soil analytical results screened against current EPA Victoria Soil Hazard Categorisation and Management Guideline (EPA Victoria, 2009). Samples were submitted under chain of custody (COC) procedures to ALS Environmental Pty Ltd (primary laboratory) and Eurofins-MGT Pty Ltd (secondary laboratory). Both laboratories are NATA accredited for the analysis requested.

Field observations during drilling did not identify any indication of landfilling.

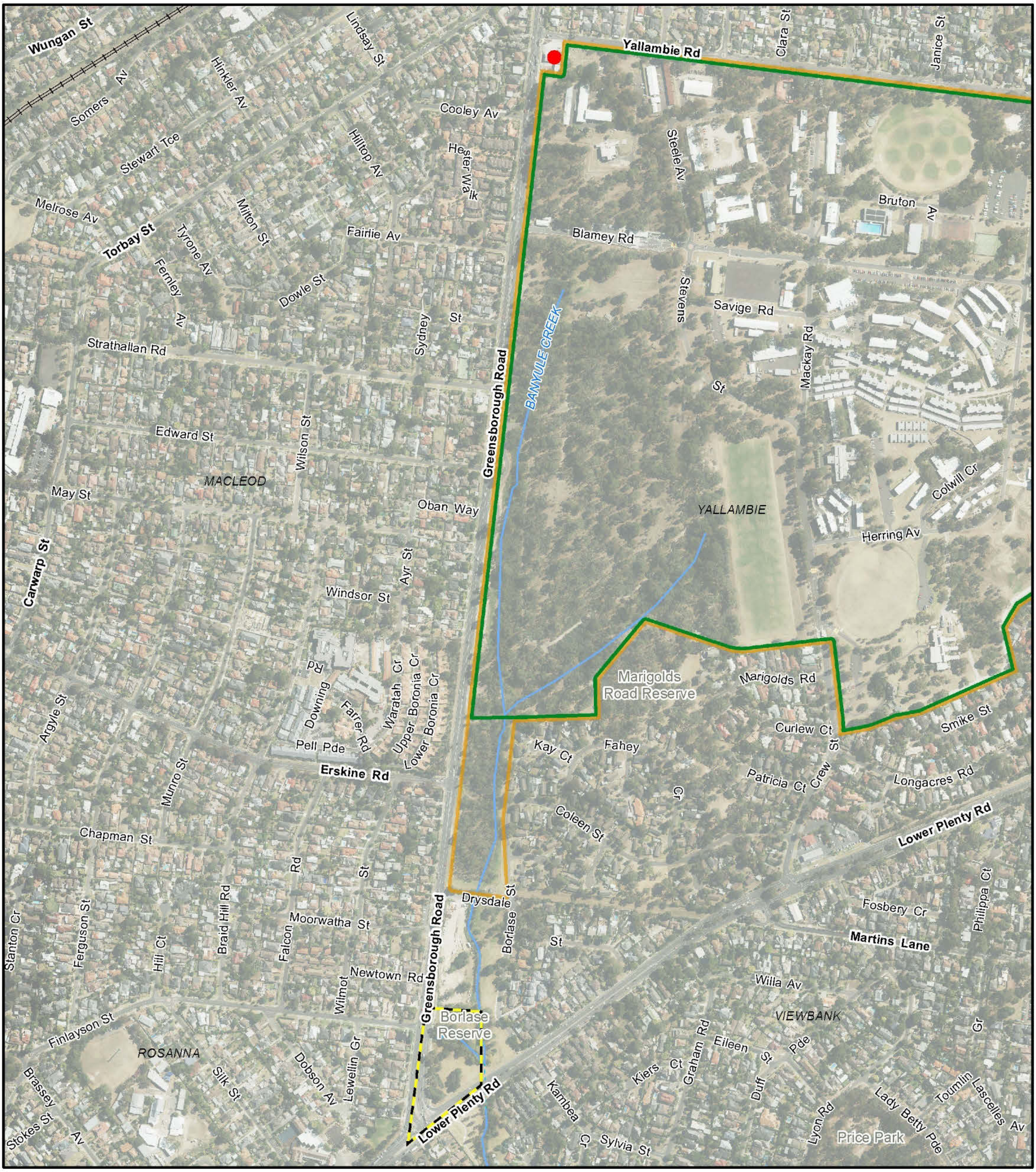
The concentrations of contaminants of concern were generally below laboratory levels of reporting (LOR) and the adopted waste classification criteria (EPA Victoria, 2009). Data exceeding the adopted waste classification criteria can be summarised as follows:

- Twelve soil samples collected from nine locations exceeded the upper Fill Material threshold limits due to elevated concentrations of fluoride. This soil would be categorised as Category C (Contaminated soil). However, a number of lines of evidence suggest the fluoride is naturally occurring and there is a case for re-classification of those soils as Fill Material. The lines of evidence include:
  - The samples were from the Silurian siltstones
  - Elevated fluoride is commonly found in Silurian siltstones throughout Melbourne
  - The elevated fluoride occurs along the length of the alignment and there are no obvious sources of fluoride over such a large area.
- Six samples reported lead concentrations indicating the need for leachate testing. Four were tested for leachability with the results indicating no detectable lead in the leachate.

No samples were classified as acid sulfate soil.

Groundwater investigation

The results of groundwater investigations are discussed in Section 24 and PER Technical Appendix B – Groundwater technical report.



Legend

- Commonwealth land
- Barracks fenceline
- Railway
- Stream
- Drain/channel/other

Contaminated Sites

- Current Service Station
- Former landfill

Paper Size A4

0 50 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	C
Date	26/02/2019

Locations for known contamination on Commonwealth land

Figure 28-1

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4P.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Boreholes - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

Legend

- Commonwealth land
- Railway
- Stream
- NEL Bore Database

Paper Size A4

0 40 80 160

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

NORTH EAST LINK PROJECT

North East Link Project
Public Environment Report

Job Number	31-35006
Revision	A
Date	15/01/2019

Soil and GW locations along Simpson Barracks

Figure 28-2

G:\31\35006\GIS\Maps\Working\KBM\EES_PER_Technical_Report\PER_Technical_Reports_A4P.mxd
180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: CIP Imagery - DELWP - 2018 | NEL Boreholes - 2018 | roads, watercourses, parks, rail, localities - Vicmap - 2018 Created by: mjshrives

28.4 Relevant impacts and mitigation measures

28.4.1 Impacts from excavation of contaminated material

Impact description

Earthworks may require excavation, stockpiling, transport and treatment/disposal of contaminated soil potentially causing temporary, indirect impacts to human health (via direct contact and vapour inhalation) and the environment. Earthworks on Commonwealth land would generate a large amount of spoil.

Soil or rock excavated from Simpson Barracks classified as Category C (requiring remediation or landfill) based on natural fluorine content could be reclassified as Fill Material.

However, it is likely that some soil and groundwater would be impacted by petroleum hydrocarbons from the fuel service station at the corner of Yallambie Road and Greensborough Road. Buried waste material is discussed in Section 28.4.3.

Exposure to a human health risk for the occupants of Simpson Barracks has the potential to be realised under the following scenarios:

- Direct contact between skin and contaminated soil or water
- Ingestion of contaminated soil or water
- Inhalation of contaminated dust or vapours, notably from the fuel service station excavation.

Exposure of the environment to an ecological risk has the potential to be realised under the following scenarios:

- Runoff of exposed contaminated soil in stockpiles or open excavations into water courses and drains
- Access to exposed contaminated soil to terrestrial animals and birds.

Proposed avoidance and mitigation measures

Further investigation of the extent of on-site contaminants would be undertaken by the contractor before construction started.

A Spoil Management Plan (SMP) would be developed that would provide guidance for spoil management and disposal during construction to mitigate potential human health and environmental risks. The SMP is based on a waste management hierarchy where landfill disposal is the least favoured option.

Any contaminated materials excavated on Commonwealth land would be managed in accordance with the SMP. The SMP would, where practicable, include requirements to mitigate impacts to the environment and human health by a number of means such as:

- Ensuring all spoil handling and transport is conducted in accordance with the IWRGs
- All stockpile compounds to be appropriately secured to prevent access by the public
- All stockpile areas to be appropriately secured, lined and bunded to prevent leaching to groundwater
- Stockpiled soils to be appropriately covered to prevent leaching by rainwater and runoff to stormwater or surface water
- Stockpile covering to also prevent dust generation to reduce the risk of inhalation of contaminated dust and to discourage terrestrial animal or birds access

- Investigating opportunities for reuse with spoil that is unable to be reused to be removed from the storage sites by truck via designated haulage routes
- Transport companies to be licensed by EPA Victoria to carry contaminated soil, with loads to be appropriately secured and covered to reduce the chance of releases along the transport route that might impact communities. Trucking routes to be selected to minimise the potential for impact to communities.

Depending on the nature and extent of contamination on Commonwealth land, area-specific remediation may be required. This could include on-site treatment techniques that would destroy or remove or reduce the concentrations of the contaminants (such as bioremediation) or techniques that may contain the contamination (such as cement stabilisation, thermal desorption or capping).

Any need for remediation would be taken into account during design and construction. It is recognised that some contamination may remain in the ground post-construction and may be exposed because of construction activities. However, the design would include measures so this material is not left exposed after construction is completed.

EPA Victoria approval may be required for any on-site soil treatment or containment. Management of contaminated soil at an on-site compound would likely be limited by available space. The framework for EPA Victoria's approval would be outlined in the site-specific SMP.

Residual impact

Following implementation of the measures above, the predicted risk to human receptors is considered low and the impact not significant.

Access to in situ contamination after construction would be managed at the design and construction stage through the SMP, which requires maintenance of adequate cover during operation and a record of the location of contaminated soil in case of future excavation of drilling in those areas. Access would also be managed during operation in accordance with an Operational Environmental Management Plan (OEMP).

28.4.2 Impact from oxidation of acid sulfate soil and rock due to excavation

Impact description

Earthworks may require excavation, stockpiling, transport and treatment/disposal of acid sulfate soil (ASS) and acid sulfate rock (ASR) could cause indirect, short-term impacts to human health (via direct contact and dust inhalation) and the environment.

ASS and ASR may also start to oxidise because of changes to the water table resulting from groundwater drawdown. These impacts are summarised in Section 24.3.6 and discussed in more detail in PER Technical Appendix B – Groundwater technical report.

The key activity within this element that has the potential to encounter or activate ASS or ASR is pile installation given the likely depth to fresh Silurian siltstone.

Proposed avoidance and mitigation measures

Acid sulfate soil and rock excavated during the construction of North East Link would be managed in accordance with the SMP prepared and implemented for North East Link.

This would include but not be limited to:

- Characterising ASS and ASR before excavation
- Development of appropriate stockpile areas including lining, covering and runoff collection to prevent release of acid to the environment
- Identifying appropriate sites for re-use, management or disposal of ASS and ASR
- Addition of neutralising compounds to prevent acid formation
- Reducing the chance of oxidation through scheduling practices (that is, ensuring ASS and ASR is not left in stockpiles for any length of time).

Residual impact

Following implementation of the measures above, the predicted risk to human receptors and the environment on Commonwealth land is considered minimal and the impact not significant.

28.4.3 Impact of disturbance of buried waste and other unknown contamination

Impact description

Excavation on Commonwealth land may encounter waste materials containing hazardous substances (including asbestos) in former landfill(s) and/or uncontrolled fill site(s) (known or unknown) causes indirect, short-term impacts to human health.

Borlase Reserve to the south of Simpson Barracks is known to contain a former landfill. While this is reported to contain inert material (see Section 28.3.3), it could contain hazardous materials. While Borlase Reserve is not on Commonwealth land, the precise extent of the former landfill is not known and it is assumed that some excavation on Commonwealth land could disturb this feature, albeit slightly. However, the landfill would be excavated as part of North East Link works not on Commonwealth land.

Waste materials containing hazardous substances could be encountered in other unrecorded sites.

Acid sulfate materials such as bonded cement sheet have been recorded in some areas of Simpson Barracks, although the exact locations have not been made available. These occurrences would likely present a low risk to human health and the environment, but may be identified during construction. The main risk posed by asbestos is thorough inhalation of fibres. This risk is considered low for bonded acid sulfate materials but their disturbance can lead to the release of fibres. Asbestos does not pose an environmental risk.

Proposed avoidance and mitigation measures

Before construction and excavation works started, detailed intrusive in situ soil investigation would be required, including sampling in accordance with EPA Victoria IWRG and Australian Standards.

To protect the environment and human health, a Spoil Management Plan (SMP) would be prepared and implemented and would include a package of mitigation measures to prevent exposure to hazardous or contaminated soil left in the ground after construction, so the material poses no future hazard to human health or ecosystems due to North East Link activities.

The SMP would include health, safety and environmental procedures for the management of hazardous substances in accordance with relevant regulations, standards and best practice guidance and to the satisfaction of WorkSafe and EPA Victoria.

Specific to asbestos, the SMP would include procedures on:

- Identification of the potential areas where asbestos may be present before works start
- Identification of asbestos and ACM in the field
- Reporting of occurrences
- Appropriate Personal Protective Equipment (PPE)
- Engaging an occupational hygienist to assess risks and guide soil movement, storage and disposal of ACMs.

Residual impact

Although construction and excavation may encounter waste materials containing hazardous substances (including asbestos), with the implementation of the measures above, the risk and potential impacts to environment, human health and amenity would likely be low.

28.4.4 Impact from release of vapours and odours due to disturbance of contaminated land

Impact description

Odours can be generated when soil containing odorous wastes, such as petroleum hydrocarbons, or naturally occurring sulphides (which oxidise to produce hydrogen sulphide), are exposed to air.

While these soils or wastes are exposed during excavation in stockpiles on the side of a trench, during off-site transport or during windy conditions, they can continue to emit odour and vapours that could lead to indirect, short-term impacts on the amenity of sensitive receptors in the surrounding area and present localised health and safety risks.

As discussed in Section 28.4.2, the probability of encountering ASSs is low, but odours may result from excavation near the fuel service station on the corner of Yallambie Road and Greensborough Road. Hazardous vapours may be exposed during excavation works around the fuel service station at Yallambie Rd/Greensborough Road.

Additionally, earthworks may cause movement of underground gases with the potential to build up in enclosed spaces and present a public safety risk. Underground gases such as methane can be generated by landfills, the nearest of which is at Borlase Reserve. The risk of methane from this is considered low.

There is also potential for abstraction of groundwater to cause migration of hazardous vapours, ground gases and/or dissolved methane which would impact human health and the environment. Impacts of groundwater migration are discussed in Section 24 and PER Technical Appendix B – Groundwater technical report.

Proposed avoidance and mitigation measures

The potential for odours due to disturbance of contaminated land would be managed under the SMP developed and implemented for North East Link. The SMP would include procedures on:

- Identification of the potential areas of contamination that may pose an odour risk
- Monitoring of the excavated material for possible odour risk
- Implementation of management measures to minimise odour, for example such as covering and/or encapsulation of the stockpiles in a vented tent.

The SMP would contain measures to manage contaminated spoil, monitor and manage intrusive vapour including potentially flammable or explosive conditions in enclosed spaces and other impacts on human health and the environment. SMP would address vapour risks associated with soil, groundwater and landfill conditions as well as measures to manage odour.

Residual impact

Following implementation of the measures above, the predicted risk to human receptors is considered minimal and the impact not significant.

28.4.5 Impact from contaminated groundwater

Groundwater quality can be affected by interactions with contamination or potentially polluting materials naturally occurring within the ground (such as potential acid sulfate soils). Impacts relating to groundwater quality are discussed in Section 24.

28.4.6 Construction impacts of a northern TBM launch

The potential contamination impacts of the alternative northern TBM launch would not change the findings of the assessment above, since the mitigation measures and risks are not predicated on where the tunnel starts but rather the contamination and spoil volumes, which are the same for both TBM launch sites.

28.5 Residual impacts

Table 28-7 summarises the residual contaminated land impacts.

Table 28-7 Summary of residual contaminated land impacts

Impact	Mitigation	Significance of residual impact
Impacts from excavation of contaminated material	• Detailed investigation of on-site contaminants • Prepare and implement a SMP • Where applicable undertake in-situ remediation	Not significant
Impact from oxidation of acid sulfate soil and rock due to excavation	• Prepare and implement a SMP that contains measures to minimise impacts from disturbance of acid sulfate soil	Not significant
Impact of disturbance of buried waste and other unknown contamination	• Detailed investigation of on-site contaminants • Prepare and implement a SMP	Not significant
Impact from release of vapours and odours due to disturbance of contaminated land	• Prepare and implement a SMP	Not significant

29. Greenhouse gases

29.1 Introduction

GHD undertook an assessment of the greenhouse gas (GHG) impacts of North East Link. The impacts of greenhouse emissions from North East Link activities on Commonwealth land are indivisible from those of the action as a whole. Consequently, this section assesses the overall implications for greenhouse emissions due to North East Link.

29.2 Assessment method

29.2.1 Key legislation, policy and guidance

The EPBC Act and relevant associated guidance (described in the main PER document) provide the legal and policy framework for the assessment of impacts on Commonwealth land. Table 29-1 summarises the other key policies and guidance relevant to the assessment.

Table 29-1 Key legislation, policy and guidance for greenhouse emissions

Policy/guidance	Relevance
National Greenhouse and Energy Reporting Act 2007 (NGER Act)	The NGER Act is a national framework for the reporting of energy usage and greenhouse gas emissions by corporations and facilities. This may apply to contractors engaged to construction North East Link as well as the future operator.
National Greenhouse and Energy Reporting (Measurement) Determination 2008 (NGER Measurement Determination)	Made under s. 10(3) of the NGER Act, the NGER Measurement Determination outlines the required methods for measuring greenhouse gases and energy use for reporting.
National Greenhouse Accounts Factors (NGA Factors) (DoEE, 2018)	The NGER Measurement Determination and the NGA Factors have been used as a guide for calculating emissions which are not calculated by the TAGG workbook and supporting carbon gauge calculator.
Environment Protection Act 2017 (Vic)	The Environment Protection Act (EP Act) and the associated *Environmental Protection Act 1970 (Vic)* ('EP Act 1970') defines greenhouse gases as a waste and gives authority to the EPA Victoria to issue approvals and licences.
Climate Change Act 2017 (Vic)	Victoria's *Climate Change Act 2017* sets the legislative foundation to manage climate change risks, and drive Victoria's transition to net zero emissions by 2050.
Greenhouse Gas Assessment Workbook for Road Projects published by the TAGG, February 2013 and its supporting calculator, Carbon Gauge release 01.8. (TAGG, 2013)	The TAGG workbook provides a process for estimating greenhouse gas emissions for major activities of a road project.
Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability (IS) Tool and its supporting resources	IS is a comprehensive rating system for evaluating sustainability across design, construction and operation of infrastructure.

29.2.2 Relevant assessment criteria

GHG impacts are assessed against the relevant criteria from the EPBC Act Significant Impact Guidelines 1.2 (DSEWPAC, 2013b). Table 30-1 summarises the performance of North East Link against these criteria.

29.2.3 Assessment scope

Due to the nature of greenhouse emissions, the scope of the assessment covers emissions of the whole action. The assessment looks at the predicted greenhouse emissions due to North East Link:

- Directly resulting from the construction, operational and maintenance activities along the entire project alignment for a 50-year period
- Indirectly resulting from changes to traffic across the Melbourne road network, including the regional areas of Geelong, Ballarat, Bendigo and Traralgon due to North East Link
- Indirect resulting from greenhouse gas emissions from material use and electricity use.

To determine the aspects to be included in the carbon calculation:

- The Materiality Checklist in the Carbon Gauge calculator (TAGG, 2013) was completed and the greenhouse gas impact assessment boundaries were determined to include Scope 1 and Scope 2 greenhouse gas emission sources and select Scope 3 greenhouse gas emission sources
- The definitions of emission scopes are described within the NGER Act and National Greenhouse and Energy Reporting Regulations 2008 (NGER Regulations) as follows:
  - Scope 1: The release of greenhouse gases into the atmosphere as a direct result of North East Link project activities, such as the combustion of fuel in construction equipment
  - Scope 2: The release of greenhouse gases into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the project through purchases. For instance, the consumption of electricity by the TBM
  - Scope 3 (an additional scope recommended by the Greenhouse Gas Assessment Workbook for Road Projects): Other indirect release of greenhouse emissions.

The emission sources included in the assessment are listed in Table 29-2.

Relative to North East Link as a whole, any differences in carbon emissions between different design or construction alternatives would unlikely be significant and have not been assessed.

29.2.4 Description of environment

Greenhouse gas emissions are a global issue and do not have localised existing conditions. Existing conditions provides a regional context for carbon emissions in Victoria.

29.2.5 Information sources

The following references were used to obtain greenhouse gas emissions associated with the production of raw materials consumed during construction, such as steel:

- Greenhouse Gas Assessment Workbook for Road Projects developed by the Transport Authorities Greenhouse Group, February 2013 and its supporting calculator, Carbon Gauge release 01.8 (TAGG, 2013)
- National Greenhouse Accounts (DoEE, 2017).

Sources of information about North East Link are presented in Table 29-2.

29.2.6 Impact assessment

Calculation

Greenhouse gas emissions from the construction, operation and maintenance of North East Link were estimated using the following three calculation methods:

- The TAGG Carbon Gauge calculator (version 01.8), supported by the TAGG Workbook
- Manual calculation using Microsoft Excel (for tunnel calculations, as the Carbon Gauge Calculator is unsuitable to estimate emissions associated with the construction and operation of tunnels)
- VLC's Zenith Economics Assessment Model (for Scope 3 emissions from road users) (VLC, 2018).

Table 29-2 outlines which calculation approach was used for assessing each emission source.

Table 29-2 Calculation methodologies for greenhouse gas emissions

Emission source category	Emission source	Source of data	Calculation approach
Construction			
Fuel use	Construction plant and equipment	Calculated by Carbon Gauge based on general North East Link information.	Carbon Gauge Release 01.8.
	Site vehicles		Carbon Gauge Release 01.8.
	Transportation of tunnel spoil	Initial estimates provided by reference project engineering team.	Manual calculation based on assumptions listed in 0.
Electricity consumption	Operation of plant and equipment, including TBM	West Gate Tunnel EES Greenhouse Gas Impact Assessment (AECOM, 2017)	Manual calculation based on relative length of tunnels.
	Operation of site office(s)	Assumption based on West Gate Tunnel EES Greenhouse Impact Assessment (AECOM, 2017)	Manual calculation based on assumption from West Gate Tunnel Project.
Materials	Construction materials (excluding materials for tunnel construction)	Initial estimates provided by reference project engineering team.	Carbon Gauge Release 01.8.
	Construction materials for tunnel construction	Initial estimates provided by reference project engineering team.	Manual calculation based on tunnel material estimates provided by Advisian.
	Lime for treatment of acid sulfate soils	Initial estimates provided by reference project engineering team.	Manual calculation based on Acid Sulfate Soil Volume estimates.

Emission source category	Emission source	Source of data	Calculation approach
Land use changes	Vegetation removal	Ecology data from the North East Link EES.	Carbon Gauge Release 01.8.
Operations			
Electricity consumption	Tunnel pumps, lighting and ventilation	Initial estimates provided by reference project engineering team.	Manual calculation based on tunnel power estimate.
	Electrical systems (such as signalling, toll gantries and intelligent transport systems)	Initial estimates provided by reference project engineering team.	Carbon Gauge Release 01.8.
Traffic	Operation of vehicles	Veitch Lister Consulting (VLC) traffic model.	
Maintenance			
Materials	Maintenance materials	Initial estimates provided by reference project engineering team.	Carbon Gauge Release 01.8.

Emission factors

Emission factors and emission rates have been used for calculations of greenhouse emissions from:

- Vehicle traffic in Melbourne – the emission factors for different fuel types give the quantity of greenhouse gases emitted per unit of energy derived from each fuel and vehicle type
- Purchased electricity consumption during operation and construction
- Concrete and steel used in construction
- Agricultural liming – emissions factor
- Diesel fuel.

Greenhouse indicators

The indicators by which this assessment measures greenhouse gas emissions performance are:

- Annual greenhouse gas emissions
- Greenhouse gas emissions per vehicle kilometre travelled (VKT).

The annual greenhouse emissions allow a comparison of total emissions from North East Link to a ‘no project’ scenario; that is, the difference in annual emissions of greenhouse gases if North East Link did not proceed.

The emissions intensity of travel by road of North East Link to the ‘no project’ scenario can be assessed in terms of the greenhouse gas emissions per VKT.

Construction assessment method

Where possible construction greenhouse gas emissions were estimated using the 'Carbon Gauge' calculator. This uses actual construction data from road projects to calculate tonnes of CO_{2-e} of a project based on specified project inputs and comprises the following steps:

- Select major activities
- Complete materiality checklist
- Add project specific data
- Review results.

Greenhouse emissions from the construction of, and manufacture of construction materials for tunnels were calculated using a separate, bespoke Microsoft Excel spreadsheet drawing on approaches used for previous major projects.

Operation assessment method

Greenhouse gas emissions from the operation and maintenance activities for North East Link were primarily calculated using the TAGG Carbon Gauge calculator (version 01.8) for the majority of calculations, and manual calculations for tunnel operations.

Emissions produced due to a change in the Melbourne (statistical division) road network including the regional areas of Geelong, Ballarat, Bendigo and Traralgon due to North East Link were also calculated separately. This assessment used the *Zenith Transport Model Economic Assessment Model* (EAM) based on a reference project (see Appendix A). It estimated the emissions from vehicle travel on the Melbourne road network for the 'no project' and 'with project' scenarios. Further discussion of the transport model is provided in Section 11 – Transport.

29.2.7 Assumptions

- This assessment has been undertaken based upon the information available from the reference project. Where data is not available, conservative assumptions have been made as documented throughout this section.
- TAGG Carbon Gauge calculator (version 01.8) contains various assumptions and limitations of which are provided in Greenhouse Gas Assessment Workbook for Road Projects (TAGG, 2013).
- 0 details which sources of emissions were assessed, assumptions made and data used using Carbon Gauge.
- The following aspects are considered to be immaterial and excluded from the assessment (in accordance with the framework set out in the Australian Government's *National Greenhouse Energy and Reporting Act 2007*):
  - Fugitive emissions (intentional or unintentional leaks or evaporative sources)
  - Employee travel to and from site
  - International delivery of plant, equipment and materials
  - Emissions from disposal of construction waste other than spoil (excluded as a materiality assessment identified that these were immaterial to the total greenhouse gas footprint)
  - Emissions sinks associated with plant vegetation
  - Construction of the motorway control centre
  - Emissions associated with project design phase.

- VLC Zenith model includes various assumptions for induced demand which are discussed in 0. Included in this is the assumption that induced demand from making additional journeys can be assumed to be negligible for a new road connection.
- The assessment is based upon data and best estimates available at the time of the assessment. Results may change in the future as the design of North East Link is further refined. The most recently available emission factors at the time of calculation were used.
- It was assumed for calculation purposes the following would not occur:
  - Inefficient use of materials, fossil fuels and electricity during construction, operation and maintenance
  - Construction delays causing additional consumption of materials and fossil fuels during construction
  - Accidental release of uncombusted natural gas during realignment of transmission gas pipeline
  - Unacceptable quality of materials from the manufacture of precast (or other materials) leading to additional resource consumption
  - Change in the planned operation of the TBM (such as a change in operation speed to reduce vibration or because of unplanned geological conditions)
  - Increases in the project boundary leading to increased vegetation clearing.
- Estimations of operational greenhouse gas emissions due to vehicle traffic do not include changes to fuel efficiency of vehicles over time or the uptake of electric vehicles.

29.2.8 Linked sections

Table 29-3 lists other technical assessments from which information has been drawn for this study.

Table 29-3 Linkages to other technical assessments

Reference	Topic	Link
PER Technical Appendix A – Flora and fauna technical report	Flora and fauna	Greenhouse gas emissions associated with the removal of vegetation during construction have been included in this section.
Section 11	Traffic and transport	Greenhouse gas emissions associated with vehicle traffic across the Melbourne road network, including the regional areas of Geelong, Ballarat, Bendigo and Traralgon, for the 'with project' and 'no project' scenarios were estimated from the VLC traffic modelling.
Section 12	Surface noise and vibration	Greenhouse gas emissions associated with the embodied energy of noise walls installed to mitigate impacts from operational noise emissions have been included in this section.
Section 14	Air quality	Greenhouse gas emissions associated with the consumption of electricity to run the tunnel ventilation system have been included in this section.

29.2.9 Stakeholder consultation

Stakeholder consultation was not applicable to the greenhouse gas assessment.

29.3 Description of environment

In alignment with the Kyoto Protocol and its pledge to the United Nations Framework Convention on Climate Change (UNFCCC) under the Cancun Agreement, Australia has a target of reducing emissions to 5 per cent below 2000 levels by 2020 (AGEIS, 2018). This was updated at the Paris climate change conference to a commitment that Australia will reduce emissions by 26 to 28 per cent of 2005 levels by 2030.

The Victorian Government has set a target of net-zero emissions for the state by 2050, meaning that greenhouse gas emissions will be reduced to the lowest possible amount, and the remaining emissions offset (DELWP, 2016).

The (AGEIS, 2018) reported national emissions for 2016 were 532,971 kt $CO_{2\text{-}e}$, representing an approximate 3 per cent drop in emissions since the 2000 total of 551,786 kt $CO_{2\text{-}e}$. The AGEIS (2018) total for Victoria in 2016 was 115,103 kt $CO_{2\text{-}e}$, an approximate 2 per cent drop since the 2000 Victorian total of 117,757 kt $CO_{2\text{-}e}$.

The most current available data for annual greenhouse gas emissions from road transport are 82,633 kt $CO_{2\text{-}e}$ (Australia) and 19,979 kt $CO_{2\text{-}e}$ (Victoria).

29.4 Relevant impacts and mitigation measures

29.4.1 Construction greenhouse gas emissions

Impact description

The predicted construction greenhouse gas emissions are summarised in Table 29-4.

Construction of North East Link is expected to take seven years. The total calculated greenhouse gas emissions per annum during construction is estimated at approximately 252 kt $CO_{2\text{-}e}$ per annum. This represents 0.22 per cent of Victorian emissions from all sectors in 2016, and 0.05 per cent of the national 2016 emissions (AGEIS, 2018).

The majority of North East Link's predicted construction-related greenhouse gas emissions would be from indirect releases of greenhouse gases from the use of construction materials. This which account for approximately 77 per cent of construction emissions, followed by the operation of plant and equipment (electricity consumption), accounting for 7 per cent.

Table 29-4 Predicted greenhouse gas emissions summary

Emission source category	Emission source	Scope 1 (kt $CO_{2\text{-}e}$)	Scope 2 (kt $CO_{2\text{-}e}$)	Scope 3 (kt $CO_{2\text{-}e}$)	Total* (kt $CO_{2\text{-}e}$)
Construction					
Fuel use	Electricity generation	1	<1	<1	1
	Site vehicles	1	-	<1	1
	Transportation of spoil	49	-	2	51
	Plant and equipment	61	-	11	72
	Demolition and earthworks	57	-	4	66
	Vegetation removal	<1	-	<1	<1

Emission source category	Emission source	Scope 1 (kt CO_{2-e})	Scope 2 (kt CO_{2-e})	Scope 3 (kt CO_{2-e})	Total* (kt CO_{2-e})
Electricity use	Operation of plant and equipment, including TBMs		133	12	145
Materials	Construction materials	-	-	1357	1357
	Liming treatment of acid sulfate soils	-	-	65	65
Land use	Vegetation removal	4	-	-	4
TOTAL* (kt CO_{2-e})		**178**	**133**	**1450**	**1761**

*Due to rounding, figures may appear to not total correctly.

Proposed avoidance and mitigation measures

Measures to minimise greenhouse gas emissions would be developed and implemented for North East Link. The impact assessment identified that material consumption and electricity consumption would be the largest sources of greenhouse gas emissions from North East Link. Practical measures that can be potentially implemented to reduce these emissions include investigating and implementing:

- Energy efficiency measures
- The use of renewable energy
- The purchase of carbon offsets
- Sourcing materials with lower embodied energy.

These measures are directly linked to the Energy and Carbon and Resource Efficiency credits under the Infrastructure Sustainability Council of Australia's (ISCA) Infrastructure Sustainability Rating Tool (IS Rating Tool). Specific credits to be achieved by North East Link in these categories would be determined later in the design process, although before final approval.

Measures would be developed which relate to the North East Link sustainability program, including ratings that would be specified under the ISCA IS rating tool. These sustainability considerations are governed by the North East Link Sustainability Policy. Under the Protocol for Environmental Management (Greenhouse Gas Emissions and Energy Efficiency in Industry) NELP is required to apply best practice with regard to the energy efficiency of the tunnel ventilation system. This would be assessed by EPA Victoria in its determination of the Works Approval Application for the tunnel ventilation system.

Measures are proposed which identify the need to apply best practice to this element of North East Link as follows:

- Develop and implement a Sustainability Management Plan to meet, as a minimum, project sustainability targets, including achieving specified ratings under the Infrastructure Sustainability Council of Australia's Infrastructure Sustainability Rating Tool
- Integrate sustainable design practices into the design process to minimise, to the extent practicable, greenhouse gas emissions arising from construction, operations and maintenance of North East Link. Include mandatory actions under the Protocol for Environmental Management (Greenhouse Gas Emissions and Energy Efficiency in Industry) for selection of best practice energy usage for the tunnel ventilation and lighting systems.

Residual impact

Specific energy and carbon' and 'resource efficiency' targets are intended to be established. Because of the implementation of these targets, the greenhouse gas emissions would be reduced to the degree specified by those targets, or higher. It is therefore anticipated the residual greenhouse gas impact following the mitigation measures would be lower than those predicted in the construction greenhouse gas impact evaluation.

29.4.2 Operational emissions from electricity consumption and maintenance

Impact description

The predicted greenhouse gas emissions from the electricity consumption and materials use in maintenance during operation are summarised in Table 29-5.

The total calculated greenhouse gas emissions per annum during operation (including maintenance) is approximately 84 kt $CO_{2\text{-}e}$ p.a. This represents 0.07 per cent of the Victorian emissions from all sectors in 2016, and 0.02 per cent of national 2016 emissions (AGEIS, 2018).

Table 29-5 Annual greenhouse gas emissions summary during operation (including maintenance)

Emission source category	Emission source	Scope 1 (kt $CO_{2\text{-}e}$)	Scope 2 (kt $CO_{2\text{-}e}$)	Scope 3 (kt $CO_{2\text{-}e}$)	Total* (kt $CO_{2\text{-}e}$)
Operations					
Electricity consumption	Operation of tunnel (such as pumps, lighting and ventilation)	-	54	5	59
	Operation of other technical systems (such as signalling, toll gantries, and operations centre)	-	2	<1	2
Maintenance					
Materials	Maintenance materials	<1	-	<1	1
TOTAL* (kt $CO_{2\text{-}e}$)		**<1**	**57**	**5**	**62**

*Due to rounding, figures may appear to not total correctly.

Proposed avoidance and mitigation measures

A number of practical measures are available to reduce emissions including energy efficiency measures, renewable energy, carbon offsets and using materials with lower embodied energy. These measures are directly linked to the 'Energy and Carbon' and Resource Efficiency categories under the ISCA IS rating scheme being adopted for North East Link.

Residual impact

Specific 'energy and carbon' and 'resource efficiency' targets are intended to be established. Implementation of these targets would reduce greenhouse gas emissions to the degree specified by those targets, or higher. It is therefore anticipated that the residual greenhouse gas impact following the mitigation measures would be lower than those predicted in the operational greenhouse gas impact evaluation.

29.4.3 Operational emissions from vehicle traffic

The predicted greenhouse gas emissions from road traffic during operation in 20126 are summarised in Table 29-6 and for 2036 in Table 29-7. These are predicted to decline relative to the 'no project' scenario.

This section uses the outputs from the VLC model to estimate greenhouse gas emissions from vehicle traffic across the Melbourne (statistical division) road network including the regional areas of Geelong, Ballarat, Bendigo and Traralgon (as described in Section 29.2.6). Table 29-6 and Table 29-7 show model outputs for the Melbourne road network for 'no project' and 'with project' scenarios in 2026 and 2036.

Model outputs estimate a marginal decrease (0.04 per cent and 0.13 per cent respectively) in greenhouse gas emissions in 2026 and 2036 under the 'with project' scenario, compared with the 'no project' scenario. Values have been converted from a weekday value to a yearly value by multiplying by a factor of 330, which is currently considered to be the best known way of converting weekday traffic from day to yearly, and has been used across multiple Melbourne road project calculations.

The results show that while North East Link would increase emissions from cars, this is more than offset by a larger reduction in emissions from heavy vehicles. This is likely to be due to heavy vehicles moving off local roads and on to North East Link.

The results were sensitivity tested by VLC by varying a number of parameters within its model. In all scenarios, emissions from the traffic network were lower with North East Link than without.

Estimations were also made by (VLC, 2018) of the VKT for 'with project' and 'no project' scenarios. While in the 2026 and 2036 'with project' scenarios, North East Link results in a higher daily amount of kilometres travelled, there are also less emissions per VKT compared with the 'no project' scenarios. Estimations of greenhouse gas emissions do not include changes to fuel efficiency of vehicles over time, nor the uptake of electric vehicles.

Table 29-6 Estimated 2026 road traffic emissions

Mode	2026 no project forecast (kt CO_{2-e}/year)	2026 with project forecast (kt CO_{2-e}/year)	Change in emissions (kt CO_{2-e}/year)	Change in emissions (%)
Car	16,851	16,906	+56	0.33%
LCV	1,178	1,175	-3	-0.29%
HCV	3,805	3,744	-62	-1.62%
Total*	**21,835**	**21,825**	**-10**	**-0.04%**

*Due to rounding, figures may appear to not total correctly.
Source: (VLC, 2018)

Table 29-7 Estimated 2036 road traffic emissions

Mode	2036 no project forecast (kt CO_{2-e}/year)	2036 with project forecast (kt CO_{2-e}/year)	Change in emissions (kt CO_{2-e}/year)	Change in emissions (%)
Car	20,005	20,058	+53	0.27%
LCV	1,420	1,414	-7	-0.48%
HCV	4,701	4,622	-79	-1.69%
Total*	**26,126**	**26,093**	**-33**	**-0.13%**

*Due to rounding, figures may appear to not total correctly.
Source: (VLC, 2018)

29.5 Residual impacts

Table 29-8 summarises the residual greenhouse gas impacts.

Table 29-8 Summary of residual greenhouse gas impacts

Impact	Mitigation	Significance of residual impact
The use of construction materials and lime, land use changes, and the consumption of fuel and electricity consumption in the operation of site offices, plant and equipment (including the TBM), site vehicles, and the transportation of plant, equipment, construction materials and tunnel spoil during construction result in the release of greenhouse gas emissions which could contribute to global climate change. The overall construction emissions for the action are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. Only a small proportion of North East Link would lie on Commonwealth land and so emissions associated with construction on this land would similarly represent a small proportion of the overall project emissions. While emissions are not considered significant, the importance of minimising emission is recognised and so mitigation measures have been identified.	Sustainability management through sustainability targets, North East Link Sustainability Policy and Sustainability Management Plan. Further opportunities for greenhouse gas mitigation through sustainable design practices in the design process have been identified.	Not significant
Operational and maintenance activities including consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment result in greenhouse gas emissions, which could contribute to global climate change. The operation and maintenance of North East Link are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. Only a small proportion of North East Link would lie on Commonwealth land and so emissions associated with construction on this land would similarly represent a small proportion of the overall project emissions. While emissions are not considered significant, the importance of minimising emission is recognised and so mitigation measures have been identified.	Sustainability management through sustainability targets, North East Link Sustainability Policy and Sustainability Management Plan Best practice energy efficiency in the tunnel ventilation system Further opportunities for operational greenhouse gas mitigation have been identified	Not significant
Operation of North East Link would cause a change in vehicle flow through metropolitan Melbourne which may result in a minor increase or decrease in the overall vehicle emissions.	Not applicable	Not significant

30. Relevant impacts related to pollutants, chemicals, and toxic substances

30.1 Simpson Barracks

Table 30-1 summarises the performance of North East Link on Commonwealth land at Simpson Barracks (including the publicly accessible Commonwealth land south of Simpson Barracks) related to pollutants, chemicals, and toxic substances against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 30-1 Relevant impacts related to pollutants, chemicals, and toxic substances – Simpson Barracks

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality	**Air quality** As discussed in Section 14, North East Link would generate emissions to air that may impact local air quality. Construction emissions would mainly comprise dust and odour, and would be managed through a Construction Environmental Management Plan (CEMP) and a Dust and Air Quality Management and Monitoring Plan (DAQMMP). Impacts were assessed for operational emissions of particulates (PM_{10} and $PM_{2.5}$), CO, NO_2, BTEX, 1,3-Butadiene, Formaldehyde and PAHs from the tunnel ventilation structure and from changes to surface traffic volumes. In some cases, fine particulates were predicted to exceed the SEPP (AAQ) objectives. This was predominantly because of the predicted background levels, rather than emissions from North East Link. The tunnel ventilation system would be designed to meet EPA Victoria requirements for air quality and to meet in-tunnel air quality standards for CO and NO_2. In-tunnel and ambient air quality monitoring programmes would be developed and implemented, with remedial action taken to the satisfaction of EPA Victoria if standards are not met.
	Water quality There is potential for spills and mobilising sediment and other pollutants in stormwater runoff leading to a reduction in surface water quality (see Section 23.4.2). Groundwater quality could also be reduced by accidental spills or the introduction of contaminated fill (see Section 24.4.2). However, with the application of preventative measures and incident response procedures implemented through a CEMP, the potential for adverse impacts would be minimised. Injection fluids that are consistent with SEPP (Waters) would be used to minimise the risk of impacts on groundwater quality from use of inappropriate quality water for artificial recharge (see Section 24.4.2).

Assessment criteria	Impact
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal	As discussed in Section 23.4.2, construction may require the transportation, storage and use of some hazardous (which could include flammable, explosive, toxic, carcinogenic, or mutagenic substances) materials at Simpson Barracks. North East Link would not have the potential for release of radioactive materials. The amount of hazardous material brought onto and stored on-site would be minimised and would managed in accordance with all legal requirements. The CEMP would contain requirements for management of chemicals, fuels and hazardous materials. As discussed in Section 24.4.5, there is potential for contaminated materials to be disturbed during excavation of the trench. In particular, this could include leaked petroleum from the Yallambie Road fuel service station that had migrated beneath the adjoining Simpson Barracks and various potential materials associated with a landfill on Borlase Reserve immediately south of the publicly accessible Commonwealth land south of Simpson Barracks. A detailed contamination survey would be undertaken before construction and any hazardous material encountered would be treated, handled, transported, and disposed of with procedures to protect health, safety and the environment, implemented through a Spoil Management Plan (SMP). Section 14 discusses emissions to air.
Increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage, or	Construction of North East Link would create greenhouse gas emissions from construction materials, fuel and electricity consumption. The overall construction emissions for North East Link are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. Operation and maintenance activities including consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment result in greenhouse gas emissions. The operational and maintenance emissions for North East Link are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. In terms of vehicle emissions, operation of North East Link would change vehicle flow through metropolitan Melbourne which may result in little change in overall vehicle emissions.
Substantially disturb contaminated or acid-sulphate soils?	Testing as part of the North East Link geotechnical survey identified that although no PASS were detected in the Silurian bedrock underlying Simpson Barracks, there was potential for PASS material to be encountered in deeper, fresher bedrock, and occur at depths greater than 20 m below the surface. Away from the deeper excavations drawdowns decline towards 0.1 to one metre. These drawdowns are within the range of seasonal fluctuation and so PASS geological materials are likely to have already been oxidised, or drawdowns are too small to result in the unsaturation and oxidation of fresh bedrock. Dewatering would be undertaken on Simpson Barracks, but the magnitude of dewatering is not likely to expose fresh bedrock. The primary control for minimising groundwater drawdowns is to minimise dewatering to the extent practicable during construction and operation (see Section 24.4.3). Designers may also need to consider the water chemistry and potentially aggressive nature of groundwater on foundation materials. Groundwater levels and quality would be monitored during construction. A SMP would include measures to manage spoil recovered from excavations that could contain PASS.

30.2 War Services easement

Table 30-2 summarises the performance of the action on Commonwealth land at the War Services easement related to pollutants, chemicals, and toxic substances against the relevant significant impact criteria from the EPBC Act Significant Impact Guidelines 1.2, covering impacts related to Commonwealth land (DSEWPAC, 2013b).

Table 30-2 Relevant impacts related to pollutants, chemicals, and toxic substances – War Services easement

Assessment criteria	Impact
Is there a real chance or possibility that the action will:	
Generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality	**Air quality** North East Link would generate emissions to air that may impact local air quality. Construction emissions would mainly comprise dust and odour, and would be managed through a Construction Environmental Management Plan (CEMP) and a Dust and Air Quality Management and Monitoring Plan (DAQMMP). Combined impacts of tunnel ventilation and surface road emissions are comparable to impacts predicted for Simpson Barracks with surface road emissions having a greater contribution to total concentrations (due to the relative proximity of North East Link and distance from the ventilation structure). **Water quality** There is potential for spills and mobilising sediment and other pollutants in stormwater runoff during construction, leading to reduced surface water quality. Groundwater quality could also be reduced by accidental spills or the introduction of contaminated fill. However with the application of preventative measures and incident response procedures significant implemented through a CEMP, the potential for adverse impacts would be minimised. During operation of North East Link, the potential for pollutants to end up in waterways and groundwater has been minimised by the inclusion of water treatment features along the alignment. One of these features in the reference project is a water treatment bioretention pond to be located partly on the War Services easement that would filter and treat the stormwater captured by new road surfaces.
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal	Construction may require the transportation, storage and use of some hazardous (which could include flammable, explosive, toxic, carcinogenic, or mutagenic substances) materials on the War Services easement. North East Link would not have the potential for release of radioactive materials. The amount of hazardous material brought onto and stored on-site would be minimised, and would be managed in accordance with legal requirements. The CEMP would contain requirements for management of chemicals, fuels and hazardous materials. No contamination issues were identified on the War Services easement, although the presence of an electricity substation adjacent to Frensham SEC Reserve would increase the potential for contamination to be present. It is not expected there would be any significant excavation on the War Service easement. Any excavation required would be managed in accordance with a SMP developed in consultation with EPA Victoria to meet relevant regulations, standards or best practice guidelines. Emissions to air are discussed in the row immediately above.

Assessment criteria	Impact
Increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage, or	Construction of North East Link would create greenhouse gas emissions from construction materials, fuel and electricity consumption. The overall construction emissions for the action are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. Operation and maintenance activities including consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment result in greenhouse gas emissions. The operational and maintenance emissions for North East Link are not considered significant in the context of Victoria's and Australia's annual greenhouse gas emissions. In both cases, the contribution of North East Link on the War Services easement is a very small part of this and not significant. In terms of vehicle emissions, operation of North East Link would change vehicle flow through metropolitan Melbourne which may result in little change in overall vehicle emissions.
Substantially disturb contaminated or acid-sulphate soils?	No contamination issues were identified on the War Services easement, although the presence of an electricity substation adjacent to Frensham SEC Reserve would increase the potential for contamination to be present. It is not expected there would be any significant excavation on the War Service easement. Any excavation required would be managed in accordance with a SMP developed in accordance with EPA Victoria to meet relevant regulations, standards or best practice guidelines.

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Appendices

Appendix A – Arboriculture

AR1 Tree assessment data

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-432	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	70						5-10m	12	Semi-mature	20+yrs	Fair-Good	Fair	
C-453	20	Acacia melanoxylon	Blackwood	I	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair	
C-455	8	Acacia melanoxylon	Blackwood	I	20						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-464	20	Acacia melanoxylon	Blackwood	I	15						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-466	3	Melaleuca linariifolia	Snow-in-summer	A	30						3-5m	6	Mature	20+yrs	Fair-Good	Fair	
C-467	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	80						10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair	
C-471	4	Acacia implexa	Lightwood	I	22						5-10m	4	Mature	11-20yrs	Fair-Good	Fair-Good	
C-473	1	Hakea drupacea	Sweet Hakea	A	40					Multi-stemmed	3-5m	6	Mature	11-20yrs	Fair-Good	Fair	
C-475	9	Acacia implexa	Lightwood	I	15						5-10m	6	Semi-mature	6-10yrs	Fair-Poor	Fair	
C-476	4	Acacia baileyana	Cootamundra Wattle	A						Multi-stemmed	3-5m	4	Over-mature	1-5yrs	Fair	Fair-Poor	Weed
C-483	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	90						15-20m	11	Semi-mature	20+yrs	Fair-Good	Fair	
C-485	1	Acacia baileyana	Cootamundra Wattle	A						Multi-stemmed	3-5m	3	Over-mature	0	Poor	Poor	Breaking up
C-487	1	Prunus cerasifera	Cherry Plum	E	20						3-5m	4	Mature	11-20yrs	Fair-Good	Fair	
C-488	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	50	50					15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-489	1	Acacia implexa	Lightwood	I	35						5-10m	8	Mature	6-10yrs	Fair-Poor	Fair	
C-499	1	Eucalyptus goniocalyx	Long-leaved Box	I	60					Estimate Low	10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-501	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	80						15-20m	12	Semi-mature	20+yrs	Fair-Good	Fair	
C-502	2	Acacia baileyana	Cootamundra Wattle	A						Multi-stemmed	3-5m	4	Senescent	0	Poor	Poor	Breaking up
C-503	1	Eucalyptus mannifera	Brittle Gum	V	35						5-10m	9	Semi-mature	20+yrs	Fair-Good	Fair	
C-506	1	Eucalyptus leucoxylon	Yellow Gum	I	50	25					10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-507	20	Acacia implexa	Lightwood	I	18						5-10m	4	Semi-mature	6-10yrs	Fair	Fair	
C-514	1	Melaleuca linariifolia	Snow-in-summer	A	35						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-515	1	Eucalyptus leucoxylon subsp. leucoxylon	Yellow Gum	I	80						10-15m	16	Mature	20+yrs	Fair-Good	Fair	
C-517	1	Eucalyptus sp.	Eucalypt	A	38						15-20m	10	Mature	20+yrs	Fair-Good	Fair-Poor	
C-519	1	Eucalyptus mannifera	Brittle Gum	V	45						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-520	1	Eucalyptus saligna	Sydney Blue Gum	A	45						15-20m	9	Semi-mature	20+yrs	Fair	Fair	
C-522	1	Eucalyptus mannifera	Brittle Gum	V	70						15-20m	14	Mature	20+yrs	Fair-Good	Fair-Good	
C-523	1	Eucalyptus sp.	Eucalypt	A	30						3-5m	6	Mature	11-20yrs	Fair	Fair	
C-526	1	Eucalyptus sideroxylon	Red Ironbark	V	65						15-20m	14	Mature	20+yrs	Fair-Good	Fair-Good	
C-527	1	Melaleuca linariifolia	Snow-in-summer	A	40						3-5m	6	Mature	11-20yrs	Fair-Good	Fair-Good	
C-528	4	Acacia baileyana	Cootamundra Wattle	A	15						3-5m	3	Semi-mature	6-10yrs	Fair-Good	Fair	
C-531	1	Eucalyptus cinerea subsp. cinerea	Argyle Apple	A	45						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair	
C-533	1	Eucalyptus sideroxylon	Red Ironbark	V	50						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-534	1	Corymbia maculata	Spotted Gum	V	30	25	25				15-20m	8	Mature	11-20yrs	Fair-Good	Fair-Poor	Included union
C-535	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	20						3-5m	6	Semi-mature	6-10yrs	Fair-Good	Poor	
C-536	1	Eucalyptus mannifera	Brittle Gum	V	36						10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-537	5	Acacia baileyana	Cootamundra Wattle	A	15						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-538	1	Eucalyptus mannifera	Brittle Gum	V	45						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair	
C-541	1	Eucalyptus sideroxylon	Red Ironbark	V	60						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-542	2	Melaleuca styphelioides	Prickly-leaved Paperbark	A	40					Multi-stemmed	5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-543	1	Melaleuca armillaris	Giant Honey-myrtle	V	35						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
C-544	1	Eucalyptus polyanthemos	Red Box	I	15						5-10m	3	Semi-mature	11-20yrs	Fair	Fair	
C-545	3	Acacia baileyana	Cootamundra Wattle	A						Multi-stemmed	3-5m	4	Semi-mature	6-10yrs	Fair-Good	Fair	Weed
C-546	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	50						10-15m	7	Semi-mature	11-20yrs	Fair	Fair-Poor	Deadwood
C-547	1	Eucalyptus cladocalyx	Sugar Gum	A	85						15-20m	16	Mature	20+yrs	Fair-Good	Fair-Good	
C-548	1	Eucalyptus sp.	Eucalypt	A	28						5-10m	3	Semi-mature	0	Poor	Poor	Fire scorched
C-549	1	Eucalyptus mannifera	Brittle Gum	V	50						15-20m	12	Mature	11-20yrs	Fair-Good	Fair-Poor	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-550	1	Eucalyptus sideroxylon	Red Ironbark	V	20						10-15m	3	Semi-mature	1-5yrs	Fair-Poor	Fair-Poor	
C-551	1	Eucalyptus saligna	Sydney Blue Gum	A	80						>20m	18	Mature	20+yrs	Fair-Good	Fair-Good	
C-552	7	Melaleuca linariifolia	Snow-in-summer	A	30						3-5m	4	Mature	6-10yrs	Fair-Good	Poor	
C-553	1	Eucalyptus sp.	Eucalypt	A	45						10-15m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-554	1	Eucalyptus leucoxylon	Yellow Gum	I	27						5-10m	8	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
C-555	1	Eucalyptus mannifera	Brittle Gum	V	70						15-20m	14	Mature	11-20yrs	Fair-Good	Fair	
C-556	1	Eucalyptus nicholii	Narrow-leaved Peppermint	A	50						10-15m	12	Mature	11-20yrs	Fair-Good	Poor	
C-557	9	Eucalyptus mannifera	Brittle Gum	V	45						10-15m	8	Mature	6-10yrs	Fair-Poor	Fair	A line of trees in declining health. High amenity as a group.
C-558	2	Eucalyptus sideroxylon	Red Ironbark	V	55						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-559	1	Eucalyptus saligna	Sydney Blue Gum	A	70						15-20m	14	Mature	20+yrs	Fair-Good	Fair	
C-560	1	Eucalyptus melliodora	Yellow Box	I	50						10-15m	9	Semi-mature	6-10yrs	Fair-Good	Poor	Trunk cavity
C-561	9	Acacia baileyana	Cootamundra Wattle	A	10						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-562	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	45					Multi-stemmed	5-10m	8	Mature	20+yrs	Fair-Good	Fair	
	35	Acacia implexa	Lightwood	I	12						3-5m	4	Semi-mature	6-10yrs	Fair	Fair-Good	
C-564	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	12						3-5m	3	Semi-mature	0	Fair	Fair	Weed
C-565	1	Eucalyptus melliodora	Yellow Box	I	30						10-15m	8	Semi-mature	11-20yrs	Fair-Good	Poor	Flared union
C-566	1	Eucalyptus sideroxylon	Red Ironbark	V	65						15-20m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-567	6	Melaleuca styphelioides	Prickly-leaved Paperbark	A	45						5-10m	5	Mature	20+yrs	Fair-Good	Fair-Good	Line of closely planted trees which have a high amenity value as a group.
C-568	1	Eucalyptus leucoxylon	Yellow Gum	I	18						3-5m	6	Semi-mature	11-20yrs	Fair	Fair	
C-569	1	Eucalyptus saligna	Sydney Blue Gum	A	80						>20m	20	Mature	20+yrs	Fair-Good	Fair-Good	
C-570	9	Acacia baileyana	Cootamundra Wattle	A	10						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-571	1	Eucalyptus melliodora	Yellow Box	I	20					Multi-stemmed	5-10m	5	Semi-mature	0	Fair-Good	Poor	Regrowth from stump
C-572	3	Acacia implexa	Lightwood	I	35						5-10m	4	Mature	6-10yrs	Fair-Poor	Fair-Good	
C-573	2	Eucalyptus leucoxylon	Yellow Gum	I	27						5-10m	5	Semi-mature	11-20yrs	Fair	Fair	Sparse
C-574	1	Acacia mearnsii	Black Wattle	I						Multi-stemmed	3-5m	2	Semi-mature	6-10yrs	Fair	Fair-Poor	
C-575	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	30						3-5m	5	Mature	6-10yrs	Fair-Good	Poor	Regrowth from cut stump.
C-576	1	Eucalyptus sideroxylon	Red Ironbark	V	55						10-15m	9	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Included primary union
C-577	1	Eucalyptus melliodora	Yellow Box	I	35						15-20m	35	Semi-mature	20+yrs	Fair-Good	Fair	
C-578	2	Eucalyptus sideroxylon	Red Ironbark	V	50						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair	
C-579	3	Myoporum insulare	Boobialla	I	16						3-5m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-580	7	Acacia implexa	Lightwood	I	15						3-5m	2	Semi-mature	11-20yrs	Fair-Good	Fair	
C-581	1	Eucalyptus camaldulensis	River Red Gum	I	40						15-20m	8	Semi-mature	20+yrs	Fair-Good	Fair	Growth lean
C-582	4	Eucalyptus leucoxylon	Yellow Gum	I	20						3-5m	3	Semi-mature	11-20yrs	Fair	Fair	
C-583	2	Eucalyptus melliodora	Yellow Box	I	35						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	Eastern specimen of fair structure
C-584	1	Hakea drupacea	Sweet Hakea	A	20						3-5m	5	Mature	1-5yrs	Fair-Good	Poor	
C-585	1	Eucalyptus leucoxylon	Yellow Gum	I	17	10					5-10m	5	Semi-mature	11-20yrs	Fair	Fair-Poor	Stub in union
C-586	1	Eucalyptus leucoxylon	Yellow Gum	I	9						3-5m	3	Semi-mature	1-5yrs	Fair-Poor	Fair-Poor	
C-587	1	Eucalyptus camaldulensis	River Red Gum	I	20	20					5-10m	7	Semi-mature	11-20yrs	Fair	Fair-Poor	Possible basal regrowth
C-588	2	Acacia implexa	Lightwood	I	8						3-5m	2	Juvenile	11-20yrs	Fair-Good	Fair-Good	
C-589	1	Eucalyptus sideroxylon	Red Ironbark	V	50						15-20m	10	Mature	11-20yrs	Fair-Good	Fair-Good	
C-590	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	20						5-10m	8	Mature	11-20yrs	Fair	Fair	
C-591	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	30						5-10m	7	Mature	11-20yrs	Fair	Fair	
C-592	1	Acacia baileyana	Cootamundra Wattle	A	20						3-5m	6	Mature	1-5yrs	Fair	Poor	
C-593	1	Acacia implexa	Lightwood	I	15						3-5m	4	Semi-mature	6-10yrs	Fair	Fair-Poor	
C-594	1	Eucalyptus sideroxylon	Red Ironbark	V	45						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-595	1	Acacia implexa	Lightwood	I	28						3-5m	5	Mature	1-5yrs	Fair-Poor	Fair	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-596	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	30						3-5m	6	Mature	6-10yrs	Fair-Poor	Fair-Good	
C-597	9	Acacia implexa	Lightwood	I	12						3-5m	2	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-598	1	Acacia baileyana	Cootamundra Wattle	A	10						3-5m	2	Juvenile	11-20yrs	Fair-Good	Fair-Good	
C-599	1	Eucalyptus melliodora	Yellow Box	I	40						5-10m	10	Mature	11-20yrs	Fair-Poor	Fair-Good	
C-600	1	Eucalyptus melliodora	Yellow Box	I	35						10-15m	6	Mature	11-20yrs	Fair	Fair-Good	
C-601	1	Casuarina cunninghamiana	River She-oak	A	25						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-602	1	Eucalyptus camaldulensis	River Red Gum	I	15						3-5m	4	Semi-mature	1-5yrs	Poor	Fair	
C-603	1	Eucalyptus sideroxylon	Red Ironbark	V	35						5-10m	5	Mature	20+yrs	Fair-Good	Fair	
C-604	1	Acacia implexa	Lightwood	I	30						5-10m	8	Mature	6-10yrs	Fair-Poor	Fair	
C-605	2	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	15						5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-606	1	Acacia implexa	Lightwood	I	35						5-10m	8	Mature	1-5yrs	Fair-Poor	Fair-Good	
C-607	1	Eucalyptus sideroxylon	Red Ironbark	V	50						15-20m	10	Mature	20+yrs	Fair-Good	Fair-Good	
C-608	1	Eucalyptus sideroxylon	Red Ironbark	V	60						15-20m	10	Semi-mature	20+yrs	Fair-Good	Fair	
C-609	1	Eucalyptus melliodora	Yellow Box	I	30						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-610	1	Eucalyptus sp.	Eucalypt	A	50						5-10m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-611	1	Acacia implexa	Lightwood	I	28						3-5m	6	Mature	1-5yrs	Fair-Poor	Fair	
C-612	1	Acacia baileyana	Cootamundra Wattle	A	25						3-5m	6	Mature	1-5yrs	Poor	Poor	
C-613	1	Eucalyptus melliodora	Yellow Box	I	100						5-10m	5	Over-mature	20+yrs	Fair-Good	Poor	Remnant specimen being retained for habitat. ESO4 tree.
C-614	1	Eucalyptus sideroxylon	Red Ironbark	V	60					Multi-stemmed	15-20m	10	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Trifurcated at ground level
C-615	1	Eucalyptus camaldulensis	River Red Gum	I	25						5-10m	4	Semi-mature	11-20yrs	Fair	Fair	
C-616	1	Acacia implexa	Lightwood	I	25						3-5m	5	Mature	6-10yrs	Fair	Fair	
C-617	1	Eucalyptus sideroxylon	Red Ironbark	V	40						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-618	1	Acacia implexa	Lightwood	I	35						5-10m	8	Mature	6-10yrs	Fair-Poor	Fair-Poor	
C-619	1	Eucalyptus leucoxylon	Yellow Gum	I	15						3-5m	3	Semi-mature	0	Poor	Poor	
C-620	1	Acacia baileyana	Cootamundra Wattle	A	13						3-5m	4	Mature	1-5yrs	Fair	Poor	
C-621	3	Eucalyptus melliodora	Yellow Box	I	30						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-622	1	Acacia implexa	Lightwood	I	20						5-10m	6	Mature	11-20yrs	Fair-Good	Fair-Good	
C-623	1	Eucalyptus leucoxylon	Yellow Gum	I	15						3-5m	3	Semi-mature	20+yrs	Fair	Fair	
C-624	1	Corymbia ficifolia	Red Flowering Gum	A	40						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-625	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	20					Multi-stemmed	3-5m	4	Mature	1-5yrs	Fair-Good	Poor	Regrowth from cut stump.
C-626	2	Eucalyptus sideroxylon	Red Ironbark	V	40						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-627	3	Eucalyptus camaldulensis	River Red Gum	I	25						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-628	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	22					Multi-stemmed	3-5m	5	Mature	1-5yrs	Fair-Good	Fair-Poor	Regrowth from cut stump.
C-629	1	Eucalyptus melliodora	Yellow Box	I	40						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-630	3	Acacia baileyana	Cootamundra Wattle	A	25					Multi-stemmed	3-5m	6	Mature	1-5yrs	Fair-Poor	Poor	
C-631	1	Eucalyptus spathulata	Swamp Mallet	A	45						5-10m	8	Mature	11-20yrs	Fair-Good	Fair-Good	
C-632	1	Eucalyptus camaldulensis	River Red Gum	I	40						10-15m	7	Semi-mature	20+yrs	Fair-Good	Fair	
C-633	1	Callistemon salignus	Willow Bottlebrush	A						Multi-stemmed	3-5m	2	Semi-mature	0	Fair-Poor	Poor	
C-634	3	Eucalyptus melliodora	Yellow Box	I	10						3-5m	8	Juvenile	20+yrs	Fair-Good	Fair-Good	
C-635	1	Corymbia ficifolia	Red Flowering Gum	A	80						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair	
C-636	4	Acacia implexa	Lightwood	I	20						5-10m	4	Mature	11-20yrs	Fair-Good	Fair	
C-637	1	Eucalyptus melliodora	Yellow Box	I	90						10-15m	16	Mature	20+yrs	Fair-Good	Fair	ESO4 tree.
C-638	1	Eucalyptus leucoxylon	Yellow Gum	I	20						5-10m	2	Semi-mature	0	Poor	Poor	
C-639	1	Eucalyptus camaldulensis	River Red Gum	I	10						3-5m	3	Semi-mature	0	Poor	Poor	
C-640	1	Eucalyptus melliodora	Yellow Box	I	30						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair-Poor	Acute bifurcation
C-641	1	Eucalyptus sideroxylon	Red Ironbark	V	40						10-15m	9	Semi-mature	20+yrs	Good	Fair	
C-642	3	Eucalyptus sideroxylon	Red Ironbark	V	50						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-643	1	Hakea drupacea	Sweet Hakea	A	20					Multi-stemmed	3-5m	4	Mature	11-20yrs	Fair-Good	Fair-Good	
C-644	1	Eucalyptus melliodora	Yellow Box	I	10						3-5m	2	Juvenile	20+yrs	Fair-Good	Fair-Good	
C-645	1	Melaleuca linariifolia	Snow-in-summer	A	30						3-5m	6	Mature	1-5yrs	Fair-Good	Poor	Failing root ball.

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-646	2	Acacia implexa	Lightwood	I	16						5-10m	4	Mature	11-20yrs	Fair-Good	Fair	
C-647	2	Eucalyptus leucoxylon	Yellow Gum	I	30						5-10m	6	Semi-mature	11-20yrs	Fair	Fair	
C-648	1	Corymbia ficifolia	Red Flowering Gum	A	80						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair	
C-649	1	Eucalyptus camaldulensis	River Red Gum	I	40						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-650	1	Eucalyptus camaldulensis	River Red Gum	I	15						3-5m	2	Semi-mature	1-5yrs	Poor	Poor	
C-651	1	Eucalyptus camaldulensis	River Red Gum	I	40						10-15m	8	Semi-mature	20+yrs	Fair-Good	Good	
C-652	2	Acacia implexa	Lightwood	I	25						5-10m	4	Mature	6-10yrs	Fair-Poor	Fair-Good	
C-653	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	40						10-15m	8	Mature	11-20yrs	Fair	Fair-Good	
C-654	1	Eucalyptus leucoxylon	Yellow Gum	I	35						5-10m	7	Semi-mature	11-20yrs	Fair	Fair	
C-655	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	85						15-20m	12	Mature	20+yrs	Fair-Good	Fair	
C-656	1	Acacia implexa	Lightwood	I							5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-657	4	Acacia baileyana	Cootamundra Wattle	A	25						3-5m	4	Over-mature	1-5yrs	Fair-Poor	Fair-Poor	
C-658	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	35						10-15m	6	Semi-mature	20+yrs	Fair	Fair	
C-659	1	Eucalyptus camaldulensis	River Red Gum	I	35						5-10m	7	Semi-mature	11-20yrs	Fair	Fair	
C-660	1	Eucalyptus polyanthemos	Red Box	I	30						10-15m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-661	1	Melaleuca linariifolia	Snow-in-summer	A	35						5-10m	6	Mature	6-10yrs	Fair-Good	Fair-Poor	
C-662	1	Acacia implexa	Lightwood	I	8						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair	
C-663	2	Acacia implexa	Lightwood	I	20						5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-664	1	Eucalyptus camaldulensis	River Red Gum	I	50						15-20m	9	Semi-mature	20+yrs	Fair	Fair	
C-665	1	Acacia implexa	Lightwood	I	22						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
C-666	2	Acacia baileyana	Cootamundra Wattle	A	20						3-5m	5	Mature	6-10yrs	Fair-Poor	Fair	
C-667	1	Eucalyptus sideroxylon	Red Ironbark	V	50						15-20m	8	Semi-mature	11-20yrs	Good	Fair-Poor	Previous failure of first order included branch.
C-668	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	50						15-20m	7	Semi-mature	11-20yrs	Fair	Fair	
C-669	1	Eucalyptus melliodora	Yellow Box	I	>125						10-15m	18	Mature	11-20yrs	Fair	Fair-Poor	ESO4 tree.
C-670	1	Acacia implexa	Lightwood	I	10						3-5m	3	Juvenile	6-10yrs	Fair-Poor	Fair-Good	
C-671	1	Melaleuca linariifolia	Snow-in-summer	A	25	25					5-10m	4	Semi-mature	11-20yrs	Fair	Fair	Overshadowed
C-672	1	Cedrus deodara	Deodar Cedar	E	60						10-15m	10	Mature	20+yrs	Fair	Fair-Good	
C-673	1	Melaleuca linariifolia	Snow-in-summer	A	65					Estimate Low	5-10m	7	Semi-mature	20+yrs	Good	Fair-Good	
C-674	1	Cedrus deodara	Deodar Cedar	E	60						15-20m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-675	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	60	30					5-10m	7	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Lean to east
C-676	1	Prunus cerasifera 'Nigra'	Cherry Plum	E	25						3-5m	4	Mature	6-10yrs	Fair	Fair	
C-677	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	65						10-15m	8	Mature	20+yrs	Fair-Good	Fair-Good	
C-678	1	Eucalyptus nicholii	Narrow-leaved Peppermint	A	70						10-15m	10	Mature	11-20yrs	Fair-Good	Fair	
C-679	1	Casuarina cunninghamiana	River She-oak	A	30						15-20m	4	Semi-mature	11-20yrs	Fair	Fair	
C-680	1	Melaleuca linariifolia	Snow-in-summer	A	50						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-681	1	Melaleuca linariifolia	Snow-in-summer	A	40	40	30	30			5-10m	7	Mature	20+yrs	Good	Fair	
C-682	1	Acacia implexa	Lightwood	I	12						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-683	1	Callistemon sieberi	River Bottlebrush	I	10					Estimate Low	3-5m	2	Semi-mature	11-20yrs	Fair	Fair	
C-684	1	Cedrus deodara	Deodar Cedar	E	70						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-685	1	Melaleuca linariifolia	Snow-in-summer	A	35	35					3-5m	6	Semi-mature	20+yrs	Fair-Good	Fair	
C-686	1	Casuarina cunninghamiana	River She-oak	A	35						15-20m	8	Semi-mature	11-20yrs	Fair	Fair-Good	
C-687	1	Melaleuca linariifolia	Snow-in-summer	A	30					Estimate Low	3-5m	3	Semi-mature	11-20yrs	Fair	Fair	Low vigour
C-688	1	Eucalyptus camaldulensis	River Red Gum	I	15						3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-689	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	50						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-690	1	Quercus palustris	Pin Oak	E	50						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-691	7	Cupressus torulosa	Bhutan Cypress	E	50						5-10m	4	Semi-mature	20+yrs	Good	Fair-Good	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-692	1	Callistemon viminalis	Weeping Bottlebrush	A	25						3-5m	4	Semi-mature	11-20yrs	Fair-Good	Fair	
C-693	6	Malus sp.	Crabapple	E	20						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-694	1	Phoenix canariensis	Canary Island Date Palm	E	75						5-10m	6	Mature	20+yrs	Fair-Good	Fair-Good	
C-695	1	Quercus palustris	Pin Oak	E	60						10-15m	11	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-696	1	Callistemon salignus	Willow Bottlebrush	A	27					Estimate Low	5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
C-697	2	Cupressus torulosa	Bhutan Cypress	E	40						5-10m	4	Semi-mature	20+yrs	Good	Fair-Good	
C-698	1	Callistemon salignus	Willow Bottlebrush	A	25						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-699	1	Arbutus unedo	Strawberry Tree	E	35						3-5m	6	Mature	6-10yrs	Fair-Poor	Fair	
C-700	3	Cupressus torulosa	Bhutan Cypress	E	45						5-10m	3	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-701	1	Eucalyptus sp.	Eucalypt	A	30					Multi-stemmed	5-10m	6	Semi-mature	6-10yrs	Fair-Good	Poor	Regrowth from cut stump.
C-702	1	Eucalyptus camaldulensis	River Red Gum	I	45						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-703	1	Callistemon salignus	Willow Bottlebrush	A	20						5-10m	2	Semi-mature	11-20yrs	Fair-Good	Fair	
C-704	1	Quercus palustris	Pin Oak	E	60						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-705	5	Melaleuca armillaris	Giant Honey-myrtle	V	35						5-10m	6	Mature	11-20yrs	Fair-Good	Fair-Poor	
C-706	1	Eucalyptus camaldulensis	River Red Gum	I	90						10-15m	18	Mature	1-5yrs	Fair-Good	Poor	
C-707	1	Corymbia maculata	Spotted Gum	V	35						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-708	1	Quercus palustris	Pin Oak	E	60						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair	
C-709	1	Eucalyptus goniocalyx	Long-leaved Box	I	45						5-10m	10	Mature	11-20yrs	Fair-Good	Fair-Good	
C-710	1	Callistemon salignus	Willow Bottlebrush	A	28					Estimate Low	5-10m	3	Mature	6-10yrs	Good	Fair-Poor	
C-711	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	45						10-15m	12	Mature	6-10yrs	Fair-Poor	Fair	
C-712	1	Eucalyptus leucoxylon	Yellow Gum	I	10						3-5m	3	Semi-mature	20+yrs	Good	Fair	Lean
C-713	1	Eucalyptus camaldulensis	River Red Gum	I	90						10-15m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-714	1	Eucalyptus camaldulensis	River Red Gum	I	15						3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-715	1	Grevillea robusta	Silky Oak	A	25						5-10m	8	Semi-mature	11-20yrs	Fair	Fair-Good	
C-716	1	Eucalyptus spathulata	Swamp Mallet	A	60	60	25				10-15m	14	Mature	11-20yrs	Fair-Good	Fair	
C-717	1	Eucalyptus camaldulensis	River Red Gum	I	45						10-15m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-718	1	Eucalyptus melliodora	Yellow Box	I	80						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
C-719	1	Callistemon salignus	Willow Bottlebrush	A	30						5-10m	4	Semi-mature	6-10yrs	Fair-Poor	Fair	
C-720	1	Eucalyptus leucoxylon	Yellow Gum	I	25						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-721	1	Eucalyptus nicholii	Narrow-leaved Peppermint	A	90						10-15m	12	Mature	20+yrs	Fair-Good	Fair	
C-722	1	Quercus palustris	Pin Oak	E	40						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-723	1	Eucalyptus polyanthemos	Red Box	I	80						15-20m	15	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-724	1	Callistemon salignus	Willow Bottlebrush	A	20						3-5m	2	Semi-mature	1-5yrs	Poor	Fair	
C-725	1	Eucalyptus sideroxylon	Red Ironbark	V	80						15-20m	15	Mature	20+yrs	Good	Fair	
C-726	1	Callistemon salignus	Willow Bottlebrush	A	25						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-727	1	Callistemon salignus	Willow Bottlebrush	A	15	15					5-10m	3	Semi-mature	6-10yrs	Fair-Good	Fair-Poor	
C-728	1	Callistemon salignus	Willow Bottlebrush	A	25						5-10m	3	Semi-mature	11-20yrs	Fair	Fair	
C-729	1	Callistemon salignus	Willow Bottlebrush	A	35						5-10m	3	Semi-mature	1-5yrs	Fair	Poor	Included unions beginning to separate. History of 1st order branch failure.
C-730	1	Callistemon salignus	Willow Bottlebrush	A	20						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
C-731	1	Eucalyptus leucoxylon	Yellow Gum	I	45						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-770	1	Eucalyptus mannifera	Brittle Gum	V	10						5-10m	2	Semi-mature	20+yrs	Fair-Good	Fair	
C-776	1	Melaleuca linariifolia	Snow-in-summer	A	20						3-5m	3	Semi-mature	11-20years	Good	Fair-Good	
C-794	1	Hakea francisiana	Emu Tree	A	3						3-5m	2	Juvenile	11-20yrs	Fair-Good	Fair-Good	
C-804	1	Ulmus parvifolia	Chinese Elm	E	20						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
C-819	1	Eucalyptus mannifera	Brittle Gum	V	15						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	
C-820	1	Hakea salicifolia	Willow-leaved Hakea	A	20						3-5m	3	Semi-mature	0	Fair-Good	Fair-Good	Weed
C-821	1	Eucalyptus polyanthemos	Red Box	I	30						10-15m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-827	1	Eucalyptus camaldulensis	River Red Gum	I	35						3-5m	3	Semi-mature	1-5years	Poor	Fair-Good	
C-880	6	Acacia sp.	Wattle	A	10						5-10m	2	Semi-mature	1-5years	Fair-Poor	Fair-Poor	Acacia pycnantha
C-888	1	Pittosporum undulatum	Sweet Pittosporum	V	20						5-10m	4	Semi-mature	0	Good	Fair	Weed
C-889	1	Lophostemon confertus	Brush Box	A	35						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-901	1	Ulmus parvifolia	Chinese Elm	E	25						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
C-902	1	Ulmus parvifolia	Chinese Elm	E	25						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
C-905	1	Lophostemon confertus	Brush Box	A	30						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
C-906	1	Phoenix canariensis	Canary Island Date Palm	E						Multi-stemmed	3-5m	4	Juvenile	20+yrs	Fair-Good	Fair-Good	Naturalised
C-924	1	Prunus cerasifera	Cherry Plum	E	15					Estimate Low	3-5m	4	Over-mature	1-5yrs	Fair-Good	Fair-Poor	
C-925	1	Corymbia ficifolia	Red Flowering Gum	A	20						3-5m	3	Semi-mature	1-5yrs	Fair	Poor	
C-927	1	Lophostemon confertus	Brush Box	A	45					Estimate Low	5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
C-943	1	Eucalyptus camaldulensis	River Red Gum	I	50						5-10m	2	Semi-mature	0	Poor	Poor	
C-945	1	Eucalyptus conferruminata	Bald Island Marlock	A	30						5-10m	6	Semi-mature	11-20years	Fair-Good	Fair-Good	
C-947	5	Eucalyptus cladocalyx 'Nana'	Dwarf Sugar Gum	A	25						5-10m	5	Semi-mature	11-20years	Fair-Good	Fair-Poor	
C-951	1	Lophostemon confertus	Brush Box	A	25					Estimate Low	3-5m	4	Semi-mature	20+yrs	Fair-Good	Fair	Powerlines
C-962	1	Brachychiton acerifolius	Illawarra Flame Tree	A	40						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	Powerlines
C-982	1	Corymbia ficifolia	Red Flowering Gum	A	45						5-10m	8	Semi-mature	11-20yrs	Fair	Fair	
C-984	1	Acacia implexa	Lightwood	I	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
C-987	1	Acacia implexa	Lightwood	I	5						3-5m	1	Juvenile	6-10yrs	Fair-Poor	Fair	
D-1	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	45						5-10m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	Weed
D-3	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	35						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	Weed
D-5	1	Eucalyptus tereticornis	Gippsland Manna Gum	V	60	50					10-15m	20	Semi-mature	6-10yrs	Fair-Poor	Fair-Good	Central crown very sparse
D-7	1	Crataegus monogyna	Hawthorn	E	30	10					5-10m	3	Mature	0	Fair	Fair	Declared noxious weed
D-8	1	Crataegus monogyna	Hawthorn	E	30	10					5-10m	3	Mature	0	Fair	Fair	Declared noxious weed
D-9	2	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	20						3-5m	4	Semi-mature	11-20yrs	Fair-Good	Fair	Weed
D-10	6	Pinus radiata	Monterey Pine	E	90						15-20m	12	Mature	20+yrs	Good	Fair-Good	
D-12	1	Eriobotrya japonica	Loquat	E	15						3-5m	3	Semi-mature	11-20yrs	Fair	Fair	
D-14	1	Eucalyptus nicholii	Narrow-leaved Peppermint	A	80						10-15m	14	Mature	11-20yrs	Fair-Good	Fair-Good	Straddling property boundary
D-15	1	Melaleuca armillaris	Giant Honey-myrtle	V						Multi-stemmed	3-5m	7	Over-mature	1-5yrs	Fair	Poor	Breaking up
D-16	1	Melaleuca armillaris	Giant Honey-myrtle	V						Multi-stemmed	3-5m	7	Over-mature	1-5yrs	Fair	Poor	Breaking up
D-17	1	Pittosporum undulatum	Sweet Pittosporum	V	30						5-10m	6	Mature	0	Fair-Good	Fair	Weed
D-18	1	Pittosporum undulatum	Sweet Pittosporum	V	30						5-10m	6	Mature	0	Fair-Good	Fair	Weed
D-19	3	Lophostemon confertus	Brush Box	A						Multi-stemmed	5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	
D-21	1	Corymbia maculata	Spotted Gum	V	50						>20m	10	Semi-mature	20+yrs	Good	Fair	
D-22	1	Angophora floribunda	Rough-barked Apple	A	40						15-20m	9	Semi-mature	11-20yrs	Good	Fair	
D-23	1	Angophora floribunda	Rough-barked Apple	A	40						15-20m	9	Semi-mature	11-20yrs	Good	Fair	
D-25	1	Hakea drupacea	Sweet Hakea	A	25						5-10m	6	Mature	11-20yrs	Fair-Good	Fair	
D-26	1	Allocasurina verticillata	Drooping She-oak	I	25						5-10m	5	Semi-mature	11-20yrs	Fair	Fair	
D-28	1	Agonis flexuosa	Willow Myrtle	A	17						3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair	
D-30	1	Eucalyptus sp.	Eucalypt	A	27						5-10m	6	Semi-mature	6-10yrs	Fair-Poor	Fair	
D-31	1	Angophora floribunda	Rough-barked Apple	A	45						15-20m	7	Semi-mature	20+yrs	Good	Fair-Poor	
D-32	1	Angophora floribunda	Rough-barked Apple	A	45						15-20m	7	Semi-mature	20+yrs	Good	Fair-Poor	
D-34	1	Pittosporum undulatum	Sweet Pittosporum	V						Multi-stemmed	3-5m	3	Semi-mature	0	Fair-Good	Fair	Weed
D-35	1	Eucalyptus sp.	Eucalypt	A	45						5-10m	9	Senescent	0	Poor	Poor	
D-37	1	Pittosporum undulatum	Sweet Pittosporum	V						Multi-stemmed	5-10m	4	Semi-mature	0	Fair-Good	Fair	Weed
D-39	1	Angophora floribunda	Rough-barked Apple	A	55						15-20m	14	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-40	1	Casuarina cunninghamiana	River She-oak	A	25						15-20m	5	Semi-mature	11-20yrs	Fair	Fair	Limited crown
D-43	1	Melaleuca nesophila	Showy Honey-myrtle	A	28						5-10m	4	Senescent	0	Poor	Poor	
D-44	1	Melaleuca nesophila	Showy Honey-myrtle	A	28						5-10m	4	Senescent	0	Poor	Poor	
D-45	1	Agonis flexuosa	Willow Myrtle	A	28					Estimate Low	3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair	
D-48	1	Pinus radiata	Monterey Pine	E	60						10-15m	10	Senescent	0	Poor	Poor	
D-49	1	Lophostemon confertus	Brush Box	A	25	25					5-10m	8	Semi-mature	20+yrs	Good	Fair-Good	
D-51	1	Eucalyptus camaldulensis	River Red Gum	I	20						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	
D-52	9	Pinus radiata	Monterey Pine	E	70						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	Includes two C. macrocarpa
D-53	1	Eucalyptus camaldulensis	River Red Gum	I	9						3-5m	2	Juvenile	20+yrs	Fair-Good	Fair	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
D-54	1	Eucalyptus camaldulensis	River Red Gum	I						Multi-stemmed	3-5m	2	Semi-mature	11-20yrs	Fair	Poor	Stump sprout
D-55	1	Eucalyptus camaldulensis	River Red Gum	I	15						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Stump sprout
D-56	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	100					Estimate Low	10-15m	14	Mature	20+yrs	Good	Fair	
D-57	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	100					Estimate Low	10-15m	14	Mature	20+yrs	Good	Fair	
D-58	1	Eucalyptus spathulata	Swamp Mallet	A	40						5-10m	9	Semi-mature	20+yrs	Fair-Good	Fair-Poor	
D-59	1	Eucalyptus sideroxylon	Red Ironbark	V	35						5-10m	6	Semi-mature	20+yrs	Fair	Fair-Good	
D-60	1	Eucalyptus sideroxylon	Red Ironbark	V	65						15-20m	14	Mature	11-20yrs	Fair	Fair	
D-61	1	Acacia implexa	Lightwood	I	20						5-10m	3	Dead	0	Poor	Poor	
D-62	1	Eucalyptus camaldulensis	River Red Gum	I	90						15-20m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-63	1	Eucalyptus camaldulensis	River Red Gum	I	80						15-20m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-64	1	Callistemon salignus	Willow Bottlebrush	A	20						3-5m	5	Mature	20+yrs	Fair-Good	Fair-Poor	
D-65	1	Callistemon salignus	Willow Bottlebrush	A	20					Estimate Low	3-5m	4	Semi-mature	11-20yrs	Fair	Fair-Poor	
D-66	1	Callistemon salignus	Willow Bottlebrush	A	20						3-5m	5	Mature	20+yrs	Good	Fair	
D-67	1	Callistemon salignus	Willow Bottlebrush	A	22						3-5m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
D-68	1	Eucalyptus melliodora	Yellow Box	I	50						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-69	1	Allocasurina torulosa	Forest She-oak	A	30						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	Powerlines
D-70	1	Eucalyptus melliodora	Yellow Box	I	50						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-71	1	Pittosporum undulatum	Sweet Pittosporum	V						Multi-stemmed	3-5m	4	Semi-mature	0	Fair-Good	Fair	Weed
D-72	1	Eucalyptus polyanthemos	Red Box	I	50					Estimate Low	5-10m	6	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Tight union, girdling root
D-73	3	Eucalyptus camaldulensis	River Red Gum	I	17						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair-Good	Young trees
D-75	1	Acacia mearnsii	Black Wattle	I	17						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair-Good	Short lived taxon
D-76	3	Casuarina glauca	Swamp She-oak	A	17						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	Cluster of suckers
D-77	1	Allocasurina torulosa	Forest She-oak	A	17						3-5m	4	Semi-mature	20+yrs	Fair-Good	Fair	Powerlines
D-78	1	Allocasurina torulosa	Forest She-oak	A	15						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	Powerlines
D-79	1	Allocasurina torulosa	Forest She-oak	A	20					Estimate Low	3-5m	4	Semi-mature	11-20yrs	Fair-Good	Fair	Powerlines
D-80	1	Callistemon citrinus	Crimson Bottlebrush	V						Multi-stemmed	3-5m	3	Semi-mature	6-10yrs	Fair	Fair-Poor	
D-81	1	Callistemon viminalis	Weeping Bottlebrush	A						Multi-stemmed	3-5m	3	Semi-mature	6-10yrs	Fair	Fair	
D-82	1	Allocasurina torulosa	Forest She-oak	A	30	15	10				5-10m	5	Semi-mature	11-20yrs	Good	Fair	Powerlines
D-83	1	Eucalyptus mannifera	Brittle Gum	V	55						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-84	1	Callistemon viminalis	Weeping Bottlebrush	A						Multi-stemmed	5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
D-85	2	Eucalyptus camaldulensis	River Red Gum	I	12						3-5m	3	Juvenile	20+yrs	Good	Fair-Good	
D-86	2	Acacia melanoxylon	Blackwood	I	8						3-5m	3	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-87	1	Callistemon viminalis	Weeping Bottlebrush	A						Multi-stemmed	5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair	
D-88	3	Acacia melanoxylon	Blackwood	I	14						3-5m	3	Juvenile	20+yrs	Fair-Good	Fair	
D-89	1	Allocasurina torulosa	Forest She-oak	A	15	10					3-5m	5	Semi-mature	11-20yrs	Fair-Good	Fair	Powerlines
D-90	1	Allocasurina torulosa	Forest She-oak	A	15					Estimate Low	3-5m	3	Semi-mature	11-20yrs	Fair	Fair	Powerlines
D-91	1	Allocasurina torulosa	Forest She-oak	A	10						3-5m	2	Semi-mature	6-10yrs	Fair	Poor	Leader tear out
D-92	1	Acacia dealbata	Silver Wattle	I	20						5-10m	8	Semi-mature	11-20yrs	Fair	Fair	
D-93	1	Allocasurina torulosa	Forest She-oak	A	15						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	Powerlines
D-94	1	Allocasurina torulosa	Forest She-oak	A	15						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	Powerlines
D-95	1	Acacia dealbata	Silver Wattle	I	20						5-10m	8	Semi-mature	11-20yrs	Fair	Fair	
D-96	4	Acacia melanoxylon	Blackwood	I	15						3-5m	3	Juvenile	20+yrs	Good	Fair-Good	
D-97	1	Eucalyptus sp.	Eucalypt	A	16						5-10m	3	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-98	1	Eucalyptus sp.	Eucalypt	A	16						5-10m	3	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-99	1	Prunus sp.	Flowering Plum	E						Multi-stemmed	3-5m	4	Senescent	0	Poor	Poor	Few shoots from base
D-100	7	Eucalyptus camaldulensis	River Red Gum	I	15						3-5m	3	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-101	3	Prunus sp.	Flowering Plum	E	20						3-5m	6	Mature	11-20yrs	Fair-Good	Fair	
D-102	2	Eucalyptus camaldulensis	River Red Gum	I	45						15-20m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-103	1	Cupressocyparis leylandii	Leyland Cypress	E	45						10-15m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-104	1	Cupressocyparis leylandii	Leyland Cypress	E	30						5-10m	4	Semi-mature	20+yrs	Fair	Fair	
D-105	1	Eucalyptus camaldulensis	River Red Gum	I	40					Multi-stemmed	5-10m	4	Mature	1-5yrs	Poor	Poor	
D-106	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	60						10-15m	12	Mature	20+yrs	Fair-Good	Fair-Good	
D-107	1	Eucalyptus camaldulensis	River Red Gum	I	40					Multi-stemmed	5-10m	4	Mature	1-5yrs	Poor	Poor	
D-108	4	Cupressus sempervirens	Italian Cypress	E	28						5-10m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
D-109	1	Prunus cerasifera	Cherry Plum	E	35						3-5m	5	Over-mature	0	Fair	Poor	Weed
D-111	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	65					Multi-stemmed	5-10m	12	Mature	20+yrs	Fair-Good	Fair	
D-112	1	Phoenix canariensis	Canary Island Date Palm	E	65						3-5m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-113	1	Phoenix canariensis	Canary Island Date Palm	E	65						3-5m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-114	1	Melia azedarach	White Cedar	A	55						10-15m	14	Mature	20+yrs	Fair-Good	Fair-Good	
D-115	1	Melia azedarach	White Cedar	A	55						10-15m	14	Mature	20+yrs	Fair-Good	Fair-Good	
D-116	1	Cupressus torulosa	Bhutan Cypress	E	40						10-15m	4	Semi-mature	11-20yrs	Fair	Fair	
D-118	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	30						15-20m	6	Semi-mature	11-20yrs	Fair	Fair	
D-120	1	Eucalyptus melliodora	Yellow Box	I	30						15-20m	6	Semi-mature	11-20yrs	Fair-Good	Fair	
D-122	1	Eucalyptus sideroxylon	Red Ironbark	V	35						15-20m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
D-123	1	Eucalyptus sideroxylon	Red Ironbark	V	40						10-15m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-124	1	Eucalyptus sideroxylon	Red Ironbark	V	40						10-15m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-125	1	Pinus radiata	Monterey Pine	E	60						15-20m	10	Semi-mature	20+yrs	Fair	Fair	Weed potential
D-126	1	Pinus radiata	Monterey Pine	E	60						15-20m	10	Semi-mature	20+yrs	Fair	Fair	Weed potential
D-127	1	Quercus canariensis	Algerian Oak	E	60						15-20m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	Inspection limited due to fencing
D-128	1	Eucalyptus camaldulensis	River Red Gum	I	35						15-20m	8	Semi-mature	20+yrs	Fair-Good	Fair	
D-131	1	Melia azedarach	White Cedar	A	40						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-133	1	Eucalyptus polyanthemos	Red Box	I	34						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-134	1	Cupressus macrocarpa	Monterey Cypress	E	70						10-15m	10	Mature	6-10yrs	Fair-Poor	Fair	
D-136	1	Cupressus macrocarpa	Monterey Cypress	E	>125						15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
D-137	1	Photinia serratifolia	Photinia	E	25						3-5m	4	Mature	1-5yrs	Poor	Fair	
D-139	1	Photinia serratifolia	Photinia	E	30					Estimate Low	3-5m	5	Mature	11-20yrs	Fair	Fair-Good	
D-140	1	Melaleuca linariifolia	Snow-in-summer	A	80						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-142	1	Photinia serratifolia	Photinia	E	50						5-10m	10	Mature	20+yrs	Fair-Good	Fair	
D-143	1	Prunus sp.	Flowering Plum	E	20						3-5m	5	Mature	20+yrs	Fair-Good	Fair-Good	
D-144	1	Melia azedarach	White Cedar	A	65						5-10m	12	Mature	20+yrs	Fair-Good	Fair-Good	
D-146	1	Melia azedarach	White Cedar	A	35						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-148	1	Melaleuca linariifolia	Snow-in-summer	A	55						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-150	1	Corymbia maculata	Spotted Gum	V	60						15-20m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-151	4	Cupressus macrocarpa	Monterey Cypress	E	80						>20m	10	Mature	6-10yrs	Fair-Poor	Fair	
D-152	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	85						>20m	12	Mature	20+yrs	Fair-Good	Fair	
D-153	1	Eucalyptus viminalis subsp. viminalis	Manna Gum	I	85						>20m	12	Mature	20+yrs	Fair-Good	Fair	
D-154	1	Eucalyptus polyanthemos	Red Box	I	30						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-155	1	Melia azedarach	White Cedar	A	40						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-156	1	Melia azedarach	White Cedar	A	50						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-157	1	Eucalyptus melliodora	Yellow Box	I	30						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-158	3	Eucalyptus melliodora	Yellow Box	I	45						15-20m	14	Mature	20+yrs	Fair-Good	Fair-Good	
D-159	9	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	5						5-10m	2	Juvenile	0	Fair-Good	Fair-Good	Weed
D-160	1	Melaleuca linariifolia	Snow-in-summer	A	60						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
D-162	1	Eucalyptus camaldulensis	River Red Gum	I	30						3-5m	7	Juvenile	20+yrs	Fair-Good	Fair	
D-164	4	Salix babylonica	Willow	E	90						10-15m	15	Over-mature	0	Fair-Good	Poor	Weed
D-165	1	Melia azedarach	White Cedar	A	35					Multi-stemmed	5-10m	10	Mature	11-20yrs	Fair-Good	Fair-Poor	
D-166	1	Eucalyptus camaldulensis	River Red Gum	I	25						3-5m	6	Juvenile	20+yrs	Fair-Good	Fair	
D-167	1	Eucalyptus camaldulensis	River Red Gum	I	25						3-5m	6	Juvenile	20+yrs	Fair-Good	Fair	
D-168	7	Eucalyptus melliodora	Yellow Box	I	30						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-170	1	Melaleuca linariifolia	Snow-in-summer	A	60						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-171	1	Melia azedarach	White Cedar	A	50						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-174	1	Corymbia maculata	Spotted Gum	V	60						15-20m	10	Semi-mature	20+yrs	Good	Fair-Good	
D-175	3	Acacia melanoxylon	Blackwood	I	20						5-10m	4	Mature	6-10yrs	Fair	Fair-Poor	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
D-177	1	Eucalyptus camaldulensis	River Red Gum	I	45						10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-178	4	Salix babylonica	Willow	E	80						10-15m	15	Semi-mature	0	Fair-Good	Fair-Poor	
D-179	1	Eucalyptus camaldulensis	River Red Gum	I	50						5-10m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-180	1	Eucalyptus camaldulensis	River Red Gum	I	16						3-5m	6	Juvenile	11-20yrs	Fair-Good	Fair	
D-182	1	Eucalyptus sideroxylon	Red Ironbark	V	60						5-10m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-183	1	Eucalyptus sideroxylon	Red Ironbark	V	25						5-10m	4	Semi-mature	20+yrs	Fair-Good	Fair	
D-184	1	Eucalyptus melliodora	Yellow Box	I	36						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair	
D-187	1	Eucalyptus polyanthemos	Red Box	I	40						15-20m	10	Mature	20+yrs	Fair-Good	Fair-Good	
D-188	6	Eucalyptus camaldulensis	River Red Gum	I	36						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
D-190	1	Pinus radiata	Monterey Pine	E	70						15-20m	12	Mature	20+yrs	Fair-Good	Good	
D-191	1	Eucalyptus polyanthemos	Red Box	I	35						10-15m	10	Semi-mature	11-20yrs	Fair	Fair	
D-192	4	Eucalyptus melliodora	Yellow Box	I	30						5-10m	9	Semi-mature	20+yrs	Fair-Good	Fair	
D-193	4	Eucalyptus camaldulensis	River Red Gum	I	20						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
D-194	1	Eucalyptus leucoxylon	Yellow Gum	I	30						10-15m	6	Semi-mature	20+yrs	Fair	Fair	
D-195	2	Eucalyptus camaldulensis	River Red Gum	I	35						10-15m	8	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-196	1	Pinus radiata	Monterey Pine	E	65						15-20m	14	Mature	20+yrs	Fair-Good	Fair-Good	
D-197	1	Eucalyptus melliodora	Yellow Box	I	35					Multi-stemmed	5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair	
D-198	6	Eucalyptus melliodora	Yellow Box	I	32						5-10m	8	Semi-mature	20+yrs	Fair-Good	Fair	
D-199	9	Acacia dealbata	Silver Wattle	I	15						3-5m	6	Mature	1-5yrs	Poor	Poor	
D-201	1	Eucalyptus melliodora	Yellow Box	I	20						10-15m	4	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-203	1	Casuarina cunninghamiana	River She-oak	A	60						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-204	1	Eucalyptus lehmannii	Bushy Yate	A	35						5-10m	6	Semi-mature	6-10yrs	Fair-Poor	Fair-Poor	
D-205	3	Salix babylonica	Willow	E	50						5-10m	10	Semi-mature	0	Fair-Good	Fair	Weed
D-207	1	Angophora costata	Sydney Red Gum	A	70						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-209	1	Eucalyptus camaldulensis	River Red Gum	I	50						15-20m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-211	4	Acacia implexa	Lightwood	I	25						5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
D-214	7	Acacia implexa	Lightwood	I	25						5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
D-218	1	Eucalyptus cladocalyx	Sugar Gum	A	60						5-10m	10	Semi-mature	20+yrs	Fair-Good	Fair	
D-218	1	Eucalyptus leucoxylon	Yellow Gum	I	10						3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-219	1	Eucalyptus melliodora	Yellow Box	I	6						3-5m	1	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-220	1	Eucalyptus sp.	Eucalypt	A	5						3-5m	1	Juvenile	20+yrs	Fair-Good	Fair	
D-221	3	Allocasurina verticillata	Drooping She-oak	I	7						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair	
D-227	8	Allocasurina verticillata	Drooping She-oak	I	10						3-5m	2	Semi-mature	20+yrs	Fair	Fair	Cluster of small trees in island
D-230	1	Melaleuca linariifolia	Snow-in-summer	A	75						5-10m	7	Mature	20+yrs	Good	Fair	
D-244	1	Callistemon viminalis	Weeping Bottlebrush	A	10						3-5m	2	Semi-mature	6-10yrs	Fair-Good	Poor	Limited crown
D-245	1	Corymbia citriodora	Lemon-scented Gum	A	45						10-15m	10	Semi-mature	20+yrs	Fair	Fair	
D-246	1	Callistemon salignus	Willow Bottlebrush	A	30						5-10m	4	Semi-mature	6-10yrs	Fair-Poor	Fair-Poor	Sparse
D-247	1	Melaleuca linariifolia	Snow-in-summer	A	50						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-248	1	Corymbia ficifolia	Red Flowering Gum	A	35						5-10m	4	Semi-mature	20+yrs	Good	Fair	
D-249	1	Melaleuca linariifolia	Snow-in-summer	A	45						5-10m	7	Semi-mature	20+yrs	Good	Fair-Good	
D-250	1	Eucalyptus goniocalyx	Long-leaved Box	I	70						5-10m	8	Mature	11-20yrs	Fair-Good	Fair-Poor	Heavily pruned. Overextended scaffolds
D-251	1	Acacia implexa	Lightwood	I	40						5-10m	6	Semi-mature	6-10yrs	Fair-Poor	Fair-Poor	Declining
D-252	1	Acacia implexa	Lightwood	I	40	30					5-10m	6	Semi-mature	6-10yrs	Fair-Poor	Fair-Poor	Declining
D-253	1	Eucalyptus goniocalyx	Long-leaved Box	I	30						10-15m	5	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-254	1	Callistemon salignus	Willow Bottlebrush	A	20						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
D-255	1	Eucalyptus goniocalyx	Long-leaved Box	I	40	30	30	20			10-15m	11	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
D-256	3	Acacia implexa	Lightwood	I	15						5-10m	2	Semi-mature	11-20yrs	Fair	Fair	
D-257	1	Corymbia maculata	Spotted Gum	V	15						5-10m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-258	1	Malus sp.	Crabapple	E	45						5-10m	7	Over-mature	6-10yrs	Fair	Poor	
D-259	1	Prunus cerasifera 'Nigra'	Cherry Plum	E	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-260	6	Ulmus procera	English Elm	E	40						5-10m	8	Semi-mature	11-20yrs	Fair	Fair	
D-267	1	Melia azedarach	White Cedar	A	60						5-10m	6	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
D-268	1	Eucalyptus occidentalis	Swamp Yate	A	30						10-15m	7	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
D-269	1	Eucalyptus camaldulensis	River Red Gum	I	10						5-10m	2	Juvenile	20+yrs	Fair	Fair	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
D-270	1	Eucalyptus microcarpa	Grey Box	I	40						5-10m	8	Semi-mature	11-20yrs	Fair-Good	Fair	
D-271	1	Eucalyptus melliodora	Yellow Box	I	30						10-15m	6	Semi-mature	20+yrs	Fair-Good	Fair	
D-272	1	Callistemon viminalis	Weeping Bottlebrush	A	10						3-5m	2	Semi-mature	11-20yrs	Fair-Good	Fair	
D-273	1	Acer negundo	Box Elder	E	45						5-10m	8	Semi-mature	1-5yrs	Poor	Poor	Major deacy and dieback
D-274	1	Eucalyptus polyanthemos	Red Box	I	20						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-275	1	Melia azedarach	White Cedar	A	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-276	1	Eucalyptus microcarpa	Grey Box	I	25						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-277	1	Eucalyptus microcarpa	Grey Box	I	25						5-10m	5	Semi-mature	20+yrs	Fair-Good	Fair	
D-278	1	Ulmus procera	English Elm	E	5						3-5m	2	Juvenile	0	Fair-Good	Fair-Poor	Sucker growth
D-279	1	Eucalyptus microcarpa	Grey Box	I	400						5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair	
D-280	1	Eucalyptus microcarpa	Grey Box	I	30						5-10m	3	Semi-mature	11-20yrs	Fair	Fair	
D-281	1	Eucalyptus microcarpa	Grey Box	I	50						10-15m	81	Semi-mature	11-20yrs	Fair-Good	Fair	
D-282	1	Eucalyptus microcarpa	Grey Box	I	40						10-15m	8	Semi-mature	11-20yrs	Fair-Good	Fair	
D-283	1	Eucalyptus goniocalyx	Long-leaved Box	I	35						5-10m	6	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
D-284	1	Eucalyptus nicholii	Narrow-leaved Peppermint	A	35						10-15m	5	Semi-mature	0	Poor	Poor	Irresponsible decline
D-285	1	Acer negundo	Box Elder	E	25						5-10m	4	Semi-mature	6-10yrs	Fair-Poor	Poor	Major die back and decay
D-286	1	Hakea francisiana	Emu Tree	A	10						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
D-287	1	Corymbia ficifolia	Red Flowering Gum	A	15						3-5m	3	Semi-mature	20+yrs	Fair-Good	Fair	
D-288	1	Hakea francisiana	Emu Tree	A	2						3-5m	1	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-289	1	Melia azedarach	White Cedar	A	40						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair-Good	
D-290	1	Melaleuca linariifolia	Snow-in-summer	A	70						5-10m	6	Mature	11-20yrs	Fair-Good	Fair	
D-291	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	30						5-10m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
D-292	1	Callistemon sp.	Bottlebrush	A	10						3-5m	2	Semi-mature	11-20yrs	Fair-Good	Fair	
D-293	1	Eucalyptus goniocalyx	Long-leaved Box	I	50						15-20m	9	Semi-mature	11-20yrs	Fair-Good	Fair	
D-294	1	Eucalyptus goniocalyx	Long-leaved Box	I	45						10-15m	8	Semi-mature	11-20yrs	Fair-Good	Fair	
D-295	1	Callistemon viminalis	Weeping Bottlebrush	A	10						3-5m	2	Semi-mature	11-20yrs	Fair-Good	Fair	
D-296	1	Hakea francisiana	Emu Tree	A	10						3-5m	3	Semi-mature	11-20yrs	Fair-Good	Fair	
D-297	1	Tristaniopsis laurina	Water Gum	V	5						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair	
D-298	1	Corymbia ficifolia	Red Flowering Gum	A	5						3-5m	1	Juvenile	20+yrs	Fair-Good	Fair	
D-299	1	Corymbia maculata	Spotted Gum	V						Multi-stemmed	3-5m	2	Semi-mature	6-10yrs	Fair-Good	Poor	Stump sprout
D-300	1	Fraxinus angustifolia subsp. angustifolia	Desert Ash	E						Multi-stemmed	3-5m	3	Semi-mature	0	Fair-Good	Poor	Weed
D-301	1	Eucalyptus melliodora	Yellow Box	I	30	15					5-10m	7	Semi-mature	20+yrs	Fair-Good	Fair	
D-302	1	Tristaniopsis laurina	Water Gum	V	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-303	2	Ulmus procera	English Elm	E	35						10-15m	8	Semi-mature	11-20yrs	Fair-Good	Fair	Sucker growth
D-305	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	8						3-5m	1	Juvenile	20+yrs	Fair-Good	Fair-Good	
D-306	1	Lagunaria patersonia	Norfolk Island Hibiscus	A	50						5-10m	9	Semi-mature	11-20yrs	Fair-Good	Fair-Good	Nuisance tree
D-310	1	Eucalyptus cladocalyx	Sugar Gum	A	75						>20m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-312	1	Prunus sp.	Flowering Plum	E	15						3-5m	4	Semi-mature	11-20yrs	Fair-Good	Fair	
D-314	1	Eucalyptus goniocalyx	Long-leaved Box	I	35						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-316	1	Eucalyptus melliodora	Yellow Box	I	70						10-15m	10	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-318	1	Allocasurina verticillata	Drooping She-oak	I	10						3-5m	2	Semi-mature	6-10yrs	Fair	Poor	Acute lean
D-319	1	Melaleuca linariifolia	Snow-in-summer	A	40						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
D-320	1	Eucalyptus goniocalyx	Long-leaved Box	I	45						10-15m	7	Semi-mature	20+yrs	Good	Fair-Good	
D-321	1	Corymbia maculata	Spotted Gum	V	50						>20m	11	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-322	1	Eucalyptus goniocalyx	Long-leaved Box	I	30						5-10m	6	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
D-323	1	Melaleuca styphelioides	Prickly-leaved Paperbark	A	40						5-10m	6	Semi-mature	11-20yrs	Fair-Good	Fair	
D-324	1	Corymbia maculata	Spotted Gum	V	45						10-15m	7	Semi-mature	6-10yrs	Fair-Poor	Fair	
D-325	1	Eucalyptus camaldulensis	River Red Gum	I	85	50					15-20m	12	Mature	20+yrs	Fair-Good	Fair-Good	
D-327	1	Melia azedarach	White Cedar	A	50						5-10m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-328	1	Melaleuca linariifolia	Snow-in-summer	A	40						5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair	
D-329	1	Hakea francisiana	Emu Tree	A	15						3-5m	3	Semi-mature	11-20yrs	Good	Fair	

PID	No of trees	Taxa	Common Name	Origin	DBH	DBH_2	DBH_3	DBH_4	DBH_5	Other	Height	Width	Age	ULE	Health	Structure	Notes
D-330	1	Melaleuca linariifolia	Snow-in-summer	A	55						5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair	
D-331	1	Ulmus sp.	Elm	E	15					Estimate Low	3-5m	2	Semi-mature	6-10yrs	Fair	Poor	
D-332	1	Eucalyptus goniocalyx	Long-leaved Box	I	30						5-10m	5	Semi-mature	20+yrs	Good	Fair-Good	
D-333	1	Hakea laurina	Pincushion Hakea	A	20					Estimate Low	3-5m	3	Mature	11-20yrs	Good	Fair	
D-334	1	Corymbia ficifolia	Red Flowering Gum	A	50						5-10m	5	Semi-mature	11-20yrs	Good	Fair	Powerlines
D-335	1	Eucalyptus sideroxylon	Red Ironbark	V	50						10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-336	1	Allocasurina verticillata	Drooping She-oak	I	20					Estimate Low	5-10m	4	Semi-mature	20+yrs	Good	Fair	
D-337	1	Eucalyptus melliodora	Yellow Box	I	40	25					10-15m	9	Semi-mature	20+yrs	Fair-Good	Fair	
D-338	1	Eucalyptus melliodora	Yellow Box	I	50						10-15m	7	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-339	1	Acacia implexa	Lightwood	I	10						3-5m	1	Semi-mature	11-20yrs	Fair	Fair	
D-340	1	Eucalyptus melliodora	Yellow Box	I	75						10-15m	12	Semi-mature	20+yrs	Good	Fair-Good	
D-341	1	Eucalyptus goniocalyx	Long-leaved Box	I	20	15					5-10m	5	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
D-342	1	Eucalyptus goniocalyx	Long-leaved Box	I	35					Estimate Low	5-10m	4	Semi-mature	11-20yrs	Fair-Good	Fair-Poor	
D-343	1	Syzygium paniculatum	Magenta Cherry	A	28					Estimate Low	5-10m	3	Semi-mature	20+yrs	Good	Fair-Good	Cultivar
D-344	1	Eucalyptus camaldulensis	River Red Gum	I	50						10-15m	8	Semi-mature	20+yrs	Fair	Fair-Good	
D-345	1	Eucalyptus goniocalyx	Long-leaved Box	I	45	35					15-20m	10	Semi-mature	20+yrs	Fair-Good	Fair	
D-346	1	Callistemon viminalis	Weeping Bottlebrush	A	10						3-5m	2	Semi-mature	20+yrs	Fair-Good	Fair	
D-347	1	Eucalyptus melliodora	Yellow Box	I	30						5-10m	6	Semi-mature	20+yrs	Fair-Good	Fair-Poor	
D-348	1	Eucalyptus mannifera	Brittle Gum	V	60	50	50				10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair-Good	
D-349	1	Eucalyptus goniocalyx	Long-leaved Box	I	40						15-20m	6	Semi-mature	20+yrs	Good	Fair-Good	
D-350	1	Lagunaria patersonia	Norfolk Island Hibiscus	A	35						5-10m	5	Semi-mature	20+yrs	Good	Fair-Good	
D-351	1	Eucalyptus melliodora	Yellow Box	I	35						15-20m	7	Semi-mature	20+yrs	Fair	Fair	
D-352	1	Lophostemon confertus	Brush Box	A	10						3-5m	2	Juvenile	20+yrs	Good	Fair-Good	
D-354	1	Eucalyptus goniocalyx	Long-leaved Box	I	70						10-15m	12	Semi-mature	20+yrs	Fair-Good	Fair	
D-355	1	Eucalyptus leucoxylon subsp. megalocarpa	Large-fruited South Australian Blue Gum	V	5						3-5m	2	Juvenile	20+yrs	Fair-Good	Fair-Good	

Descriptors

PID: Unique identifier for tree or tree group

Taxon: Botanical name of tree.

Common Name: Accepted common name of taxon
Sources for Taxon and Common Names:
Flora of Victoria online (https://vicflora.rbg.vic.gov.au/)
Horticultural Flora of South Eastern Australia (Vols. 1-5)

Origin:

I Indigenous to locale. Considered Native under planning scheme provisions

V Naturally occurring taxon within Victoria. Considered Native under planning scheme provisions

A Australian native. Occurs naturally within Australia, but outside Victoria.

E Exotic. Introduced taxon to Australia.

DBH: Diameter at breast height (1.4m), expressed in centimetres. Estimated.

Height: Estimated height of tree. Expressed as a range, in metres.

Width: Estimated width of tree, in metres.

Age

Juvenile: Young, recently planted tree.

Semi-mature: Tree is developing and established.

Mature: Specimen has reached expected size in current situation, limited extension growth.

Over-mature: Specimen has reached expected size in current situation, showing indicators of reduced health or structure.

Senescent Tree is in advancing decline.

Useful Life Expectancy (ULE)

The length of time a tree can be maintained as a useful amenity specimen. Contingent on a number of factors including expected life-span of the taxon, health and structure, pest and diseases, weed status.

Health

Good: Crown full with good density, foliage entire, with good colour, minimal or no pathogen damage. Good growth indicators, e.g. extension growth. No or minimal canopy dieback. Good wound-wood and callus formation.

Fair: Tree is exhibiting one or more of the following:
Tree has <30% deadwood. Or can have minor canopy dieback. Foliage generally with good colour, some discolouration may be present, minor pathogen damage present. Typical growth indicators, e.g. extension growth, leaf size, canopy density for species in location may be slightly abnormal.

Poor: Tree has >30% deadwood. Canopy dieback present. Discoloured or distorted leaves and/or excessive epicormic re-growth. Pathogen is present and/or stress symptoms that could lead to or are contributing to the decline of tree.

Dead: Tree is dead.

Structure

Good:	Sound branch attachment and/or no minor structural defects. Trunk and scaffold branches sound or only minor damage. Good trunk and scaffold branch taper. No branch over extension. No damage to structural roots, good buttressing present. No obvious root pests or diseases.
Fair:	Some minor structural defects and/or minimal damage to trunk. Bark missing. Cavities could be present. Minimal or no damage to structural roots. Typical structure for species.
Poor:	Major structural defects and/or trunk damaged and/or missing bark. Large cavities and/or girdling or damaged roots that are problematic.

AR2 Planned tree removals

APPENDIX AR2 – PLANNED TREE REMOVALS

Table AR2-1 Planned amenity tree removals from Commonwealth Land

Taxon	Common Name	Origin	Total
Agonis flexuosa	Willow Myrtle	A	2
Angophora floribunda	Rough-barked Apple	A	5
Casuarina cunninghamiana	River She-oak	A	1
Corymbia maculata	Spotted Gum	V	1
Eriobotrya japonica	Loquat	E	1
Eucalyptus nicholii	Narrow-leaved Peppermint	A	1
Eucalyptus sp.	Eucalypt	A	2
Eucalyptus tereticornis	Gippsland Manna Gum	V	1
Fraxinus angustifolia subsp. angustifolia	Desert Ash	E	3
Hakea drupacea	Sweet Hakea	A	1
Lophostemon confertus	Brush Box	A	4
Melaleuca armillaris	Giant Honey-myrtle	V	2
Melaleuca nesophila	Showy Honey-myrtle	A	2
Melaleuca styphelioides	Prickly-leaved Paperbark	A	2
Pinus radiata	Monterey Pine	E	10
Pittosporum undulatum	Sweet Pittosporum	V	4
Ulmus procera	English Elm	E	8
TOTAL			**50**

Appendix B – Air quality

AQ1 Gradient scaling for emission factors

Vehicle class	Vehicle speed (kph)	Gradient (%)														
		PM_{10} and $PM_{2.5}$					CO					NO_2				
		-4	-2	0	+2	+4	-4	-2	0	+2	+4	-4	-2	0	+2	+4
Passenger Car – Petrol (PC-P)	20	28	34	100	154	205	79	90	100	115	132	42	48	100	135	165
	40	17	32	100	155	216	61	77	100	128	167	30	46	100	146	209
	50	16	31	100	163	231	55	74	100	136	189	28	39	100	160	240
	60	14	28	100	169	238	50	71	100	144	206	25	41	100	176	264
	80	9	40	100	160	218	41	62	100	163	253	17	46	100	174	256
	100	6	50	100	148	196	35	56	100	191	363	11	46	100	163	237
Passenger Car – Diesel PC-D	20	28	34	100	154	205	87	89	100	108	102	42	48	100	135	165
	40	17	32	100	155	216	80	84	100	103	111	30	46	100	146	209
	50	16	31	100	163	231	83	87	100	119	94	28	39	100	160	240
	60	14	28	100	169	238	86	91	100	118	79	25	41	100	176	264
	80	9	40	100	160	218	79	93	100	72	65	17	46	100	174	256
	100	6	50	100	148	196	98	117	100	80	100	11	46	100	163	237

Vehicle class	Vehicle speed (kph)	Gradient (%)														
		PM_{10} and $PM_{2.5}$					CO					NO_2				
		-4	-2	0	+2	+4	-4	-2	0	+2	+4	-4	-2	0	+2	+4
LCV	20	21	39	100	150	200	32	49	100	89	50	29	44	100	110	115
	40	13	43	100	151	205	48	118	100	91	204	30	78	100	109	181
	50	11	41	100	157	214	64	169	100	193	436	34	96	100	166	276
	60	9	44	100	157	212	62	204	100	318	696	31	115	100	211	342
	80	6	53	100	146	193	19	72	100	262	418	15	56	100	136	265
	100	25	62	100	137	174	21	31	100	172	258	20	47	100	154	214
HCV	20	52	74	100	123	148	46	81	100	112	133	24	70	100	141	199
	40	41	76	100	134	183	39	82	100	130	172	17	62	100	167	255
	50	36	71	100	148	203	35	77	100	143	189	13	55	100	188	282
	60	31	64	100	161	221	29	68	100	155	204	9	43	100	203	302

AQ2 Traffic fleet mix and emissions inventory

Table 1: Scenarios A1 and A2 northbound traffic fleet composition

Hour	North section					South section				
	PCP	PCD	LCV	HCV	Total	PCP	PCD	LCV	HCV	Total
1	208	37	7	66	318	211	37	9	68	325
2	206	36	10	66	318	208	37	12	68	325
3	206	36	10	66	318	208	37	12	68	325
4	208	37	7	66	318	211	37	9	68	325
5	792	140	37	253	1222	713	126	41	234	1113
6	1376	243	65	353	2037	1239	219	71	326	1855
7	1861	328	88	399	2677	1678	296	96	369	2438
8	2380	420	225	425	3450	2040	360	225	400	3025
9	2380	420	225	425	3450	2040	360	225	400	3025
10	2255	398	167	394	3214	1906	336	171	343	2756
11	2087	368	170	401	3026	1871	330	185	370	2756
12	2046	361	185	435	3026	1831	323	200	402	2756
13	2087	368	170	401	3026	1871	330	185	370	2756
14	2245	396	167	393	3201	2016	356	181	363	2915
15	2516	444	159	373	3492	2339	413	178	356	3286
16	3021	533	155	365	4074	2724	481	168	337	3710
17	3995	705	200	350	5250	3613	638	225	350	4825
18	3995	705	200	350	5250	3613	638	225	350	4825
19	2913	514	120	236	3783	2632	465	130	218	3445
20	2178	384	104	244	2910	1965	347	113	225	2650
21	1481	261	71	225	2037	1335	236	76	207	1855
22	809	143	38	173	1164	729	129	42	160	1060
23	203	36	10	69	318	205	36	12	72	325
24	202	36	10	72	318	203	36	12	74	325

Table 2: Scenarios B1 and B2 northbound traffic fleet composition

Hour	North section					South section				
	PCP	PCD	LCV	HCV	Total	PCP	PCD	LCV	HCV	Total
1	244	43	8	75	370	284	50	12	91	437
2	242	43	11	75	370	281	50	16	91	437
3	242	43	11	75	370	281	50	16	91	437
4	244	43	8	75	370	284	50	12	91	437
5	972	172	46	300	1489	830	146	47	268	1292
6	1702	300	80	422	2505	1442	255	82	374	2153
7	2460	434	116	510	3520	2121	374	121	459	3075
8	2720	480	250	550	4000	2295	405	250	500	3450
9	2720	480	250	550	4000	2295	405	250	500	3450
10	2634	465	195	445	3739	2216	391	198	393	3198
11	2439	430	198	453	3520	2176	384	214	424	3198
12	2392	422	215	492	3520	2130	376	232	460	3198
13	2439	430	198	453	3520	2176	384	214	424	3198
14	2623	463	194	444	3724	2344	414	209	415	3383
15	3182	562	200	457	4401	2719	480	206	408	3813
16	3776	666	193	442	5078	3391	598	209	414	4613
17	3953	698	200	350	5200	3740	660	225	375	5000
18	3953	698	200	350	5200	3740	660	225	375	5000
19	3823	675	157	301	4955	3366	594	165	275	4401
20	2540	448	121	276	3385	2284	403	130	258	3075
21	1729	305	82	254	2370	1552	274	89	238	2153
22	946	167	45	196	1354	848	150	48	184	1230
23	238	42	11	78	370	277	49	16	95	437
24	236	42	11	81	370	275	48	16	98	437

Table 3: Scenario A1 northbound traffic emission rates

Hour	PM_{10}	$PM_{2.5}$	CO	NO_2	Benzene	Toulene	Ethylbenzene	Xylene isomers	1,3-Butadiene	Formaldehyde	B(a)P TEQ
	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
1	1.8E-02	1.6E-02	3.7E-01	1.4E-01	6.2E-03	1.2E-02	4.6E-03	1.2E-02	1.8E-03	3.6E-03	9.4E-07
2	1.8E-02	1.6E-02	3.8E-01	1.4E-01	6.2E-03	1.3E-02	4.6E-03	1.2E-02	1.8E-03	3.7E-03	9.4E-07
3	1.8E-02	1.6E-02	3.8E-01	1.4E-01	6.2E-03	1.3E-02	4.6E-03	1.2E-02	1.8E-03	3.7E-03	9.4E-07
4	1.8E-02	1.6E-02	3.7E-01	1.4E-01	6.2E-03	1.2E-02	4.6E-03	1.2E-02	1.8E-03	3.6E-03	9.4E-07
5	6.9E-02	6.1E-02	1.4E+00	5.4E-01	2.3E-02	4.7E-02	1.7E-02	4.6E-02	6.7E-03	1.4E-02	3.5E-06
6	1.0E-01	9.0E-02	2.4E+00	7.8E-01	4.0E-02	8.2E-02	3.0E-02	8.0E-02	1.1E-02	2.2E-02	5.5E-06
7	1.2E-01	1.1E-01	3.1E+00	9.2E-01	5.5E-02	1.1E-01	4.1E-02	1.1E-01	1.4E-02	2.7E-02	6.9E-06
8	1.5E-01	1.3E-01	4.4E+00	1.0E+00	7.3E-02	1.5E-01	5.4E-02	1.4E-01	1.7E-02	3.5E-02	8.6E-06
9	1.5E-01	1.3E-01	4.4E+00	1.0E+00	7.3E-02	1.5E-01	5.4E-02	1.4E-01	1.7E-02	3.5E-02	8.6E-06
10	1.3E-01	1.2E-01	3.9E+00	9.6E-01	6.7E-02	1.4E-01	5.0E-02	1.3E-01	1.6E-02	3.2E-02	7.9E-06
11	1.3E-01	1.2E-01	3.8E+00	9.6E-01	6.4E-02	1.3E-01	4.7E-02	1.3E-01	1.5E-02	3.1E-02	7.7E-06
12	1.4E-01	1.2E-01	3.9E+00	1.0E+00	6.3E-02	1.3E-01	4.7E-02	1.2E-01	1.6E-02	3.2E-02	7.9E-06
13	1.3E-01	1.2E-01	3.8E+00	9.6E-01	6.4E-02	1.3E-01	4.7E-02	1.3E-01	1.5E-02	3.1E-02	7.7E-06
14	1.4E-01	1.2E-01	4.0E+00	9.6E-01	6.8E-02	1.4E-01	5.1E-02	1.3E-01	1.6E-02	3.2E-02	7.9E-06
15	1.4E-01	1.2E-01	4.2E+00	9.6E-01	7.6E-02	1.5E-01	5.6E-02	1.5E-01	1.7E-02	3.4E-02	8.4E-06
16	1.5E-01	1.2E-01	4.7E+00	9.9E-01	8.9E-02	1.8E-01	6.7E-02	1.8E-01	2.0E-02	3.8E-02	9.3E-06
17	1.7E-01	1.4E-01	6.0E+00	1.1E+00	1.2E-01	2.4E-01	8.8E-02	2.3E-01	2.5E-02	4.7E-02	1.1E-05
18	1.7E-01	1.4E-01	6.0E+00	1.1E+00	1.2E-01	2.4E-01	8.8E-02	2.3E-01	2.5E-02	4.7E-02	1.1E-05
19	1.2E-01	9.6E-02	4.2E+00	7.5E-01	8.5E-02	1.7E-01	6.3E-02	1.7E-01	1.8E-02	3.3E-02	8.0E-06
20	1.0E-01	8.5E-02	3.3E+00	6.8E-01	6.4E-02	1.3E-01	4.8E-02	1.3E-01	1.4E-02	2.7E-02	6.5E-06
21	8.0E-02	6.8E-02	2.3E+00	5.7E-01	4.3E-02	8.8E-02	3.2E-02	8.6E-02	1.0E-02	2.0E-02	4.9E-06
22	5.4E-02	4.7E-02	1.3E+00	4.0E-01	2.4E-02	4.8E-02	1.8E-02	4.7E-02	6.0E-03	1.2E-02	3.0E-06
23	1.9E-02	1.7E-02	3.8E-01	1.5E-01	6.1E-03	1.2E-02	4.6E-03	1.2E-02	1.8E-03	3.7E-03	9.6E-07
24	1.9E-02	1.7E-02	3.8E-01	1.5E-01	6.1E-03	1.2E-02	4.5E-03	1.2E-02	1.8E-03	3.8E-03	9.7E-07

Table 4: Scenario A2 traffic emission rates

Hour	PM_{10}	$PM_{2.5}$	NO_2
	g/s	g/s	g/s
1	1.1E-02	7.1E-03	4.8E-02
2	1.1E-02	7.2E-03	4.8E-02
3	1.1E-02	7.2E-03	4.8E-02
4	1.1E-02	7.1E-03	4.8E-02
5	4.2E-02	2.7E-02	1.8E-01
6	6.5E-02	4.2E-02	2.6E-01
7	8.1E-02	5.2E-02	3.0E-01
8	1.0E-01	6.6E-02	3.4E-01
9	1.0E-01	6.6E-02	3.4E-01
10	9.3E-02	6.0E-02	3.1E-01
11	9.1E-02	5.9E-02	3.2E-01
12	9.4E-02	6.1E-02	3.4E-01
13	9.1E-02	5.9E-02	3.2E-01
14	9.4E-02	6.0E-02	3.2E-01
15	9.9E-02	6.3E-02	3.1E-01
16	1.1E-01	6.8E-02	3.2E-01
17	1.3E-01	8.3E-02	3.5E-01
18	1.3E-01	8.3E-02	3.5E-01
19	9.3E-02	5.8E-02	2.4E-01
20	7.6E-02	4.8E-02	2.2E-01
21	5.7E-02	3.6E-02	1.9E-01
22	3.5E-02	2.3E-02	1.3E-01
23	1.1E-02	7.3E-03	5.0E-02
24	1.1E-02	7.4E-03	5.1E-02

Table 5: Scenario B1 northbound traffic emission rates

Hour	PM_{10}	$PM_{2.5}$	CO	NO_2	Benzene	Toulene	Ethylbenzene	Xylene isomers	1,3-Butadiene	Formaldehyde	B(a)P TEQ
	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
1	2.2E-02	1.9E-02	4.4E-01	1.7E-01	7.5E-03	1.5E-02	5.6E-03	1.5E-02	2.1E-03	4.3E-03	1.1E-06
2	2.2E-02	1.9E-02	4.5E-01	1.7E-01	7.5E-03	1.5E-02	5.6E-03	1.5E-02	2.1E-03	4.4E-03	1.1E-06
3	2.2E-02	1.9E-02	4.5E-01	1.7E-01	7.5E-03	1.5E-02	5.6E-03	1.5E-02	2.1E-03	4.4E-03	1.1E-06
4	2.2E-02	1.9E-02	4.4E-01	1.7E-01	7.5E-03	1.5E-02	5.6E-03	1.5E-02	2.1E-03	4.3E-03	1.1E-06
5	8.2E-02	7.2E-02	1.7E+00	6.4E-01	2.8E-02	5.7E-02	2.1E-02	5.6E-02	8.0E-03	1.6E-02	4.2E-06
6	1.2E-01	1.1E-01	2.9E+00	9.3E-01	4.9E-02	1.0E-01	3.7E-02	9.8E-02	1.3E-02	2.6E-02	6.7E-06
7	1.6E-01	1.4E-01	4.0E+00	1.2E+00	7.2E-02	1.4E-01	5.4E-02	1.4E-01	1.8E-02	3.6E-02	9.0E-06
8	1.8E-01	1.6E-01	5.1E+00	1.3E+00	8.3E-02	1.7E-01	6.2E-02	1.6E-01	2.0E-02	4.1E-02	1.0E-05
9	1.8E-01	1.6E-01	5.1E+00	1.3E+00	8.3E-02	1.7E-01	6.2E-02	1.6E-01	2.0E-02	4.1E-02	1.0E-05
10	1.5E-01	1.3E-01	4.6E+00	1.1E+00	7.9E-02	1.6E-01	5.9E-02	1.6E-01	1.9E-02	3.7E-02	9.1E-06
11	1.5E-01	1.3E-01	4.4E+00	1.1E+00	7.4E-02	1.5E-01	5.5E-02	1.5E-01	1.8E-02	3.6E-02	8.9E-06
12	1.6E-01	1.4E-01	4.5E+00	1.2E+00	7.4E-02	1.5E-01	5.5E-02	1.5E-01	1.8E-02	3.6E-02	9.1E-06
13	1.5E-01	1.3E-01	4.4E+00	1.1E+00	7.4E-02	1.5E-01	5.5E-02	1.5E-01	1.8E-02	3.6E-02	8.9E-06
14	1.6E-01	1.3E-01	4.6E+00	1.1E+00	7.9E-02	1.6E-01	5.9E-02	1.6E-01	1.9E-02	3.7E-02	9.2E-06
15	1.7E-01	1.4E-01	5.2E+00	1.2E+00	9.4E-02	1.9E-01	7.0E-02	1.9E-01	2.1E-02	4.2E-02	1.0E-05
16	1.8E-01	1.5E-01	5.9E+00	1.2E+00	1.1E-01	2.3E-01	8.3E-02	2.2E-01	2.4E-02	4.7E-02	1.2E-05
17	1.7E-01	1.4E-01	6.0E+00	1.1E+00	1.2E-01	2.4E-01	8.8E-02	2.3E-01	2.5E-02	4.7E-02	1.1E-05
18	1.7E-01	1.4E-01	6.0E+00	1.1E+00	1.2E-01	2.4E-01	8.8E-02	2.3E-01	2.5E-02	4.7E-02	1.1E-05
19	1.5E-01	1.2E-01	5.5E+00	9.6E-01	1.1E-01	2.2E-01	8.3E-02	2.2E-01	2.3E-02	4.3E-02	1.0E-05
20	1.2E-01	9.8E-02	3.9E+00	7.8E-01	7.4E-02	1.5E-01	5.6E-02	1.5E-01	1.6E-02	3.1E-02	7.6E-06
21	9.2E-02	7.8E-02	2.7E+00	6.5E-01	5.1E-02	1.0E-01	3.8E-02	1.0E-01	1.2E-02	2.3E-02	5.6E-06
22	6.2E-02	5.3E-02	1.6E+00	4.6E-01	2.8E-02	5.6E-02	2.1E-02	5.5E-02	6.9E-03	1.4E-02	3.5E-06
23	2.2E-02	2.0E-02	4.5E-01	1.7E-01	7.4E-03	1.5E-02	5.5E-03	1.5E-02	2.1E-03	4.4E-03	1.1E-06
24	2.3E-02	2.0E-02	4.5E-01	1.8E-01	7.3E-03	1.5E-02	5.5E-03	1.5E-02	2.2E-03	4.5E-03	1.2E-06

Table 6: Scenario B2 traffic emission rates

Hour	PM_{10}	$PM_{2.5}$	NO_2
	g/s	g/s	g/s
1	1.3E-02	8.4E-03	5.6E-02
2	1.3E-02	8.5E-03	5.6E-02
3	1.3E-02	8.5E-03	5.6E-02
4	1.3E-02	8.4E-03	5.6E-02
5	5.0E-02	3.2E-02	2.1E-01
6	7.8E-02	5.0E-02	3.1E-01
7	1.1E-01	6.7E-02	3.9E-01
8	1.2E-01	7.9E-02	4.3E-01
9	1.2E-01	7.9E-02	4.3E-01
10	1.1E-01	6.9E-02	3.6E-01
11	1.1E-01	6.8E-02	3.6E-01
12	1.1E-01	7.0E-02	3.8E-01
13	1.1E-01	6.8E-02	3.6E-01
14	1.1E-01	6.9E-02	3.6E-01
15	1.2E-01	7.7E-02	3.8E-01
16	1.3E-01	8.5E-02	3.9E-01
17	1.3E-01	8.3E-02	3.5E-01
18	1.3E-01	8.3E-02	3.5E-01
19	1.2E-01	7.5E-02	3.1E-01
20	8.8E-02	5.5E-02	2.5E-01
21	6.5E-02	4.2E-02	2.1E-01
22	4.1E-02	2.6E-02	1.5E-01
23	1.3E-02	8.7E-03	5.8E-02
24	1.4E-02	8.8E-03	6.0E-02

AQ3 Ventilation structure impact isopleths

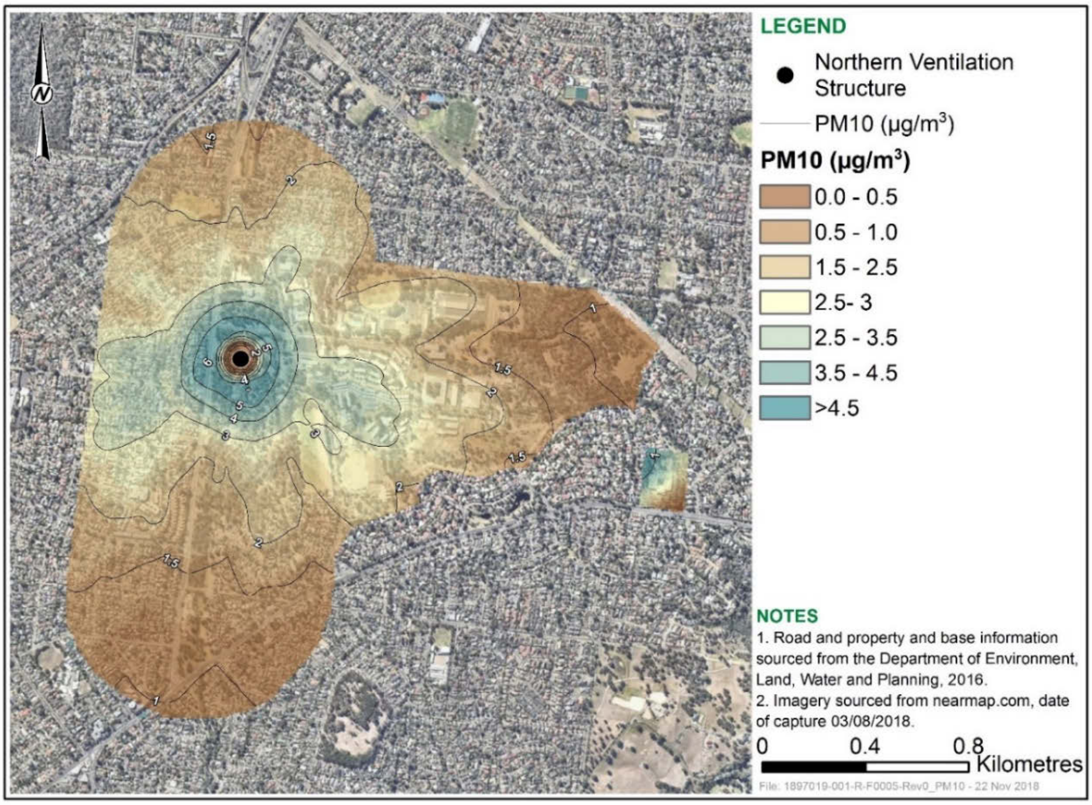

Figure 1: Scenario B: Maximum predicted one-hour average PM_{10} GLC

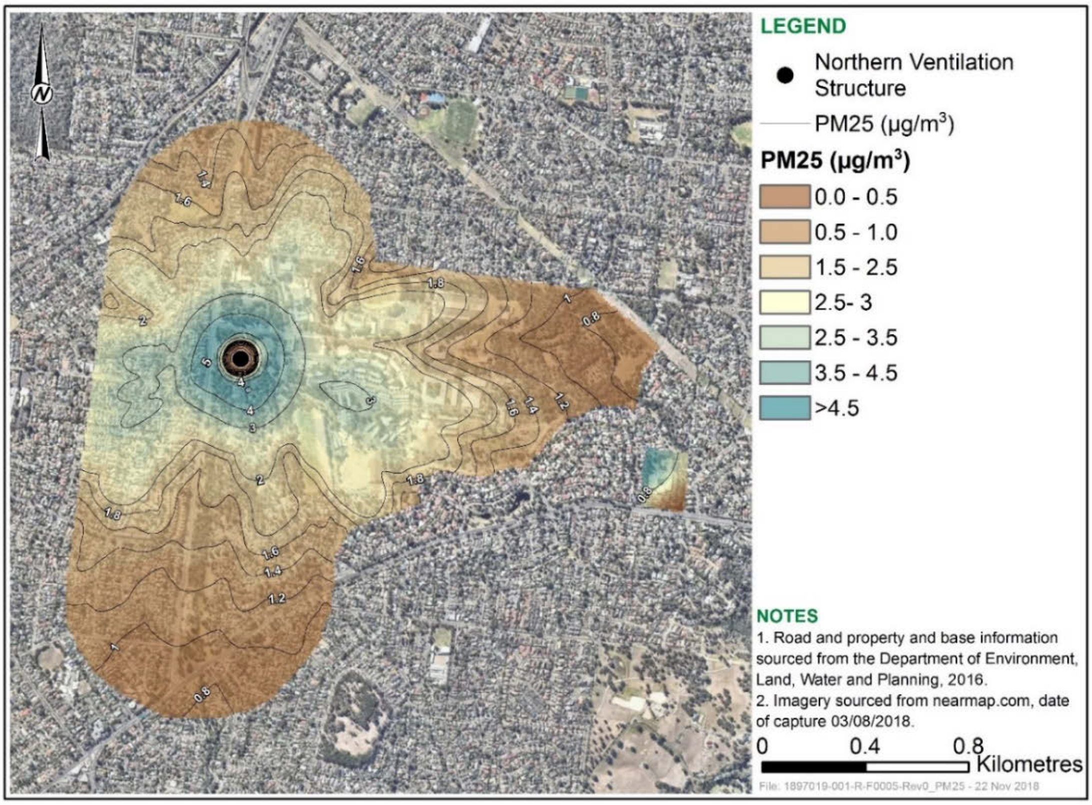

Figure 2: Scenario B: Maximum predicted one-hour average $PM_{2.5}$ GLC

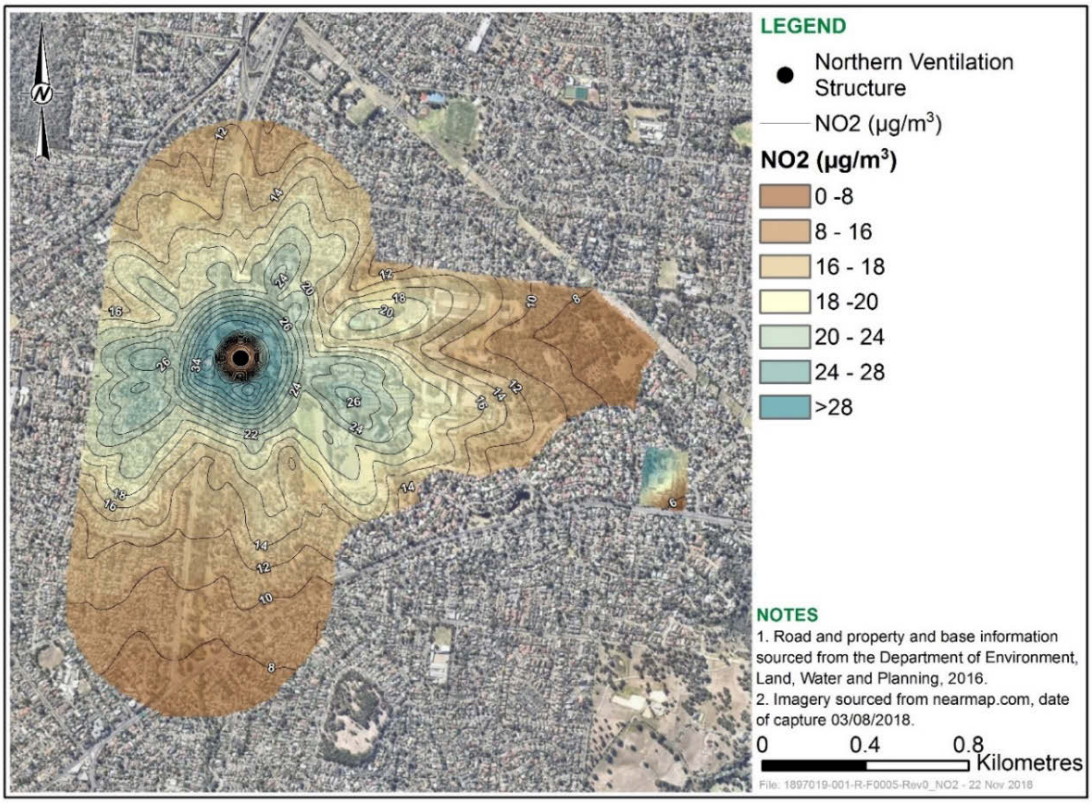

Figure 3: Scenario B: Maximum predicted one hour average NO_2 GLC

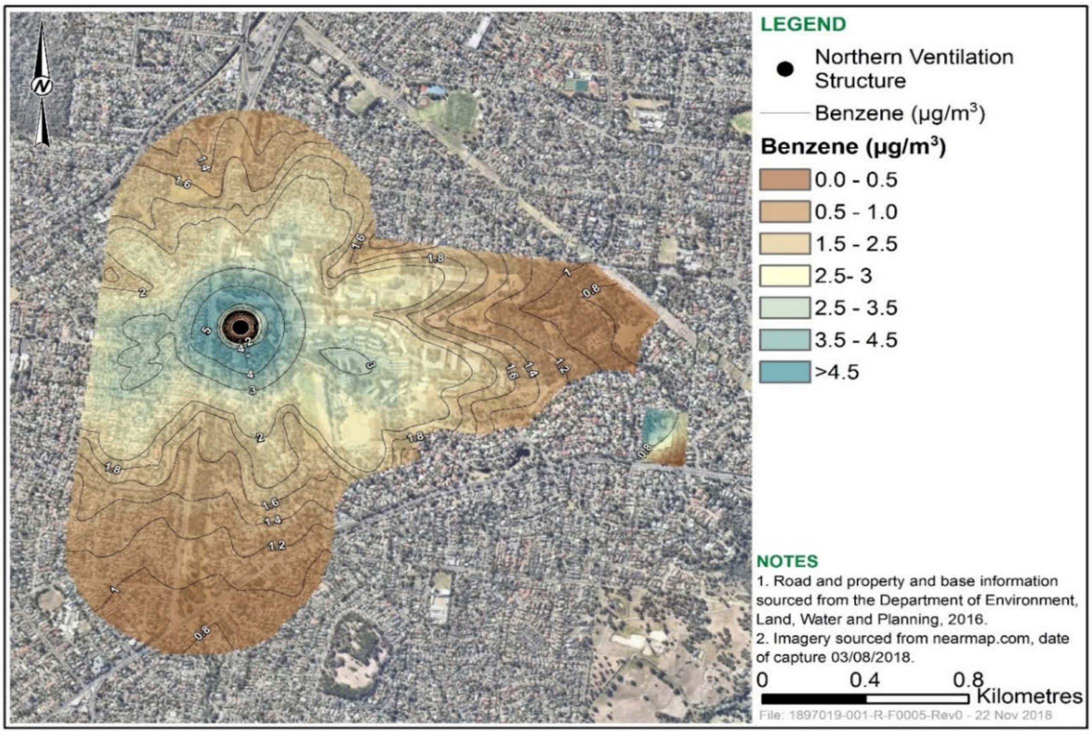

Figure 4: Scenario B: Maximum predicted three-minute average benzene GLC

Appendix C – Contaminated land

CL1 Summary of analytical results

Appendix CL1
Table 1
Summary of Soil Analytical Results

	Unit	EQL	EPA Victoria IWRG 621 Category B	EPA Victoria IWRG 621 Category C	EPA Victoria IWRG 621 Clean Fill	EPA Victoria IWRG 621 Trigger for Leachate Testing																
Location Code							NEL-BH086	NEL-BH087	NEL-BH087	NEL-BH088	NEL-BH088	NEL-BH089	NEL-BH089	NEL-BH101	NEL-BH101	NEL-BH161	NEL-BH161	NEL-BH162	NEL-BH162	NEL-BH163	NEL-BH163	NEL-BH163
Depth							0.3 - 0.4	0.2 - 0.3	0.7 - 0.8	0.2 - 0.3	0.6 - 0.7	0.2 - 0.3	0.6 - 0.7	0.5 - 0.6	1 - 1.1	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	1 - 1.1	0.2 - 0.3	0.2 - 0.3	1 - 1.1
Date							2/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	14/06/2018	14/06/2018	13/06/2018	13/06/2018	6/06/2018	6/06/2018	13/06/2018	13/06/2018	13/06/2018
Field ID							NEL-BH086_0.3m	NEL-BH087_0.2m	NEL-BH087_0.7m	NEL-BH088_0.2m	NEL-BH088_0.6m	NEL-BH089_0.2m	NEL-BH089_0.6m	NEL-BH101_0.5	NEL-BH101_1.0	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH162_0.2m	NEL-BH162_1.0m	NEL-BH163_0.2m	QC1005	NEL-BH163_1.0m
Sample Type							Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal
Lab Report Number							EM1716457	EM1715998	EM1715998	EM1715998	EM1715998	EM1715998	EM1715998	EM1809614	EM1809614	EM1809532	EM1809532	EM1809233	EM1809233	EM1809532	EM1809532	EM1809532
Inorganics																						
Cyanide (Total)	mg/kg	1	10000	2500	50	160	2	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Major Ions																						
Fluoride	mg/kg	40	40000	10000	450	3000	530	130	330	160	620	480	520	610	200	230	530	510	560	360	320	740
Metals																						
Arsenic	mg/kg	5	2000	500	20	14	<5	<5	8	<5	<5	7	9	<5	5	<5	7	<5	<5	10	<5	<5
Cadmium	mg/kg	1	400	100	3	4	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium (hexavalent)	mg/kg	0.5	2000	500	1	100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (III+VI)	mg/kg	2					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	mg/kg	5	20000	5000	100	4000	9	<5	6	<5	12	17	30	14	<5	5	17	<5	13	6	5	17
Lead	mg/kg	5	6000	1500	300	20	10	8	15	6	12	24	23	12	13	18	15	7	12	16	13	24
Mercury	mg/kg	0.1	300	75	1	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.5	<0.1	<0.1	0.2	<0.1	0.1
Molybdenum	mg/kg	2	4000	1000	40	100	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel	mg/kg	2	12000	3000	60	40	16	3	8	2	16	9	10	20	8	4	17	5	28	13	9	30
Selenium	mg/kg	5	200	50	10	20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver	mg/kg	2	720	180	10	200	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Tin	mg/kg	5		500	50		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Zinc	mg/kg	5	140000	35000	200	6000	12	6	6	<5	16	21	10	23	9	7	17	7	23	16	12	54
BTEXN																						
Benzene	mg/kg	0.2	16	4	1	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene (o)	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene (m & p)	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene Total	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TRH - NEPM 2013																						
F1 (C6-C10 minus BTEXN)	mg/kg	10					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C6-C10 Fraction	mg/kg	10					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
F2 (>C10-C16 minus Naphthalene)	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
>C10-C16 Fraction	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
F3 (>C16-C34 Fraction)	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F4 (>C34-C40 Fraction)	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
>C10-C40 (Sum of Total)	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
TRH - NEPM 1999																						
C6-C9 Fraction	mg/kg	10	2600	650	100		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C10-C14 Fraction	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C15-C28 Fraction	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C29-C36 Fraction	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C10-C36 (Sum of Total)	mg/kg	50	40000	10000	1000		<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
PAHs																						
Sum of polycyclic aromatic hydrocarbons	mg/kg	0.5					-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a) pyrene	mg/kg	0.5	20	5	1	0.02	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j+k)fluoranthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-c,d)pyrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PAHs (Sum of total) - Lab calc	mg/kg	0.5	400	100	20		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Ca	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total 8 PAHs (as BaP TEQ)(half LOR) - Lab Calc	mg/kg	0.5					0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc	mg/kg	0.5					1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Phenols																						
Phenols(halogenated) - Lab Calc	mg/kg	0.03				40	<1	<1	<1	<1	<1	<1	<1	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
3/4-Methylphenol (m/p-cresol)	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenols (non-halogenated) - Lab Calc	mg/kg	1				280	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,3,5,6-Tetrachlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,4,5-trichlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,6-trichlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-dichlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,4-dimethylphenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-dinitrophenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,6-dichlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,3,4,5 & 2,3,4,6-Tetrachlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-chlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2-methylphenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-nitrophenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4,6-Dinitro-o-cyclohexyl phenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-chloro-3-methylphenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
4-nitrophenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Pentachlorophenol	mg/kg	0.2					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Phenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenols (Total Halogenated)	mg/kg	0.03					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols (Total Non Halogenated)	mg/kg	1					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix CL1
Table 1
Summary of Soil Analytical Results

						Location Code	NEL-BH164	NEL-BH164	NEL-BH165	NEL-BH165	NEL-BH223	NEL-BH223	NEL-BH224	NEL-BH224	NEL-ENV-BH022	NEL-ENV-BH022	NEL-ENV-BH022
						Depth	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	1.5 - 1.6
						Date	13/06/2018	13/06/2018	6/06/2018	6/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	6/06/2018	6/06/2018	6/06/2018
						Field ID	NEL-BH164_0.2m	NEL-BH164_0.5m	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-BH223_0.2m	NEL-BH223_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
						Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
						Lab Report Number	EM1809532	EM1809532	EM1809233	EM1809233	EM1809532	EM1809532	EM1809532	EM1809532	EM1809233	EM1809233	EM1809233
	Unit	EQL	EPA Victoria IWRG 621 Category B	EPA Victoria IWRG 621 Category C	EPA Victoria IWRG 621 Clean Fill	EPA Victoria IWRG 621 Trigger for Leachate Testing											
Inorganics																	
Cyanide (Total)	mg/kg	1	10000	2500	50	160	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Major Ions																	
Fluoride	mg/kg	40	40000	10000	450	3000	70	200	210	200	140	380	110	520	640	340	750
Metals																	
Arsenic	mg/kg	5	2000	500	20	14	<5	<5	5	5	<5	12	<5	5	8	11	8
Cadmium	mg/kg	1	400	100	3	4	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium (hexavalent)	mg/kg	0.5	2000	500	1	100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (III+VI)	mg/kg	2					-	-	-	-	-	-	-	-	-	-	-
Copper	mg/kg	5	20000	5000	100	4000	<5	<5	7	16	<5	10	<5	18	18	39	46
Lead	mg/kg	5	6000	1500	300	20	8	9	14	14	7	26	8	16	33	24	16
Mercury	mg/kg	0.1	300	75	1	2	<0.1	<0.1	<0.1	0.1	<0.1	0.3	<0.1	0.3	<0.1	<0.1	<0.1
Molybdenum	mg/kg	2	4000	1000	40	100	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel	mg/kg	2	12000	3000	60	40	3	4	12	35	4	15	4	23	14	27	15
Selenium	mg/kg	5	200	50	10	20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver	mg/kg	2	720	180	10	200	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Tin	mg/kg	5		500	50		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Zinc	mg/kg	5	140000	35000	200	6000	6	<5	12	21	5	11	6	18	16	22	13
BTEXN																	
Benzene	mg/kg	0.2	16	4	1	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene (o)	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene (m & p)	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene Total	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TRH - NEPM 2013																	
F1 (C6-C10 minus BTEXN)	mg/kg	10					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C6-C10 Fraction	mg/kg	10					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
F2 (>C10-C16 minus Naphthalene)	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
>C10-C16 Fraction	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
F3 (>C16-C34 Fraction)	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F4 (>C34-C40 Fraction)	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
>C10-C40 (Sum of Total)	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
TRH - NEPM 1999																	
C6-C9 Fraction	mg/kg	10	2600	650	100		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C10-C14 Fraction	mg/kg	50					<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C15-C28 Fraction	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C29-C36 Fraction	mg/kg	100					<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
C10-C36 (Sum of Total)	mg/kg	50	40000	10000	1000		<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
PAHs																	
Sum of polycyclic aromatic hydrocarbons	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a) pyrene	mg/kg	0.5	20	5	1	0.02	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j+k)fluoranthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-c,d)pyrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PAHs (Sum of total) - Lab calc	mg/kg	0.5	400	100	20		-	-	-	-	-	-	-	-	-	-	-
Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Ca	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total 8 PAHs (as BaP TEQ)(half LOR) - Lab Cal	mg/kg	0.5					0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc	mg/kg	0.5					1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Phenols																	
Phenols(halogenated) - Lab Calc	mg/kg	0.03				40	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
3/4-Methylphenol (m/p-cresol)	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenols (non-halogenated) - Lab Calc	mg/kg	1				280	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,3,5,6-Tetrachlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,4,5-trichlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,6-trichlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-dichlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,4-dimethylphenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-dinitrophenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2,6-dichlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2,3,4,5 & 2,3,4,6-Tetrachlorophenol	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-chlorophenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
2-methylphenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-nitrophenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4,6-Dinitro-o-cyclohexyl phenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-chloro-3-methylphenol	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
4-nitrophenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Pentachlorophenol	mg/kg	0.2					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Phenol	mg/kg	1					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenols (Total Halogenated)	mg/kg	0.03					-	-	-	-	-	-	-	-	-	-	-
Phenols (Total Non Halogenated)	mg/kg	1					-	-	-	-	-	-	-	-	-	-	-

Appendix CL1
Table 1
Summary of Soil Analytical Results

						Location Code	NEL-BH086	NEL-BH087	NEL-BH087	NEL-BH088	NEL-BH088	NEL-BH089	NEL-BH089	NEL-BH101	NEL-BH101	NEL-BH161	NEL-BH161	NEL-BH162	NEL-BH162	NEL-BH163	NEL-BH163	NEL-BH163
						Depth	0.3 - 0.4	0.2 - 0.3	0.7 - 0.8	0.2 - 0.3	0.6 - 0.7	0.2 - 0.3	0.6 - 0.7	0.5 - 0.6	1 - 1.1	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	1 - 1.1	0.2 - 0.3	0.2 - 0.3	1 - 1.1
						Date	2/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	21/11/2017	14/06/2018	14/06/2018	13/06/2018	13/06/2018	6/06/2018	6/06/2018	13/06/2018	13/06/2018	13/06/2018
						Field ID	NEL-BH086_0.3m	NEL-BH087_0.2m	NEL-BH087_0.7m	NEL-BH088_0.2m	NEL-BH088_0.6m	NEL-BH089_0.2m	NEL-BH089_0.6m	NEL-BH101_0.5	NEL-BH101_1.0	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH162_0.2m	NEL-BH162_1.0m	NEL-BH163_0.2m	QC1005	NEL-BH163_1.0m
						Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal
						Lab Report Number	EM1716457	EM1715998	EM1715998	EM1715998	EM1715998	EM1715998	EM1715998	EM1809614	EM1809614	EM1809532	EM1809532	EM1809233	EM1809233	EM1809532	EM1809532	EM1809532
	Unit	EQL	EPA Victoria IWRG 621 Category B	EPA Victoria IWRG 621 Category C	EPA Victoria IWRG 621 Clean Fill	EPA Victoria IWRG 621 Trigger for Leachate Testing																
VOCs																						
TCE	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tetrachloroethene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
trans-1,2-dichloroethene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SVOCs																						
4,6-Dinitro-2-methylphenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
OC Pesticides																						
Other organochlorine pesticides - Lab Calc	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Organochlorine pesticides EPAVic	mg/kg	0.03			1		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Other organochlorine pesticides EPAVic	mg/kg	0.03	50	10			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4,4-DDE	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
a-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin + Dieldrin	mg/kg	0.03	4.8	1.2		0.6	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
b-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane	mg/kg	0.03	16	4		2	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane (cis)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane (trans)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
d-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
4,4 DDD	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4,4 DDT	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
DDT+DDE+DDD - Lab Calc	mg/kg	0.05	50	50		40	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan I	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan II	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan Sulfate	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
g-BHC (Lindane)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	mg/kg	0.03	4.8	1.2		0.6	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Methoxychlor	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
MAH																						
MAH (Sum of Total)	mg/kg	0.2					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Styrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total MAH	mg/kg	0.2					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCBs																						
PCBs (Total)	mg/kg	0.1	0	0	2		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Herbicides																						
Dinoseb	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorinated Hydrocarbons																						
Chlorinated hydrocarbons EPAVic	mg/kg	0.01			1		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Other chlorinated hydrocarbons (Total)	mg/kg	0.01	50	10			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-tetrachloroethane	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1-trichloroethane	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-tetrachloroethane	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,1,2-trichloroethane	mg/kg	0.04					<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
1,1-dichloroethene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-trichlorobenzene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-dichlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-dichloroethane	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,4-dichlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Carbon tetrachloride	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloroform	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1,2-dichloroethene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichloromethane	mg/kg	0.4					<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Hexachlorobutadiene	mg/kg	0.02	11	2.8		1.4	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vinyl chloride	mg/kg	0.02	4.8	1.2		0.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Asbestos																						
Asbestos (Trace)	Fibres	5					1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-
Asbestos Detected	g	0.1					0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-
Asbestos Type	-						1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-
weight of sample	g	0.01					20.4	20.7	21.7	17.3	20.9	30.3	28.4	-	-	-	-	-	-	-	-	-

Comments
#1 No
#2 -
#3 No*
#4 Reported Analyte LOR is higher than Requested Analyte LOR
#5 Yes
#6 Ch+Am
#7 Ch

Appendix CL1
Table 1
Summary of Soil Analytical Results

	Unit	EQL	EPA Victoria IWRG 621 Category B	EPA Victoria IWRG 621 Category C	EPA Victoria IWRG 621 Clean Fill	EPA Victoria IWRG 621 Trigger for Leachate Testing											
Location Code							NEL-BH164	NEL-BH164	NEL-BH165	NEL-BH165	NEL-BH223	NEL-BH223	NEL-BH224	NEL-BH224	NEL-ENV-BH022	NEL-ENV-BH022	NEL-ENV-BH022
Depth							0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	0.2 - 0.3	0.5 - 0.6	1.5 - 1.6
Date							13/06/2018	13/06/2018	6/06/2018	6/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	6/06/2018	6/06/2018	6/06/2018
Field ID							NEL-BH164_0.2m	NEL-BH164_0.5m	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-BH223_0.2m	NEL-BH223_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
Sample Type							Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Lab Report Number							EM1809532	EM1809532	EM1809233	EM1809233	EM1809532	EM1809532	EM1809532	EM1809532	EM1809233	EM1809233	EM1809233
VOCs																	
TCE	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tetrachloroethene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
trans-1,2-dichloroethene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SVOCs																	
4,6-Dinitro-2-methylphenol	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
OC Pesticides																	
Other organochlorine pesticides - Lab Calc	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Organochlorine pesticides EPAVic	mg/kg	0.03			1		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Other organochlorine pesticides EPAVic	mg/kg	0.03	50	10			-	-	-	-	-	-	-	-	-	-	-
4,4-DDE	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
a-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin + Dieldrin	mg/kg	0.03	4.8	1.2		0.6	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
b-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane	mg/kg	0.03	16	4		2	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane (cis)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chlordane (trans)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
d-BHC	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
4,4 DDD	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4,4 DDT	mg/kg	0.05					<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
DDT+DDE+DDD - Lab Calc	mg/kg	0.05	50	50		40	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan I	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan II	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan Sulfate	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
g-BHC (Lindane)	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	mg/kg	0.03	4.8	1.2		0.6	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Methoxychlor	mg/kg	0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
MAH																	
MAH (Sum of Total)	mg/kg	0.2					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Styrene	mg/kg	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total MAH	mg/kg	0.2					-	-	-	-	-	-	-	-	-	-	-
PCBs																	
PCBs (Total)	mg/kg	0.1	0	0	2		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Herbicides																	
Dinoseb	mg/kg	5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorinated Hydrocarbons																	
Chlorinated hydrocarbons EPAVic	mg/kg	0.01			1		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Other chlorinated hydrocarbons (Total)	mg/kg	0.01	50	10			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-tetrachloroethane	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1-trichloroethane	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-tetrachloroethane	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,1,2-trichloroethane	mg/kg	0.04					<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
1,1-dichloroethene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-trichlorobenzene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-dichlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-dichloroethane	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,4-dichlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Carbon tetrachloride	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloroform	mg/kg	0.02					<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1,2-dichloroethene	mg/kg	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichloromethane	mg/kg	0.4					<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Hexachlorobutadiene	mg/kg	0.02	11	2.8		1.4	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Vinyl chloride	mg/kg	0.02	4.8	1.2		0.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Asbestos																	
Asbestos (Trace)	Fibres	5					-	-	-	-	-	-	-	-	-	-	-
Asbestos Detected	g	0.1					-	-	-	-	-	-	-	-	-	-	-
Asbestos Type	-						-	-	-	-	-	-	-	-	-	-	-
weight of sample	g	0.01					-	-	-	-	-	-	-	-	-	-	-

Comments
#1 No
#2 -
#3 No*
#4 Reported Analyte LOR is higher than Requested Analyte LOR
#5 Yes
#6 Ch+Am
#7 Ch

Appendix CL1
Table 2
Summary of Soil Analytical Results - Leachability

ChemName	Unit	EQL	EPA Victoria IWRG 621 Category B - Leached	EPA Victoria IWRG 621 Category C - Leached	NEL-BH163	NEL-BH223	NEL-ENV-BH022	NEL-ENV-BH022
				Field ID	NEL-BH163_1.0m	NEL-BH223_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m
				Sample_Depth_Range	1-1.1	0.5-0.6	0.2-0.3	0.5-0.6
				Sampled_Date_Time	6/07/2018	6/07/2018	6/06/2018	6/06/2018
				Lab_Report_Number	EM1810875	EM1810875	EM1809854	EM1809854
Metals								
Lead	mg/L	0.1	4	1	<0.1	<0.1	<0.1	<0.1

Appendix CL1 Table 3
Summary of Soil Analytical Results for Acid Sulphate Parameters

	Unit	EQL	EPA Vic 655.1						
Location Code				NEL-BH087	NEL-BH087	NEL-BH089	NEL-BH089	NEL-BH101	NEL-BH101
Field ID				NEL-BH087_5.60-5.79m	NEL-BH087_14.90-15.10m	NEL-BH089_8.70-8.90m	NEL-BH089_15.0-15.7m	NEL-BH101_1.90m	NEL-BH101_7.50m
Date				6/04/2018	6/04/2018	6/04/2018	6/04/2018	29/06/2018	29/06/2018
Depth				5.6 - 5.79	14.9 - 15.1	8.7 - 8.9	15 - 15.7	1.9	7.5
Matrix Type				Rock	Rock	Rock	Rock	Soil	Soil
Lab Report Number				EM1805796	EM1805796	EM1805796	EM1805796	EM1813212	EM1813212
ASS - ANC									
ANC as CaCO3	% CaCO3	0.1		0.4	0.7	0.3	0.5	0.8	0.6
ANC as H2SO4	kg H2SO4 eq/t	0.5		3.6	6.6	2.9	5.0	8.1	6.4
Fizz Rating	Fizz Unit	0		0	0	0	0	0	0
Acid Neutralising Capacity	% CaCO3	0.01		-	-	-	-	0.40	0.30
Acid Neutralising Capacity (acidity units)	mole H+/t	10		-	-	-	-	79	59
Acid Neutralising Capacity (sulfur units)	%S	0.01		-	-	-	-	0.13	0.09
NA									
Resistivity at 25°C	ohm cm	10		1,200	1,320	1,130	1,370	520	730
sulfidic - Titratable Sulfidic Acidity	% PYRITE S	0.02		-	-	-	-	-	-
NAG (pH 4.5)	kg H2SO4/t	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	kg H2SO4/t	0.1		0.2	<0.1	0.8	1.1	<0.1	<0.1
Net Acid Production Potential	kg H2SO4/t	0.5	< 4.5-	-3.6	-6.6	-2.9	-5.0	-7.5	-5.8
Inorganics									
Moisture (%)	%	1		<1.0	<1.0	<1.0	<1.0	18.2	19.2
pH (Initial)	pH Units	0.1		-	-	-	-	-	-
pH (Final)	pH Units	0.1		-	-	-	-	-	-
pH (aqueous extract)	pH Units	0.1		-	-	-	-	-	-
pH (after HCL)	pH Units	0.1		-	-	-	-	-	-
Sulfur as S	%			<0.01	<0.01	<0.01	<0.01	200	200
pH (Saturated Paste)									
pH (Saturated Paste)	pH Unit	0.1		7.6	7.8	7.4	7.4	7.3	7.4
ASS - pH									
pHKCl	pH Units	0.1		6.5	6.8	6.6	6.2	6.6	6.7
pH-OX	PH UNITS	0.1	0	7.0	7.8	6.7	6.7	7.4	7.2
ASS - Acidity Trail									
Titratable Actual Acidity	mole H+/t	2		<2	<2	<2	<2	<2	<2
Titratable Actual Acidity (sulfur units)	%S	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.020
Titratable Peroxide Acidity	mole H+/t	2		-	-	-	-	-	<2
Titratable Peroxide Acidity (sulfur units)	%S	0.02		-	-	-	-	-	<0.020
Titratable Sulfidic Acidity	mole H+/t	2		-	-	-	-	-	<2
ASS - Sulfur Trail									
KCl Extractable Sulfur	%S	0.02		-	-	-	-	-	<0.020
Peroxide Sulfur	%S	0.02		-	-	-	-	-	<0.020
Peroxide Oxidisable Sulfur (acidity units)	mole H+/t	10		-	-	-	-	-	<10
Peroxide Oxidisable Sulfur	%S	0.02		-	-	-	-	-	<0.020
ASS - Calcium Values									
KCl Extractable Calcium	%Ca	0.02		-	-	-	-	-	0.020
Calcium in Peroxide	%Ca	0.02		-	-	-	-	-	0.025
Acid Reacted Calcium	%Ca	0.02		-	-	-	-	-	<0.020
Acid Reacted Calcium (acidity units)	mole H+/t	10		-	-	-	-	-	<10
Acid Reacted Calcium (sulfur units)	%S	0.02		-	-	-	-	-	<0.020
ASS - Magnesium Values									
KCl Extractable Magnesium	%Mg	0.02		-	-	-	-	-	0.067
Magnesium in Peroxide	%Mg	0.02		-	-	-	-	-	0.081
Acid Reacted Magnesium	%Mg	0.02		-	-	-	-	-	<0.020
Acid Reacted Magnesium (acidity units)	mole H+/t	10		-	-	-	-	-	11
Acid Reacted Magnesium (sulfur units)	%S	0.02		-	-	-	-	-	<0.020
ASS - Potential Acidity									
Chromium Reducible Sulfur	%S	0.005		0.008	0.007	0.006	0.005	<0.005	<0.005
Chromium Reducible Sulphur (acidity units)	mole H+/t	10		<10	<10	<10	<10	<10	<10
ASS - Excess ANC									
Excess Acid Neutralising Capacity	%CaCO3	0.02		-	-	-	-	-	0.096
Excess Acid Neutralising Capacity (acidity units)	mole H+/t	10		-	-	-	-	-	19
Excess Acid Neutralising Capacity (sulfur units)	%S	0.02		-	-	-	-	-	0.031
ASS - Acid Base Accounting									
ANC Fineness Factor	-	0.5		1.5	1.5	1.5	1.5	1.5	1.5
Net Acidity (acidity units)	mole H+/t	10		<10	<10	<10	<10	<10	<10
Net Acidity (sulfur units)	%S	0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Liming Rate	kg CaCO3/t	1		<1	<1	<1	<1	<1	<1
Net Acidity excluding ANC (acidity units)	mole H+/t	10	18	<10	<10	<10	<10	<10	<10
Net Acidity excluding ANC (sulfur units)	%S	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Liming Rate excluding ANC	kg CaCO3/t	1		<1	<1	<1	<1	<1	<1
Major Ions									
Calcium	mg/kg	10		<10	<10	<10	<10	<10	<10
Magnesium	mg/kg	10		<10	<10	<10	<10	<10	<10
Potassium	mg/kg	10		<10	<10	<10	<10	<10	10
Sodium	mg/kg	10		250	160	320	320	600	600
Chloride	mg/kg	10		300	160	460	460	730	720
Sulfate	mg/kg	10		30	30	20	30	190	160
TOC									
Total Organic Carbon	%			-	-	-	-	-	-
Metals									
Arsenic (filtered)	mg/L	0.1		-	-	-	-	-	-
Cadmium (filtered)	mg/L	0.05		-	-	-	-	-	-
Chromium (III+VI) (filtered)	mg/L	0.1		-	-	-	-	-	-
Copper (filtered)	mg/L	0.1		-	-	-	-	-	-
Lead (filtered)	mg/L	0.1		-	-	-	-	-	-
Mercury (filtered)	mg/L	0.001		-	-	-	-	-	-
Nickel (filtered)	mg/L	0.1		-	-	-	-	-	-
Zinc (filtered)	mg/L	0.1		-	-	-	-	-	-
Biological									
Sulfate Reducing Bacteria Population Estimate	pac/g			-	-	-	-	-	-
Sulfate Reducing Bacteria Aggressivity	-	1		-	-	-	-	-	-
SPOCAS									
Acid Neutralising Capacity	% CaCO3			0.28	0.64	0.24	-	-	-
Acid Neutralising Capacity (acidity units)	mole H+/t	10		56	128	49	-	-	-
Acid Neutralising Capacity (sulfur units)	%S	0.01		0.09	0.20	0.08	-	-	-

Well ID	Date (dd.mm.yyyy)	Time (hh.mm)	Depth to Water (m TOC)	Comments
NEL-BH086	14.12.2017	10.19	9.010	*Prior to development*
	12.07.2018	10.00	9.870	-
NEL-BH087	13.12.2017	12.41	5.610	*Prior to development*
	12.07.2018	12.00	6.151	-
NEL-BH088	13.12.2017	14.21	11.970	*Prior to development*
	12.07.2018	14.00	12.693	-
NEL-BH089	13.12.2017	10.21	20.200	*Prior to development*
	12.07.2018	15.00	20.180	-
NEL-ENV-BH022	20.09.2018	8.37	18.623	*Hydrocarbon odour present, no sample collected 25.09.2018*

Appendix CL1 Table 5
Summary of Stabilized Water Quality Parameters

Well ID	Date	Stabilised Water Quality Parameters						Colour, turbidity, odour
		Temp. (c)	EC (µS/cm)	TDS	Redox (mV-ORP)	pH	DO (ppm)	
NEL-BH086	12/07/2018	15.2	13,039	10,000	115.9	6.53	0.00	pale grey to brown, low, none
NEL-BH087	12/07/2018	15.6	9,774	6,300	-12.1	6.59	0.03	clear, low, none
NEL-BH088	12/07/2018	15.7	8,947	6,100	47.7	6.70	0.40	clear, low, none
NEL-BH089	12/07/2018	16.9	10,322	6,800	-103.8	6.54	0.24	clear, low, none

Table 2 - Protected Beneficial Uses of the Segments

Beneficial Uses	Segments (mg/L TDS)				
	A1 (0-500)	A2 (501-1,000)	B (1,001-3,500)	C (3,501-13,000)	D (greater than 13,000)
1. Maintenance of ecosystems	✓	✓	✓	✓	✓
2. Potable water supply:					
desirable	✓				
acceptable		✓			
3. Potable mineral water supply	✓	✓	✓		
4. Agriculture, parks and gardens	✓	✓	✓		
5. Stock watering	✓	✓	✓	✓	
6. Industrial water use	✓	✓	✓	✓	✓
7. Primary contact recreation (eg. bathing, swimming)	✓	✓	✓	✓	
8. Buildings and structures	✓	✓	✓	✓	✓

Appendix CL1
Table 6
Summary of Groundwater Analytical Results

	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
Inorganics														
Colour(Pt/Co) true	PT/CO UNIT	2							-	-	-	-	-	-
pH (Lab)	pH Units	0.01					6-9		7.7	7.5	7.29	7.8	7.7	7.4
Electrical conductivity (lab)	µS/cm	1					2900		15,000	15,000	16,000	11,000	10,000	10,000
Total Dissolved Solids (est.)	mg/L	1	5000						-	-	-	-	-	-
Total Dissolved Solids	mg/L	10	5000						10,000	10,000	9,480	6,300	6,100	6,800
Total Suspended Solids	mg/L	1							-	-	-	-	-	-
Chlorine	mg/L	0.1		0.003	0.0004				-	-	-	-	-	-
Thiosulfate(S)	µg/L	1,000							-	-	-	-	-	-
COD	mg/L	25							-	-	-	-	-	-
Cyanide (Total)	mg/L	0.005		0.007	0.004			0.8	-	-	-	-	-	-
Sodium Adsorption Ratio (filtered)	-	0.01					5		-	-	-	-	-	-
Sulfate as S	mg/L	5	333						-	-	-	-	-	-
Total Oxidised Sulfur (as S)	mg/L	10							-	-	-	-	-	-
Major Ions														
Calcium	mg/L	0.5	1000						70	70	-	65	59	34
Calcium (filtered)	mg/L	1	1000						-	-	62	-	-	-
Magnesium	mg/L	0.5							400	400	-	230	190	190
Magnesium (filtered)	mg/L	1							-	-	421	-	-	-
Potassium	mg/L	0.5							48	50	-	43	43	51
Potassium (filtered)	mg/L	1							-	-	54	-	-	-
Sodium	mg/L	0.5							2,600	2,600	-	2,000	1,900	1,900
Sodium (filtered)	mg/L	1							-	-	2,590	-	-	-
Chloride	mg/L	1					350		3,700	3,600	5,510	2,600	2,300	2,500
Sulfate	mg/L	5	1000					5000	610	600	-	320	120	250
Sulfate (filtered)	mg/L	1	1000					5000	-	-	612	-	-	-
Fluoride	mg/L	0.1	2				1	15	-	-	-	-	-	-
Cations Total	meq/L	0.01							-	-	152	-	-	-
Anions Total	meq/L	0.01							-	-	183	-	-	-
Ionic Balance	%	0.01							-	-	9.30	-	-	-
TOC														
Total Organic Carbon	mg/L								5.1	<5	2	13	<5	27
Metals														
Arsenic	mg/L	0.001	0.5	0.013	0.0008		0.1	0.1	-	-	-	-	-	-
Arsenic (filtered)	mg/L	0.001	0.5	0.013	0.0008		0.1	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Barium (filtered)	mg/L	0.001						20	-	-	0.033	-	-	-
Beryllium	mg/L	0.001					0.1	0.6	-	-	-	-	-	-
Beryllium (filtered)	mg/L	0.001					0.1	0.6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	mg/L	0.05	5	0.37	0.09		0.5	40	-	-	-	-	-	-
Boron (filtered)	mg/L	0.05	5	0.37	0.09		0.5	40	0.17	0.20	0.15	0.17	0.20	0.07
Cadmium	mg/L	0.0002	0.01	0.0002	0.00006		0.01	0.02	-	-	-	-	-	-
Cadmium (filtered)	mg/L	0.0001	0.01	0.0002	0.00006		0.01	0.02	<0.0002	<0.0002	<0.0001	<0.0002	<0.0002	<0.0002
Chromium (hexavalent)	mg/L	0.001		0.001	0.00001			0.5	-	-	-	-	-	-
Chromium (III+VI)	mg/L	0.001	1	0.001	0.00001		0.1		-	-	-	-	-	-
Chromium (III+VI) (filtered)	mg/L	0.001	1	0.001	0.00001		0.1		<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Cobalt	mg/L	0.001	1				0.05		-	-	-	-	-	-
Cobalt (filtered)	mg/L	0.001	1				0.05		0.001	0.002	0.001	0.003	0.003	0.003
Copper	mg/L	0.001	1	0.0014	0.001		0.2	20	-	-	-	-	-	-
Copper (filtered)	mg/L	0.001	1	0.0014	0.001		0.2	20	0.006	0.086	0.005	0.012	0.022	0.013
Iron (filtered)	mg/L	0.05					0.2		<0.05	<0.05	-	0.07	0.05	1.4
Lead	mg/L	0.001	0.1	0.0034	0.001		2	0.1	-	-	-	-	-	-
Lead (filtered)	mg/L	0.001	0.1	0.0034	0.001		2	0.1	<0.001	0.003	<0.001	<0.001	0.002	0.001
Manganese	mg/L	0.005		1.9	1.2		0.2	5	-	-	-	-	-	-
Manganese (filtered)	mg/L	0.001		1.9	1.2		0.2	5	0.074	0.081	0.066	0.17	0.051	0.77
Mercury	mg/L	0.0001	0.002	0.0006	0.00006		0.002	0.01	-	-	-	-	-	-
Mercury (filtered)	mg/L	0.0001	0.002	0.0006	0.00006		0.002	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (filtered)	mg/L	0.005	0.15				0.01	0.5	-	-	-	-	-	-
Nickel	mg/L	0.001	1	0.011	0.008		0.2	0.2	-	-	-	-	-	-
Nickel (filtered)	mg/L	0.001	1	0.011	0.008		0.2	0.2	0.070	0.085	0.075	0.036	0.053	0.11
Selenium	mg/L	0.001	0.02	0.011	0.005		0.02	0.1	-	-	-	-	-	-
Selenium (filtered)	mg/L	0.001	0.02	0.011	0.005		0.02	0.1	<0.001	<0.001	<0.01	<0.001	0.012	<0.001
Silver (filtered)	mg/L	0.005		0.00005	0.00002			1	-	-	-	-	-	-
Tin (filtered)	mg/L	0.005							-	-	-	-	-	-
Vanadium (filtered)	mg/L	0.01					0.1		-	-	<0.01	-	-	-
Zinc	mg/L	0.005	20	0.008	0.0024		2		-	-	-	-	-	-
Zinc (filtered)	mg/L	0.005	20	0.008	0.0024		2		0.007	0.14	0.008	0.032	0.063	0.041

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Table 6
Summary of Groundwater Analytical Results

								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
BTEXN														
Naphthalene (BTEXN)	µg/L	5		16	2.5				<10	<10	<5	<10	<10	<10
BTEX (Sum of Total) - Lab Calc	µg/L	1							-	-	<1	-	-	-
Benzene	µg/L	1		950	600			10	<1	<1	<1	<1	<1	53
Toluene	µg/L	1						8000	<1	<1	<2	<1	<1	3
Ethylbenzene	µg/L	1						3000	<1	<1	<2	<1	<1	19
Xylene (o)	µg/L	1		350	200				<1	<1	<2	<1	<1	<1
Xylene (m & p)	µg/L	2							<2	<2	<2	<2	<2	24
Xylene Total	µg/L	2						6000	<3	<3	<2	<3	<3	24
TRH - NEPM 2013														
F1 (C6-C10 minus BTEXN)	µg/L	20							<20	<20	<20	<20	<20	130
C6-C10 Fraction	µg/L	20							<20	<20	<20	<20	<20	230
F2 (>C10-C16 minus Naphthalene)	µg/L	50							<50	<50	<100	<50	<50	<50
>C10-C16 Fraction	µg/L	50							<50	<50	<100	<50	<50	<50
F3 (>C16-C34 Fraction)	µg/L	100							<100	<100	<100	<100	<100	<100
F4 (>C34-C40 Fraction)	µg/L	100							<100	<100	<100	<100	<100	<100
>C10-C40 (Sum of Total)	µg/L	100							-	-	<100	-	-	-
TRH - NEPM 1999														
C6-C9 Fraction	µg/L	20							<20	<20	<20	<20	<20	190
C10-C14 Fraction	µg/L	50							<50	<50	<50	<50	<50	<50
C15-C28 Fraction	µg/L	100							<100	<100	<100	<100	<100	<100
C29-C36 Fraction	µg/L	50							<100	<100	<50	<100	<100	<100
C10-C36 (Sum of Total)	µg/L	50							<100	<100	<50	<100	<100	<100
Nitrosoamines														
N-Nitrosodiphenyl & Diphenylamine	µg/L	4							-	-	<4	-	-	-
Unassigned														
CO2 (Free)	mg/L	5							26	40	-	25	41	41
Acidity & Alkalinity														
Alkalinity (Carbonate as CaCO3)	mg/L	1							<10	<10	<1	<10	<10	<10
Alkalinity (Bicarbonate as CaCO3)	mg/L	1							660	680	737	790	1,100	820
Alkalinity (Hydroxide as CaCO3)	mg/L	1							<20	<20	<1	<20	<20	<20
Alkalinity (total as CaCO3)	mg/L	1							660	680	737	790	1,100	820
Hardness as CaCO3 (filtered)	mg/L	1							-	-	-	-	-	-
Nutrients														
Sulfite as S	µg/L	500							-	-	-	-	-	-
Ammonia as N	mg/L	0.01		0.9	0.32				<0.01	<0.01	0.18	<0.01	<0.01	<0.01
Nitrate (as N)	mg/L	0.01	90	7.2	4.9				<0.02	<0.02	0.03	<0.02	0.13	<0.02
Nitrite (as N)	mg/L	0.01	9.1						<0.02	<0.02	<0.01	<0.02	0.05	<0.02
Nitrogen (Total Oxidised) (as N)	mg/L	0.01							<0.05	<0.05	0.03	<0.05	0.18	<0.05
Nitrogen (Total)	mg/L	0.1					5		<0.2	<0.2	0.4	<0.2	<0.2	0.4
Phosphorus (Total)	mg/L	0.01					0.05		-	-	0.15	-	-	-
Reactive Phosphorus as P	µg/L	10							<50	<50	-	<50	<50	<50
Phosphate total (P)	µg/L	50							100	100	-	90	70	160
Kjeldahl Nitrogen Total	mg/L	0.1							<0.2	<0.2	0.4	<0.2	<0.2	0.4
Organic Indicators														
BOD	mg/L	5							-	-	-	-	-	-
PAHs														
Pyrene	µg/L	1							<1	<1	<2	<1	<1	<1
Acenaphthene	µg/L	1							<1	<1	<2	<1	<1	<1
Acenaphthylene	µg/L	1							<1	<1	<2	<1	<1	<1
Anthracene	µg/L	1							<1	<1	<2	<1	<1	<1
Benz(a)anthracene	µg/L	1							<1	<1	<2	<1	<1	<1
Benzo(a) pyrene	µg/L	1						0.1	<1	<1	<2	<1	<1	<1
Benzo[b+j]fluoranthene	µg/L	1							<1	<1	-	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1							<1	<1	-	<1	<1	<1
Benzo(b+j+k)fluoranthene	µg/L	4							-	-	<4	-	-	-
Benzo(g,h,i)perylene	µg/L	1							<1	<1	<2	<1	<1	<1
Chrysene	µg/L	1							<1	<1	<2	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1							<1	<1	<2	<1	<1	<1
Fluoranthene	µg/L	1							<1	<1	<2	<1	<1	<1
Fluorene	µg/L	1							<1	<1	<2	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1							<1	<1	<2	<1	<1	<1
Naphthalene-PAH	µg/L	1		16	2.5				<1	<1	-	<1	<1	1
Naphthalene	µg/L	2		16	2.5				-	-	<2	-	-	-
Phenanthrene	µg/L	1							<1	<1	<2	<1	<1	<1
PAHs (Sum of total) - Lab calc	µg/L	1							<1	<1	<2	<1	<1	1
Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	µg/L	2							-	-	<2	-	-	-

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Table 6
Summary of Groundwater Analytical Results

								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
Phenols														
3,4-Methylphenol (m,p-cresol)	µg/L	4							<6	<6	<4	<6	<6	<6
2,3,4,6-Tetrachlorophenol	µg/L	10		20	10				<10	<10	-	<10	<10	<10
2,4,5-trichlorophenol	µg/L	2							<10	<10	<2	<10	<10	<10
2,4,6-trichlorophenol	µg/L	2		20	3			200	<10	<10	<2	<10	<10	<10
2,4-dichlorophenol	µg/L	2		160	120			2000	<3	<3	<2	<3	<3	<3
2,4-dimethylphenol	µg/L	2							<3	<3	<2	<3	<3	<3
2,4-dinitrophenol	µg/L	30		45	13				<30	<30	-	<30	<30	<30
2,6-dichlorophenol	µg/L	2							<3	<3	<2	<3	<3	<3
2-chlorophenol	µg/L	2		490	340			3000	<3	<3	<2	<3	<3	<3
2-methylnaphthalene	µg/L	2							<5	<5	<2	<5	<5	<5
2-methylphenol	µg/L	2							<3	<3	<2	<3	<3	<3
2-nitrophenol	µg/L	2							<10	<10	<2	<10	<10	<10
3-methylcholanthrene	µg/L	2							<5	<5	<2	<5	<5	<5
4,6-Dinitro-o-cyclohexyl phenol	µg/L	100							<100	<100	-	<100	<100	<100
4-chloro-3-methylphenol	µg/L	2							<10	<10	<2	<10	<10	<10
4-nitrophenol	µg/L	30							<30	<30	-	<30	<30	<30
Acetophenone	µg/L	2							<5	<5	<2	<5	<5	<5
Pentachlorophenol	µg/L	4		10	3.6			100	<10	<10	<4	<10	<10	<10
Phenol	µg/L	2		320	85				<3	<3	<2	<3	<3	7
tetrachlorophenols	µg/L	30							<30	<30	-	<30	<30	<30
Phenols (Total Halogenated)	µg/L	10							<10	<10	-	<10	<10	<10
Phenols (Total Non Halogenated)	µg/L	100							<100	<100	-	<100	<100	<100
VOCs														
1,1-dichloroethane	µg/L	1							<1	<1	<5	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1		10	3				<5	<5	<5	<5	<5	<5
1,2,3-trichloropropane	µg/L	1							<1	<1	<5	<1	<1	<1
1,2-dibromoethane	µg/L	1						10	<1	<1	<5	<1	<1	<1
1,3-dichlorobenzene	µg/L	1		260	160				<1	<1	<2	<1	<1	<1
2-butanone (MEK)	µg/L	1							<1	<1	<50	<1	<1	2
2-hexanone (MBK)	µg/L	50							-	-	<50	-	-	-
4-methyl-2-pentanone (MIBK)	µg/L	1							<1	<1	<50	<1	<1	<1
Acetone	µg/L	1							<1	<1	-	<1	<5	41
Allyl chloride	µg/L	1							<1	<1	-	<1	<1	<1
Bromodichloromethane	µg/L	1							<1	<1	<5	<1	<1	<1
Bromoform	µg/L	1							<1	<1	<5	<1	<1	<1
Carbon disulfide	µg/L	1							<1	<1	<5	<1	<1	1
Chlorodibromomethane	µg/L	1							<1	<1	<5	<1	<1	<1
Chloroethane	µg/L	1							<1	<1	<50	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1							<1	<1	<5	<1	<1	<1
cis-1,4-Dichloro-2-butene	µg/L	5							-	-	<5	-	-	-
Dibromomethane	µg/L	1							<1	<1	<5	<1	<1	<1
Iodomethane	µg/L	1							<1	<1	<5	<1	<1	<1
n-butylbenzene	µg/L	5							-	-	<5	-	-	-
n-propylbenzene	µg/L	5							-	-	<5	-	-	-
Pentachloroethane	µg/L	5							-	-	<5	-	-	-
p-isopropyltoluene	µg/L	5							-	-	<5	-	-	-
sec-butylbenzene	µg/L	5							-	-	<5	-	-	-
TCE	µg/L	1							<1	<1	<5	<1	<1	<1
tert-butylbenzene	µg/L	5							-	-	<5	-	-	-
Tetrachloroethene	µg/L	1						500	<1	<1	<5	<1	<1	<1
trans-1,2-dichloroethene	µg/L	1							<1	<1	<5	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1							<1	<1	<5	<1	<1	<1
trans-1,4-Dichloro-2-butene	µg/L	5							-	-	<5	-	-	-
Trichlorofluoromethane	µg/L	1							<1	<1	<50	<1	<1	<1
Vinyl acetate	µg/L	50							-	-	<50	-	-	-

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	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
SVOCs														
1,2,3,4-tetrachlorobenzene	µg/L	0.1							<5	<5	-	<5	<5	<5
1,2,3,5-Tetrachlorobenzene	µg/L	0.1							<5	<5	-	<5	<5	<5
1,2,4,5-tetrachlorobenzene	µg/L	0.1							<5	<5	-	<5	<5	<5
1,3,5-Trichlorobenzene	µg/L	0.1							<5	<5	-	<5	<5	<5
1-Chloronaphthalene	µg/L	5							<5	<5	-	<5	<5	<5
1-naphthylamine	µg/L	2							<5	<5	<2	<5	<5	<5
2-(acetylamino) fluorene	µg/L	2							-	-	<2	-	-	-
2-naphthylamine	µg/L	5							<5	<5	-	<5	<5	<5
2-nitroaniline	µg/L	4							<5	<5	<4	<5	<5	<5
3,3-Dichlorobenzidine	µg/L	2							<5	<5	<2	<5	<5	<5
3-nitroaniline	µg/L	4							-	-	<4	-	-	-
4-(dimethylamino) azobenzene	µg/L	2							<5	<5	<2	<5	<5	<5
4,6-Dinitro-2-methylphenol	µg/L	30							<30	<30	-	<30	<30	<30
4-bromophenyl phenyl ether	µg/L	2							<5	<5	<2	<5	<5	<5
4-chloroaniline	µg/L	2							-	-	<2	-	-	-
4-chlorophenyl phenyl ether	µg/L	2							<5	<5	<2	<5	<5	<5
4-nitroaniline	µg/L	2							-	-	<2	-	-	-
4-Nitroquinoline-N-oxide	µg/L	2							-	-	<2	-	-	-
5-nitro-o-toluidine	µg/L	2							-	-	<2	-	-	-
7,12-dimethylbenz(a)anthracene	µg/L	2							<5	<5	<2	<5	<5	<5
Aniline	µg/L	2		250	8				<5	<5	<2	<5	<5	<5
Azobenzene	µg/L	2							-	-	<2	-	-	-
Benzyl chloride	µg/L	1							<5	<5	-	<5	<5	<5
Bis(2-chloroethoxy) methane	µg/L	2							<5	<5	<2	<5	<5	<5
Bis(2-chloroethyl)ether	µg/L	2							-	-	<2	-	-	-
Bis(2-chloroisopropyl) ether	µg/L	5							<5	<5	-	<5	<5	<5
Carbazole	µg/L	2							-	-	<2	-	-	-
Chlorobenzilate	µg/L	2							-	-	<2	-	-	-
Dibenz(a,j)acridine	µg/L	5							<5	<5	-	<5	<5	<5
Diphenylamine	µg/L	5							<5	<5	-	<5	<5	<5
Hexachlorocyclopentadiene	µg/L	0.1							<5	<5	<10	<5	<5	<5
Hexachloroethane	µg/L	0.1		360	290				<5	<5	<2	<5	<5	<5
Hexachloropropene	µg/L	2							-	-	<2	-	-	-
Isophorone	µg/L	2							-	-	<2	-	-	-
Methapyrilene	µg/L	2							-	-	<2	-	-	-
N-nitrosodiethylamine	µg/L	2							-	-	<2	-	-	-
N-nitrosodi-n-butylamine	µg/L	2							<5	<5	<2	<5	<5	<5
N-nitrosodi-n-propylamine	µg/L	2							<5	<5	<2	<5	<5	<5
N-Nitrosomethylethylamine	µg/L	2							-	-	<2	-	-	-
N-nitrosomorpholine	µg/L	2							-	-	<2	-	-	-
N-nitrosopiperidine	µg/L	2							<5	<5	<2	<5	<5	<5
N-nitrosopyrrolidine	µg/L	4							-	-	<4	-	-	-
Pentachlorobenzene	µg/L	0.1							<5	<5	<2	<5	<5	<5
Phenacetin	µg/L	2							-	-	<2	-	-	-
Trifluralin	µg/L	5		4.4	2.6			900	<5	<5	-	<5	<5	<5
OC Pesticides														
Organochlorine pesticides EPAVic	µg/L	1							<1	<1	-	<1	<1	<1
Other organochlorine pesticides EPAVic	µg/L	1							<1	<1	-	<1	<1	<1
4,4-DDE	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
a-BHC	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Aldrin + Dieldrin	µg/L	0.1						3	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
b-BHC	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Chlordane	µg/L	0.5		0.08	0.03				<1	<1	<0.5	<1	<1	<1
Chlordane (cis)	µg/L	0.5							-	-	<0.5	-	-	-
Chlordane (trans)	µg/L	0.5							-	-	<0.5	-	-	-
d-BHC	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
4,4 DDD	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
4,4 DDT	µg/L	0.1		0.01	0.006			90	<0.1	<0.1	<2.0	<0.1	<0.1	<0.1
DDT+DDE+DDD - Lab Calc	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endosulfan I	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endosulfan II	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endosulfan Sulfate	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endrin	µg/L	0.1		0.02	0.01				<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
g-BHC (Lindane)	µg/L	0.1		0.2	0.07			100	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1		0.09	0.01			3	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Hexachlorobenzene	µg/L	0.1							<0.1	<0.1	<0.5	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1						3000	<0.1	<0.1	<2.0	<0.1	<0.1	<0.1
Toxaphene	µg/L	10		0.2	0.1				<10	<10	-	<10	<10	<10

Appendix CL1
Table 6
Summary of Groundwater Analytical Results

	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
Site ID									North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
Location Code									NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
Field ID									NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
Date									12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
Sample Type									Normal	Field_D	Field_D	Normal	Normal	Normal
Lab Report Number									607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
OP Pesticides														
Tokuthion	µg/L	2							<2	<2	-	<2	<2	<2
Azinphos methyl	µg/L	0.5		0.02	0.01			300	<2	<2	<0.5	<2	<2	<2
Bolstar (Sulprofos)	µg/L	2						100	<2	<2	-	<2	<2	<2
Bromophos-ethyl	µg/L	0.5						100	-	-	<0.5	-	-	-
Carbophenothion	µg/L	0.5							-	-	<0.5	-	-	-
Chlorfenvinphos	µg/L	0.5							<2	<2	<0.5	<2	<2	<2
Chlorpyrifos	µg/L	0.5		0.01	0.00004			100	<20	<20	<0.5	<20	<20	<20
Chlorpyrifos-methyl	µg/L	0.5							<2	<2	<0.5	<2	<2	<2
Coumaphos	µg/L	20							<20	<20	-	<20	<20	<20
Demeton-O	µg/L	2							<2	<2	-	<2	<2	<2
Demeton-S	µg/L	20							<20	<20	-	<20	<20	<20
Demeton-S-methyl	µg/L	0.5							-	-	<0.5	-	-	-
Diazinon	µg/L	0.5		0.01	0.00003			40	<2	<2	<0.5	<2	<2	<2
Dichlorvos	µg/L	0.5						50	<2	<2	<0.5	<2	<2	<2
Dimethoate	µg/L	0.5		0.15	0.1			70	<2	<2	<0.5	<2	<2	<2
Disulfoton	µg/L	2						40	<2	<2	-	<2	<2	<2
EPN	µg/L	2							<2	<2	-	<2	<2	<2
Ethion	µg/L	0.5						40	<2	<2	<0.5	<2	<2	<2
Ethoprop	µg/L	2						10	<2	<2	-	<2	<2	<2
Fenamiphos	µg/L	0.5						5	-	-	<0.5	-	-	-
Fenitrothion	µg/L	2		0.2	0.1			70	<2	<2	-	<2	<2	<2
Fensulfothion	µg/L	2						100	<2	<2	-	<2	<2	<2
Fenthion	µg/L	0.5						70	<2	<2	<0.5	<2	<2	<2
Malathion	µg/L	0.5		0.05	0.002			700	<2	<2	<0.5	<2	<2	<2
Merphos	µg/L	2							<2	<2	-	<2	<2	<2
Methyl parathion	µg/L	2						7	<2	<2	<2.0	<2	<2	<2
Mevinphos (Phosdrin)	µg/L	2						50	<2	<2	-	<2	<2	<2
Monocrotophos	µg/L	2						20	<2	<2	<2.0	<2	<2	<2
Naled (Dibrom)	µg/L	2							<2	<2	-	<2	<2	<2
Omethoate	µg/L	2						10	<2	<2	-	<2	<2	<2
Parathion	µg/L	2		0.004	0.0007			200	<2	<2	<2.0	<2	<2	<2
Phorate	µg/L	2							<2	<2	-	<2	<2	<2
Pirimiphos-methyl	µg/L	20						900	<20	<20	-	<20	<20	<20
Pirimphos-ethyl	µg/L	0.5						5	-	-	<0.5	-	-	-
Prothiofos	µg/L	0.5							-	-	<0.5	-	-	-
Pyrazophos	µg/L	2						200	<2	<2	-	<2	<2	<2
Ronnel	µg/L	2							<2	<2	-	<2	<2	<2
Terbufos	µg/L	2						9	<2	<2	-	<2	<2	<2
Trichloronate	µg/L	2							<2	<2	-	<2	<2	<2
Tetrachlorvinphos	µg/L	2						1000	<2	<2	-	<2	<2	<2
MAH														
1,2,4-trimethylbenzene	µg/L	1							<1	<1	<5	<1	<1	25
1,3,5-trimethylbenzene	µg/L	1							<1	<1	<5	<1	<1	4
Isopropylbenzene	µg/L	1							<1	<1	<5	<1	<1	2
Styrene	µg/L	1						300	<1	<1	<5	<1	<1	<1
Total MAH	µg/L	3							<3	<3	-	<3	<3	101
Halogenated Hydrocarbons														
Bromomethane	µg/L	1						10	<1	<1	<50	<1	<1	<1
Dichlorodifluoromethane	µg/L	1							<1	<1	<50	<1	<1	<1
PCBs														
Arochlor 1016	µg/L	1							<1	<1	-	<1	<1	<1
Arochlor 1221	µg/L	1							<1	<1	-	<1	<1	<1
Arochlor 1232	µg/L	1							<1	<1	-	<1	<1	<1
Arochlor 1242	µg/L	1		0.6	0.3				<1	<1	-	<1	<1	<1
Arochlor 1248	µg/L	1							<1	<1	-	<1	<1	<1
Arochlor 1254	µg/L	1		0.03	0.01				<1	<1	-	<1	<1	<1
Arochlor 1260	µg/L	1							<1	<1	-	<1	<1	<1
PCBs (Total)	µg/L	1							<1	<1	<1	<1	<1	<1
Herbicides														
Dinoseb	µg/L	100							<100	<100	-	<100	<100	<100
Pronamide	µg/L	2						700	<5	<5	<2	<5	<5	<5

Appendix CL1
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	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
PFAS														
Perfluorodecanesulfonic acid (PFDS)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluoro-n-hexadecanoic acid (PFHxDA)	µg/L	0.005							-	-	-	-	-	-
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.002							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Methyl perfluorooctane sulfonamidoethano	µg/L	0.005							<0.05	<0.05	<0.12	<0.05	<0.05	<0.05
Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	µg/L	0.01							<0.01	<0.01	-	<0.01	<0.01	<0.01
Sum of US EPA PFAS (PFOS + PFOA)*	µg/L	0.01							<0.01	<0.01	-	<0.01	<0.01	<0.01
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.002							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluoropentanoic acid (PFPeA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005							<0.05	<0.05	<0.12	<0.05	<0.05	<0.05
N-Ethyl perfluorooctane sulfonamidoethano	µg/L	0.005							<0.05	<0.05	<0.12	<0.05	<0.05	<0.05
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005							<0.05	<0.05	<0.12	<0.05	<0.05	<0.05
6:2 Fluorotelomer Sulfonate (6:2 FTS)	µg/L	0.005							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorooctanoic acid (PFOA)	µg/L	0.002				19			<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorobutanoic acid (PFBA)	µg/L	0.01							<0.05	<0.05	<0.2	<0.05	<0.05	<0.05
Perfluorodecanoic acid (PFDA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorohexanoic acid (PFHxA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorononanoic acid (PFNA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002				0.00023			<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005							<0.01	<0.01	<0.12	<0.01	<0.01	<0.01
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
PFAS (Sum of Total)	µg/L	0.002							<0.1	<0.1	<0.05	<0.1	<0.1	<0.1
PFAS (Sum of Total)(WA DER List)	µg/L	0.002							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sum of PFHxS and PFOS	µg/L	0.002							<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
TPH														
Oil & Grease	mg/L	10							-	-	-	-	-	-
Biological														
Sulfate Reducing Bacteria Population Estimate	pac/mL	20							320	-	320	120,000	120,000	120,000
Sulfate Reducing Bacteria Aggressivity	-	1							1	-	1	1	1	1
Chlorinated Hydrocarbons														
Chlorinated hydrocarbons EPAVic	µg/L	5							<5	<5	-	<5	<5	<5
Other chlorinated hydrocarbons (Total)	MG/L								<0.005	<0.005	-	<0.005	<0.005	<0.005
1,1,1,2-tetrachloroethane	µg/L	1							<1	<1	<5	<1	<1	<1
1,1,1-trichloroethane	µg/L	1							<1	<1	<5	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	1							<1	<1	<5	<1	<1	<1
1,1,2-trichloroethane	µg/L	1		6500	5400				<1	<1	<5	<1	<1	<1
1,1-dichloroethene	µg/L	1						300	<1	<1	<5	<1	<1	<1
1,1-dichloropropene	µg/L	5							-	-	<5	-	-	-
1,2,4-trichlorobenzene	µg/L	1		170	85				<5	<5	<2	<5	<5	<5
1,2-dibromo-3-chloropropane	µg/L	5							-	-	<5	-	-	-
1,2-dichlorobenzene	µg/L	1		160	120			15000	<1	<1	<2	<1	<1	<1
1,2-dichloroethane	µg/L	1						30	<1	<1	<5	<1	<1	<1
1,2-dichloropropane	µg/L	1							<1	<1	<5	<1	<1	<1
1,3-dichloropropane	µg/L	1							<1	<1	<5	<1	<1	<1
1,4-dichlorobenzene	µg/L	1		60	40			400	<1	<1	<2	<1	<1	<1
2,2-dichloropropane	µg/L	5							-	-	<5	-	-	-
2-chloronaphthalene	µg/L	2							<5	<5	<2	<5	<5	<5
2-chlorotoluene	µg/L	5							-	-	<5	-	-	-
4-chlorotoluene	µg/L	1							<1	<1	<5	<1	<1	<1
Benzal Chloride	µg/L	0.1							-	-	-	-	-	-
Benzotrichloride	µg/L	0.1							-	-	-	-	-	-
Bromobenzene	µg/L	1							<1	<1	<5	<1	<1	<1
Bromochloromethane	µg/L	1							<1	<1	-	<1	<1	<1
Carbon tetrachloride	µg/L	1							<1	<1	<5	<1	<1	<1
Chlorobenzene	µg/L	1							<1	<1	<5	<1	<1	<1
Chloroform	µg/L	5							<5	<5	<5	<5	<5	<5
Chloromethane	µg/L	1							<1	<1	<50	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1							<1	<1	<5	<1	<1	<1
Dichloromethane	µg/L	1						40	<1	<1	-	<1	<1	<1
Hexachlorobutadiene	µg/L	0.1						7	<5	<5	<2	<5	<5	<5
Vinyl chloride	µg/L	1						3	<1	<1	<50	<1	<1	<1

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								Site ID	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project	North East Link Project
								Location Code	NEL-BH086	NEL-BH086	NEL-BH086	NEL-BH087	NEL-BH088	NEL-BH089
								Field ID	NEL-BH086 / 120718	QC1 / 120718	QC2/120718	NEL-BH087 / 120718	NEL-BH088 / 120718	NEL-BH089 / 120718
								Date	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018	12/07/2018
								Sample Type	Normal	Field_D	Field_D	Normal	Normal	Normal
								Lab Report Number	607533 / EM1811208	607533	EM1811208	607533 / EM1811208	607533 / EM1811208	607533 / EM1811208
	Unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 FW 95%	ANZECC 2000 FW 99%	PFAS NEMP 2018 Freshwater 99%	ANZECC 2000 Irrigation - Long-term Trigger Values	NHMRC Recreational Guidelines 2008						
Dioxins & Furans														
Dibenzofuran	µg/L	2							<5	<5	<2	<5	<5	<5
Explosives														
1,3,5-Trinitrobenzene	µg/L	2							-	-	<2	-	-	-
2,4-Dinitrotoluene	µg/L	4		65	16				<5	<5	<4	<5	<5	<5
2,6-dinitrotoluene	µg/L	4							<5	<5	<4	<5	<5	<5
Nitrobenzene	µg/L	2		550	230				<50	<50	<2	<50	<50	<50
Nitroaromatics														
2-Picoline	µg/L	2							<5	<5	<2	<5	<5	<5
4-aminobiphenyl	µg/L	2							<5	<5	<2	<5	<5	<5
Pentachloronitrobenzene	µg/L	2						300	<5	<5	<2	<5	<5	<5
Gases														
Free Carbon Dioxide as CO2	mg/L								-	-	228	-	-	-
Phthalates														
Bis(2-ethylhexyl) phthalate	µg/L	5						100	<5	<5	<10	<5	<5	<5
Butyl benzyl phthalate	µg/L	2							<5	<5	<2	<5	<5	<5
Diethylphthalate	µg/L	2		1000	900				<5	<5	<2	<5	<5	<5
Dimethyl phthalate	µg/L	2		3700	3000				<5	<5	<2	<5	<5	<5
Di-n-butyl phthalate	µg/L	2		26	9.9				<5	<5	<2	<5	<5	<5
Di-n-octyl phthalate	µg/L	2							<5	<5	<2	<5	<5	<5

Environmental Standards
HEPA, January 2018, PFAS NEMP 2018 Freshwater 99%

CL2 Laboratory certificates of analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1809233**	Page	: 1 of 19
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 07-Jun-2018 15:45
Order number	:	Date Analysis Commenced	: 13-Jun-2018
C-O-C number	: ----	Issue Date	: 19-Jun-2018 15:40
Sampler	: GHD		
Site	: ----		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 12		
No. of samples analysed	: 10		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- pH analysis is done under non-stirring condition.
- EG035T: EM1809368 #10, Poor matrix spike recovery for Mercury due to matrix effects.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809233-001	EM1809233-002	EM1809233-003	EM1809233-004	EM1809233-006
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.7**	**5.1**	**4.8**	**5.1**	**6.2**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**12.4**	**23.4**	**25.2**	**26.1**	**21.0**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**5**	**5**	**8**	**11**	**8**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Copper	7440-50-8	5	mg/kg	**7**	**16**	**18**	**39**	**46**
Lead	7439-92-1	5	mg/kg	**14**	**14**	**33**	**24**	**16**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**12**	**35**	**14**	**27**	**15**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	**12**	**21**	**16**	**22**	**13**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	**0.1**	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	<1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**210**	**200**	**640**	**340**	**750**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809233-001	EM1809233-002	EM1809233-003	EM1809233-004	EM1809233-006
				Result	Result	Result	Result	Result
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809233-001	EM1809233-002	EM1809233-003	EM1809233-004	EM1809233-006
				Result	Result	Result	Result	Result
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	<1	<1	<1	<1
2-Methylphenol	95-48-7	1	mg/kg	<1	<1	<1	<1	<1
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	<5	<5	<5
4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	<5	<5	<5
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	<5	<5	<5
Dinoseb	88-85-7	5	mg/kg	<5	<5	<5	<5	<5
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	<5	<5	<5
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	<1	<1	<1	<1
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809233-001	EM1809233-002	EM1809233-003	EM1809233-004	EM1809233-006
				Result	Result	Result	Result	Result
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH165_0.2m	NEL-BH165_0.5m	NEL-ENV-BH022_0.2m	NEL-ENV-BH022_0.5m	NEL-ENV-BH022_1.5m
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809233-001	EM1809233-002	EM1809233-003	EM1809233-004	EM1809233-006
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**104**	**85.0**	**116**	**92.2**	**88.6**
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**86.0**	**78.6**	**87.4**	**83.1**	**86.2**
Toluene-D8	2037-26-5	0.1	%	**80.1**	**75.8**	**85.6**	**78.8**	**85.2**
4-Bromofluorobenzene	460-00-4	0.1	%	**83.5**	**86.6**	**94.6**	**80.9**	**89.0**
EP075S: Acid Extractable Surrogates								
Phenol-d6	13127-88-3	0.025	%	**96.0**	**90.5**	**97.4**	**79.6**	**82.8**
2-Chlorophenol-D4	93951-73-6	0.025	%	**72.5**	**69.0**	**73.3**	**59.9**	**61.8**
2.4.6-Tribromophenol	118-79-6	0.025	%	**104**	**92.0**	**104**	**83.1**	**82.2**
EP075T: Base/Neutral Extractable Surrogates								
Nitrobenzene-D5	4165-60-0	0.025	%	**89.9**	**86.3**	**88.2**	**72.8**	**75.2**
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	**101**	**97.6**	**99.6**	**81.0**	**84.4**
2-Fluorobiphenyl	321-60-8	0.025	%	**102**	**101**	**105**	**88.6**	**90.8**
Anthracene-d10	1719-06-8	0.025	%	**104**	**102**	**104**	**90.7**	**94.1**
4-Terphenyl-d14	1718-51-0	0.025	%	**127**	**129**	**129**	**116**	**120**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH162_0.2m	NEL-BH162_1.0m	----	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1809233-007	EM1809233-009	--------	--------	--------
				Result	Result	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.6**	**6.3**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**12.9**	**23.3**	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	----
Copper	7440-50-8	5	mg/kg	<5	**13**	----	----	----
Lead	7439-92-1	5	mg/kg	**7**	**12**	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	<2	----	----	----
Nickel	7440-02-0	2	mg/kg	**5**	**28**	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	<5	----	----	----
Silver	7440-22-4	2	mg/kg	<2	<2	----	----	----
Tin	7440-31-5	5	mg/kg	<5	<5	----	----	----
Zinc	7440-66-6	5	mg/kg	**7**	**23**	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	----	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**510**	**560**	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	<0.2	----	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	----	----	----

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH162_0.2m	NEL-BH162_1.0m	----	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----	----
				EM1809233-007	EM1809233-009	--------	--------	--------
				Result	Result	----	----	----
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	<1	----	----	----
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	----	----	----
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	----	----	----
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	----	----	----
Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	----	----	----
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	----	----	----
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	----	----	----
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	----	----	----
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	----	----	----
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	----	----	----
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	----	----	----
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	----	----	----
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	----	----	----
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	----	----	----
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	----	----	----
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	----	----	----
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	----	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	----	----	----
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	----	----	----
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	----	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	----	----	----
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	----	----	----
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	<0.03	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH162_0.2m	NEL-BH162_1.0m	----	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1809233-007	EM1809233-009	--------	--------	--------
				Result	Result	----	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	<1	----	----	----
2-Methylphenol	95-48-7	1	mg/kg	<1	<1	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	----	----	----
2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	----	----	----
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	----	----	----
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	----	----	----
4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	----	----	----
Dinoseb	88-85-7	5	mg/kg	<5	<5	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	----	----	----
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	<1	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	----	----	----
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH162_0.2m	NEL-BH162_1.0m	----	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1809233-007	EM1809233-009	--------	--------	--------
				Result	Result	----	----	----
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	----	----	----
beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	----	----	----
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	----	----	----
delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	----	----	----
Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	----	----	----
Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	----	----	----
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	----	----	----
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	----	----	----
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	----	----	----
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	----	----	----
Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	----	----	----
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	----	----	----
Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	----	----	----
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	----	----	----
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	----	----	----
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	----	----	----
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	----	----	----
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	<0.03	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	----	----	----
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	<0.03	----	----	----
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	----	----	----
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH162_0.2m	NEL-BH162_1.0m	----	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1809233-007	EM1809233-009	--------	--------	--------
				Result	Result	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	77.3	90.8	----	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	84.9	83.7	----	----	----
Toluene-D8	2037-26-5	0.1	%	85.4	79.8	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	88.1	89.0	----	----	----
EP075S: Acid Extractable Surrogates								
Phenol-d6	13127-88-3	0.025	%	85.0	101	----	----	----
2-Chlorophenol-D4	93951-73-6	0.025	%	63.3	75.7	----	----	----
2.4.6-Tribromophenol	118-79-6	0.025	%	92.8	103	----	----	----
EP075T: Base/Neutral Extractable Surrogates								
Nitrobenzene-D5	4165-60-0	0.025	%	78.2	92.9	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	88.2	106	----	----	----
2-Fluorobiphenyl	321-60-8	0.025	%	95.2	113	----	----	----
Anthracene-d10	1719-06-8	0.025	%	97.2	111	----	----	----
4-Terphenyl-d14	1718-51-0	0.025	%	124	126	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TB117	RB117	FB117	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809233-010	EM1809233-011	EM1809233-012	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	----	**5.14**	**5.39**	----	----
EG020F: Dissolved Metals by ICP-MS								
Silver	7440-22-4	0.001	mg/L	----	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	----	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	----	<0.0001	<0.0001	----	----
Copper	7440-50-8	0.001	mg/L	----	<0.001	<0.001	----	----
Molybdenum	7439-98-7	0.001	mg/L	----	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	----	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	----	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	----	<0.01	<0.01	----	----
Tin	7440-31-5	0.001	mg/L	----	<0.001	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	----	<0.005	<0.005	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	<0.0001	<0.0001	----	----
EG050F: Dissolved Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	----	<0.01	<0.01	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	----	<0.004	<0.004	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	----	<0.1	<0.1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	1	µg/L	----	<1	<1	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Styrene	100-42-5	5	µg/L	----	<5	<5	----	----
EP074E: Halogenated Aliphatic Compounds								
Vinyl chloride	75-01-4	50	µg/L	----	<50	<50	----	----
1.1-Dichloroethene	75-35-4	5	µg/L	----	<5	<5	----	----
Methylene chloride	75-09-2	5	µg/L	----	<5	<5	----	----
trans-1.2-Dichloroethene	156-60-5	5	µg/L	----	<5	<5	----	----
cis-1.2-Dichloroethene	156-59-2	5	µg/L	----	<5	<5	----	----
1.1.1-Trichloroethane	71-55-6	5	µg/L	----	<5	<5	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	----	<5	<5	----	----
1.2-Dichloroethane	107-06-2	5	µg/L	----	<5	<5	----	----
Trichloroethene	79-01-6	5	µg/L	----	<5	<5	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TB117	RB117	FB117	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809233-010	EM1809233-011	EM1809233-012	--------	--------
				Result	Result	Result	----	----
EP074E: Halogenated Aliphatic Compounds - Continued								
1.1.2-Trichloroethane	79-00-5	5	µg/L	----	<5	<5	----	----
Tetrachloroethene	127-18-4	5	µg/L	----	<5	<5	----	----
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	----	<5	<5	----	----
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	----	<5	<5	----	----
Hexachlorobutadiene	87-68-3	5	µg/L	----	<5	<5	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	----	<5	<5	----	----
1.4-Dichlorobenzene	106-46-7	5	µg/L	----	<5	<5	----	----
1.2-Dichlorobenzene	95-50-1	5	µg/L	----	<5	<5	----	----
1.2.4-Trichlorobenzene	120-82-1	5	µg/L	----	<5	<5	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	----	<5	<5	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	----	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	----	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	----	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	----	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	----	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	----	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	----	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	----	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	----	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	----	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	----	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	----	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	----	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	----	<0.5	<0.5	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	----	<0.5	<0.5	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	2	µg/L	----	<2	<2	----	----
2.4-Dichlorophenol	120-83-2	2	µg/L	----	<2	<2	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TB117	RB117	FB117	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809233-010	EM1809233-011	EM1809233-012	--------	--------
				Result	Result	Result	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
2.6-Dichlorophenol	87-65-0	2	µg/L	----	<2	<2	----	----
4-Chloro-3-methylphenol	59-50-7	4	µg/L	----	<4	<4	----	----
2.4.5-Trichlorophenol	95-95-4	2	µg/L	----	<2	<2	----	----
2.4.6-Trichlorophenol	88-06-2	2	µg/L	----	<2	<2	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	----	<2	<2	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	2	µg/L	----	<2	<2	----	----
Pentachlorophenol	87-86-5	2	µg/L	----	<2	<2	----	----
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	4	µg/L	----	<4	<4	----	----
2-Methylphenol	95-48-7	4	µg/L	----	<4	<4	----	----
3- & 4-Methylphenol	1319-77-3	4	µg/L	----	<4	<4	----	----
2-Nitrophenol	88-75-5	4	µg/L	----	<4	<4	----	----
2.4-Dimethylphenol	105-67-9	4	µg/L	----	<4	<4	----	----
2.4-Dinitrophenol	51-28-5	100	µg/L	----	<100	<100	----	----
4-Nitrophenol	100-02-7	50	µg/L	----	<50	<50	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	----	<50	<50	----	----
Dinoseb	88-85-7	50	µg/L	----	<50	<50	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	----	<50	<50	----	----
EP075I: Organochlorine Pesticides								
alpha-BHC	319-84-6	0.5	µg/L	----	<0.5	<0.5	----	----
Heptachlor	76-44-8	0.5	µg/L	----	<0.5	<0.5	----	----
Aldrin	309-00-2	0.5	µg/L	----	<0.5	<0.5	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	----	<0.5	<0.5	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	----	<0.5	<0.5	----	----
4.4`-DDE	72-55-9	0.5	µg/L	----	<0.5	<0.5	----	----
Dieldrin	60-57-1	0.5	µg/L	----	<0.5	<0.5	----	----
4.4`-DDD	72-54-8	0.5	µg/L	----	<0.5	<0.5	----	----
4.4`-DDT	50-29-3	0.5	µg/L	----	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	----	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	----	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	----	<50	<50	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TB117	RB117	FB117	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809233-010	EM1809233-011	EM1809233-012	--------	--------
				Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
^ C10 - C36 Fraction (sum)	----	50	µg/L	----	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	----	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	----	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	----	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	----	<100	<100	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	----	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	----	**98.5**	**94.0**	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	5	%	----	**89.0**	**89.1**	----	----
Toluene-D8	2037-26-5	5	%	----	**97.9**	**82.0**	----	----
4-Bromofluorobenzene	460-00-4	5	%	----	**99.7**	**85.3**	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	----	**38.1**	**38.6**	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	----	**75.7**	**73.8**	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	----	**70.8**	**70.1**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	----	**98.5**	**94.3**	----	----
Anthracene-d10	1719-06-8	1.0	%	----	**97.1**	**92.4**	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	----	**110**	**105**	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	TB117	RB117	FB117	----	----
			Client sampling date / time	06-Jun-2018 00:00	06-Jun-2018 00:00	06-Jun-2018 00:00	----	----
				EM1809233-010	EM1809233-011	EM1809233-012	--------	--------
				Result	Result	Result	----	----
EP075S: Acid Extractable Surrogates								
Phenol-d6	13127-88-3	0.25	%	----	32.1	28.8	----	----
2-Chlorophenol-D4	93951-73-6	0.25	%	----	73.5	62.8	----	----
2.4.6-Tribromophenol	118-79-6	0.25	%	----	65.7	55.9	----	----
EP075T: Base/Neutral Extractable Surrogates								
Nitrobenzene-D5	4165-60-0	0.25	%	----	83.6	72.2	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.25	%	----	81.9	71.4	----	----
2-Fluorobiphenyl	321-60-8	0.25	%	----	82.8	70.3	----	----
Anthracene-d10	1719-06-8	0.25	%	----	81.2	70.0	----	----
4-Terphenyl-d14	1718-51-0	0.25	%	----	90.7	77.5	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	88.2	92.1	84.4	----	----
Toluene-D8	2037-26-5	2	%	87.2	92.2	82.1	----	----
4-Bromofluorobenzene	460-00-4	2	%	101	103	95.8	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	*CAS Number*	*Recovery Limits (%)* Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	122
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	59	119
Toluene-D8	2037-26-5	55	117
4-Bromofluorobenzene	460-00-4	59	123
EP075S: Acid Extractable Surrogates			
Phenol-d6	13127-88-3	28	134
2-Chlorophenol-D4	93951-73-6	27	123
2.4.6-Tribromophenol	118-79-6	25	149
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	29	125
1.2-Dichlorobenzene-D4	2199-69-1	31	117
2-Fluorobiphenyl	321-60-8	44	136
Anthracene-d10	1719-06-8	53	133
4-Terphenyl-d14	1718-51-0	59	141

Sub-Matrix: **WATER**

Compound	*CAS Number*	*Recovery Limits (%)* Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	125
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	77	132
4-Bromofluorobenzene	460-00-4	67	131
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	46
2-Chlorophenol-D4	93951-73-6	23	104
2.4.6-Tribromophenol	118-79-6	28	130
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	36	114
Anthracene-d10	1719-06-8	51	119
4-Terphenyl-d14	1718-51-0	49	127
EP075S: Acid Extractable Surrogates			
Phenol-d6	13127-88-3	13	90
2-Chlorophenol-D4	93951-73-6	42	117
2.4.6-Tribromophenol	118-79-6	52	140
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	49	136

Sub-Matrix: **WATER**

Compound	*CAS Number*	*Recovery Limits (%)* Low	High
EP075T: Base/Neutral Extractable Surrogates - Continued			
1.2-Dichlorobenzene-D4	2199-69-1	49	128
2-Fluorobiphenyl	321-60-8	57	137
Anthracene-d10	1719-06-8	67	137
4-Terphenyl-d14	1718-51-0	66	136
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	129
Toluene-D8	2037-26-5	70	125
4-Bromofluorobenzene	460-00-4	71	129

CHAIN OF CUSTODY RECORD

GHD

GHD Melbourne
180 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111

Job Number	31/35006/0910
GHD Office	Melbourne
Project	North East Link - Contamination
GHD Contact	David Quinn
Contact Email	David.Quinn@ghd.com
Standard TAT	
Quote No./GHD Reference	ME/124/18
Laboratory:	ALS Springvale
Address:	2 - 4 Westall Rd, Springvale
Lab Contact:	Shirley LeCornu

PLEASE NOTE:
Sign white copy on receipt and release of samples.
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact to sign white copy** and fax/email to GHD Contact.
On completion of analyses please **return white copy with results**.
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results **to the GHD Contact with the GHD Job Number** in the e-mail subject line.

Results to be provided in ESDAT compatibile format

	Sample I.D.	Date	Time	Composite Sample	Sample Matrix S: Soil SL: Sludge W: Water A: Air GW: Groundwater	Preservative	Container Type J: soil jar B: bag V: vial G: glass bottle P: plastic bottle	Container Number	Container Volume (mL)	HOLD (Analyses Required)													Remarks
1	NEL-BH165_0.2m	6/6/18	PM	/	S	/	J	1	250	X													
2	NEL-BH165_0.5m	"	"	/	S	/	J	1	250	X													
3	NEL-ENV-BH022_0.2m	"	Am	/	S	/	J	1	250	X													
4	NEL-ENV-BH022_0.5m	"	"	/	S	/	J	1	250	X													
5	NEL-ENV-BH022_1.0m	"	"	/	S	/	J	1	250	X													
6	NEL-ENV-BH022_1.5m	"	"	/	S	/	J	1	250	X													
7	NEL-BH162_0.2m	"	Am	/	S	/	J	1	250	X													
8	NEL-BH162_0.5m	"	Am	/	S	/	J	1	250	X													
9	NEL-BH162_1.0m	"	Am	/	S	/	J	1	250	X													
10	TB117	"	Pm	/	W	/	V/G/P	1	/	X													
11	RB117	"	PM	/	W	/	V/G/P	8	/	X													
12	FB117	"	Pm	/	W	/	V/G/P	8	/	X													

Environmental Division
Melbourne
Work Order Reference
EM1809233
Telephone + 61-3-8549 9600

Sampled by:	GHD	Date/Time:	6/6/18	**Relinquished by:**	M. Lo Monaco	**Date/Time:**	6/6/18 Pm
Received by:	Core Shed ~~Freeze~~	Date/Time:	6/6/18 Pm	**Relinquished by:**		**Date/Time:**	
Received by Courier:		Date/Time:		**Relinquished by:**		**Date/Time:**	
Received by Lab:	Marvel (ALS)	Date/Time:	7/6 1545				
Remarks:	Please CC reports and correspondence to Mark Davidson (mark.s.davidson@aecom.com) & Nazuha Rosli (nazuha.rosli@aecom.com)						

Peter Ravlic

From: David Quinn <David.Quinn@ghd.com>
Sent: Friday, 8 June 2018 4:51 PM
To: Peter Ravlic
Cc: Mark Clough; Kory.Auch@ghd.com; Robyn Madsen
Subject: RE: ON HOLD - EM1809231 & 9233 & 9234 - GHD 31350060910 North East Link

Hi Peter

Please analyse the below all at standard TAT and please send QC2004 to Eurofins for IWRG621 analysis.

Can you also please include Mark Clough and Kory Auch as recipients for the results.

EM1809231
1. NEL-EF-BH0019_0.2m = IWRG621
2. NEL-EF-BH0019_1.0m = IWRG621
3. RB115 = IWRG621 water equivalent
4. TB115 = Volatile TPH/BTEX
5. FB115 = IWRG621 water equivalent

9233

1 1. NEL-BH165_0.2m = IWRG621
2 2. NEL-BH165_0.5m = IWRG621
3 3. NEL-ENV-BH022_0.2m = IWRG621
4 4. NEL-ENV-BH022_0.5m = IWRG621
6 5. NEL-ENV-BH022_1.5m = IWRG621
7 7. NEL-BH162_0.2m = IWRG621
9 8. NEL-BH162_1.0m = IWRG621
11 9. RB115 = IWRG621 water equivalent
10 10. TB115 = Volatile TPH/BTEX
12 11. FB115 = IWRG621 water equivalent

9234
1. NEL-BH138_0.35m = IWRG621
3. NEL-BH138_1.0m = IWRG621
4. NEL-BH138_1.5m = IWRG621
5. NEL-EF-BH016_0.2m = IWRG621
7. NEL-EF-BH016_1.0m = IWRG621
9. NEL-EF-BH017_0.5m = IWRG621
10. NEL-EF-BH017_1.0m = IWRG621
11. NEL-EF-BH017_1.5m = IWRG621
12. QC1004 = IWRG621
13. RB116 = IWRG621 water equivalent
14. TB116 = Volatile TPH/BTEX
15. FB116 = IWRG621 water equivalent

Cheers

David Quinn
Senior Environmental Engineer
Waste Management & Environmental Compliance

GHD
Proudly employee owned

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1809233**	Page	: 1 of 19
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 07-Jun-2018
Order number	:	Date Analysis Commenced	: 13-Jun-2018
C-O-C number	: ----	Issue Date	: 19-Jun-2018
Sampler	: GHD		
Site	: ----		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 12		
No. of samples analysed	: 10		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 1722241)									
EM1809233-001	NEL-BH165_0.2m	EA001: pH (CaCl2)	----	0.1	pH Unit	4.7	4.8	2.10	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1722758)									
EM1809233-001	NEL-BH165_0.2m	EA055: Moisture Content	----	0.1	%	12.4	13.0	5.14	0% - 50%
EM1809329-003	Anonymous	EA055: Moisture Content	----	0.1	%	7.8	7.6	2.59	No Limit
EG005T: Total Metals by ICP-AES (QC Lot: 1723443)									
EM1809092-001	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	64	66	2.81	0% - 20%
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	278	286	3.14	0% - 20%
		EG005T: Lead	7439-92-1	5	mg/kg	133	136	2.54	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	456	470	3.09	0% - 20%
EM1809092-015	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	24	23	0.00	0% - 50%
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	35	34	3.56	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	28	27	0.00	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG005T: Total Metals by ICP-AES (QC Lot: 1723443) - continued									
EM1809092-015	Anonymous	EG005T: Zinc	7440-66-6	5	mg/kg	79	77	2.09	0% - 50%
EG005T: Total Metals by ICP-AES (QC Lot: 1723445)									
EM1809233-003	NEL-ENV-BH022_0.2m	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	14	14	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	8	8	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	18	18	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	33	32	0.00	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	16	16	0.00	No Limit
EM1809239-088	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	15	15	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	8	8	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	7	6	0.00	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	14	14	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1723442)									
EM1809092-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1809092-015	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1723444)									
EM1809233-003	NEL-ENV-BH022_0.2m	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1809239-088	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 1723422)									
EM1809230-067	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809233-002	NEL-BH165_0.5m	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1726921)									
EM1809170-016	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1809170-035	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1726922)									
EM1809233-003	NEL-ENV-BH022_0.2m	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1809345-003	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EK040T: Fluoride Total (QC Lot: 1722531)									
EM1809230-046	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	200	200	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EK040T: Fluoride Total (QC Lot: 1722531) - continued									
EM1809230-086	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	200	210	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 1722432)									
EM1809231-001	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1722246)									
EM1809231-001	Anonymous	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP074H: Naphthalene (QC Lot: 1722246)									
EM1809231-001	Anonymous	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP074I: Volatile Halogenated Compounds (QC Lot: 1722246)									
EM1809231-001	Anonymous	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	0.00	No Limit
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1722430)									
EM1809231-001	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1722430) - continued									
EM1809231-001	Anonymous	EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075A: Phenolic Compounds (Non-halogenated) (QC Lot: 1722430)									
EM1809231-001	Anonymous	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1722430)									
EM1809231-001	Anonymous	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP075I: Organochlorine Pesticides (QC Lot: 1722430)									
EM1809231-001	Anonymous	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP075I: Organochlorine Pesticides (QC Lot: 1722430) - continued									
EM1809231-001	Anonymous	EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1722246)									
EM1809231-001	Anonymous	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1722431)									
EM1809231-001	Anonymous	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1722246)									
EM1809231-001	Anonymous	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1722431)									
EM1809231-001	Anonymous	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005P: pH by PC Titrator (QC Lot: 1725827)									
EM1808885-007	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	9.02	8.38	7.36	0% - 20%
EM1809320-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	9.05	9.10	0.551	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1725904)									
EM1809425-004	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EM1809233-011	RB117	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1725906)									
EM1809320-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.015	0.015	0.00	0% - 50%

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1725906) - continued									
EM1809320-002	Anonymous	EG020A-F: Lead	7439-92-1	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.083	0.081	2.14	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809233-011	RB117	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1725905)									
EM1809425-005	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1809233-011	RB117	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG050F: Dissolved Hexavalent Chromium (QC Lot: 1727385)									
EM1808885-006	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809410-006	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1730275)									
EM1809113-150	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EM1809323-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	0.106	0.118	11.0	0% - 20%
EK040P: Fluoride by PC Titrator (QC Lot: 1725828)									
EM1808885-007	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EM1809320-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.3	1.3	0.00	0% - 50%
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1723557)									
EM1809318-001	Anonymous	EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.00	No Limit
EM1808885-006	Anonymous	EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.00	No Limit
EP074E: Halogenated Aliphatic Compounds (QC Lot: 1723557)									
EM1809318-001	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: Methylene chloride	75-09-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP074E: Halogenated Aliphatic Compounds (QC Lot: 1723557) - continued									
EM1809318-001	Anonymous	EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	0.00	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.00	No Limit
EM1808885-006	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: Methylene chloride	75-09-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	0.00	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.00	No Limit
EP074F: Halogenated Aromatic Compounds (QC Lot: 1723557)									
EM1809318-001	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	0.00	No Limit
EM1808885-006	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	0.00	No Limit
EP074G: Trihalomethanes (QC Lot: 1723557)									
EM1809318-001	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.00	No Limit
EM1808885-006	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1723555)									
EM1809318-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EM1808885-006	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1723555)									
EM1809318-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EM1808885-006	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 1723555)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080: BTEXN (QC Lot: 1723555) - continued									
EM1809318-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EM1808885-006	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1723443)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	93.3	79	113
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	100.0	85	109
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	94.3	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	92.7	78	106
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	90.5	86	112
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	91.2	82	111
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	101	93	109
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	80.2	80	108
EG005T: Tin	7440-31-5	5	mg/kg	<5	5.2 mg/kg	92.0	88	116
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	90.4	82	111
EG005T: Total Metals by ICP-AES (QCLot: 1723445)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	93.4	79	113
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	85.8	85	109
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	94.6	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	94.6	78	106
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	87.4	86	112
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	92.9	82	111
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	101	93	109
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	81.2	80	108
EG005T: Tin	7440-31-5	5	mg/kg	<5	5.2 mg/kg	105	88	116
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	92.9	82	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1723442)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	88.5	77	104
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1723444)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	85.3	77	104
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1723422)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	77.0	75	112
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1726921)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	93.3	80	110
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1726922)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	92.0	80	110
EK040T: Fluoride Total (QCLot: 1722531)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	91.0	77	106

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	LCS Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1722432)								
EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	110	63	118
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1722246)								
EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	2.1 mg/kg	84.9	74	118
EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	2.1 mg/kg	84.0	70	124
EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2.1 mg/kg	81.2	71	122
EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4.2 mg/kg	81.7	70	118
EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	2.1 mg/kg	84.2	76	116
EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2.1 mg/kg	82.2	74	114
EP074H: Naphthalene (QCLot: 1722246)								
EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	0.6 mg/kg	84.4	77	111
EP074I: Volatile Halogenated Compounds (QCLot: 1722246)								
EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	0.1 mg/kg	85.5	49	133
EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	0.1 mg/kg	75.4	62	127
EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	2.1 mg/kg	89.3	68	107
EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	0.1 mg/kg	80.0	68	124
EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	0.1 mg/kg	85.2	74	118
EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	0.1 mg/kg	85.8	72	118
EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	0.1 mg/kg	80.2	67	119
EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	0.1 mg/kg	75.3	65	119
EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	0.1 mg/kg	92.5	73	120
EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	0.1 mg/kg	83.6	72	124
EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	0.1 mg/kg	87.5	74	122
EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	0.1 mg/kg	77.3	64	124
EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	0.1 mg/kg	86.9	70	119
EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	0.1 mg/kg	87.4	71	125
EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	0.1 mg/kg	77.2	61	125
EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	0.1 mg/kg	86.3	73	117
EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	0.1 mg/kg	76.8	69	118
EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	0.1 mg/kg	82.4	75	114
EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	0.1 mg/kg	76.0	59	124
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1722430)								
EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	2 mg/kg	89.2	54	122
EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	2 mg/kg	92.8	58	131
EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	2 mg/kg	108	55	118
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	2 mg/kg	99.0	62	129
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	2 mg/kg	116	53	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	2 mg/kg	105	60	126

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1722430) - continued								
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	2 mg/kg	94.2	56	118
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	0.05	mg/kg	<0.05	4 mg/kg	101	54	125
EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	4 mg/kg	69.8	52	124
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1722430)								
EP075-EM: Phenol	108-95-2	1	mg/kg	<1	2 mg/kg	90.1	56	120
EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	2 mg/kg	100	52	131
EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	4 mg/kg	92.8	59	132
EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	2 mg/kg	92.3	53	130
EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	2 mg/kg	114	43	120
EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	12 mg/kg	125	23	125
EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	12 mg/kg	86.6	59	133
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	12 mg/kg	102	47	125
EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	12 mg/kg	114	51	123
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	10 mg/kg	82.4	12	132
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1722430)								
EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	2 mg/kg	95.2	58	121
EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	2 mg/kg	96.9	55	126
EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	2 mg/kg	113	59	120
EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	2 mg/kg	104	64	122
EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	2 mg/kg	104	70	128
EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	2 mg/kg	67.6	55	127
EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	2 mg/kg	102	68	134
EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	2 mg/kg	98.1	69	131
EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	2 mg/kg	98.7	65	133
EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	2 mg/kg	109	68	134
EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	4 mg/kg	97.2	64	134
EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	2 mg/kg	93.6	62	132
EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	2 mg/kg	96.4	55	137
EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	2 mg/kg	99.7	54	136
EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	2 mg/kg	93.9	55	137
EP075I: Organochlorine Pesticides (QCLot: 1722430)								
EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	2 mg/kg	109	68	122
EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	2 mg/kg	96.6	65	122
EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	2 mg/kg	112	62	133
EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	2 mg/kg	107	68	126
EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	2 mg/kg	97.6	68	133

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075I: Organochlorine Pesticides (QCLot: 1722430) - continued								
EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	2 mg/kg	101	62	128
EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	2 mg/kg	97.2	66	128
EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	2 mg/kg	100	62	133
EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	2 mg/kg	91.7	62	132
EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	2 mg/kg	91.9	61	133
EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	2 mg/kg	93.5	63	136
EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	2 mg/kg	102	57	131
EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	2 mg/kg	95.4	65	137
EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	2 mg/kg	87.6	24	174
EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	2 mg/kg	85.4	55	148
EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	2 mg/kg	99.9	66	135
EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	2 mg/kg	110	66	134
EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	2 mg/kg	94.5	63	139
EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	2 mg/kg	112	59	134
EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	2 mg/kg	114	61	136
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1722246)								
EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	39.6 mg/kg	80.2	69	114
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1722431)								
EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	806 mg/kg	107	73	134
EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	3006 mg/kg	112	81	112
EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	1584 mg/kg	105	77	116
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1722246)								
EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	48.9 mg/kg	79.9	69	112
EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1722431)								
EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	1160 mg/kg	107	77	127
EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	3978 mg/kg	110	79	113
EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	313 mg/kg	98.9	68	124

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1725904)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	109	84	116
EG020F: Dissolved Metals by ICP-MS (QCLot: 1725906)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.3	91	107
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.4	84	104
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	89.3	82	103

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1725906) - continued								
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	92.6	83	105
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	93.7	83	109
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	93.5	82	106
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	94.2	82	109
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	94.7	83	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.3	85	109
EG035F: Dissolved Mercury by FIMS (QCLot: 1725905)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	99.3	81	114
EG050F: Dissolved Hexavalent Chromium (QCLot: 1727385)								
EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	0.5 mg/L	108	90	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1730275)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	92.2	80	110
EK040P: Fluoride by PC Titrator (QCLot: 1725828)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	112	85	112
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1724162)								
EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1	10 µg/L	90.3	54	132
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1723557)								
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	93.3	79	114
EP074E: Halogenated Aliphatic Compounds (QCLot: 1723557)								
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	72.6	64	139
EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	82.1	65	124
EP074: Methylene chloride	75-09-2	5	µg/L	<5	20 µg/L	106	81	144
EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	85.4	73	121
EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	96.7	78	120
EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	86.2	68	116
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	80.8	66	119
EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	95.6	79	118
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	90.5	70	120
EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	99.2	87	114
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	84.8	75	119
EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	91.3	75	112
EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	99.5	81	125
EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	20 µg/L	93.4	63	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1723557)								
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	94.8	82	114
EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	20 µg/L	96.2	76	118
EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	20 µg/L	96.5	82	112

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP074F: Halogenated Aromatic Compounds (QCLot: 1723557) - continued								
EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	20 µg/L	92.2	62	119
EP074G: Trihalomethanes (QCLot: 1723557)								
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	96.5	79	119
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1724163)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	86.1	48	110
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	86.3	49	124
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	90.0	53	117
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	90.4	54	118
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	92.7	57	119
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	110	51	113
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	95.2	59	123
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	93.2	58	123
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	95.4	52	126
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	96.3	55	123
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	96.3	52	131
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	98.8	57	126
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	97.6	56	126
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	96.1	53	123
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	95.9	53	125
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	97.2	53	125
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1724123)								
EP075-EM: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	74.9	44	114
EP075-EM: 2.4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	74.1	53	121
EP075-EM: 2.6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	82.2	55	119
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	4	µg/L	<4	10 µg/L	70.5	57	116
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	84.0	51	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	75.4	56	120
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	<2	10 µg/L	87.2	41	125
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	2	µg/L	<2	20 µg/L	89.4	47	125
EP075-EM: Pentachlorophenol	87-86-5	2	µg/L	<2	20 µg/L	81.8	22	122
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1724123)								
EP075-EM: Phenol	108-95-2	4	µg/L	<4	10 µg/L	33.6	20	57
EP075-EM: 2-Methylphenol	95-48-7	4	µg/L	<4	10 µg/L	66.4	49	107
EP075-EM: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	20 µg/L	59.6	48	101
EP075-EM: 2-Nitrophenol	88-75-5	4	µg/L	<4	10 µg/L	77.7	53	123
EP075-EM: 2.4-Dimethylphenol	105-67-9	4	µg/L	<4	10 µg/L	87.2	52	128

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1724123) - continued								
EP075-EM: 2.4-Dinitrophenol	51-28-5	100	µg/L	<100	60 µg/L	84.2	21	130
EP075-EM: 4-Nitrophenol	100-02-7	50	µg/L	<50	60 µg/L	24.7	13	60
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	<50	60 µg/L	68.9	56	126
EP075-EM: Dinoseb	88-85-7	50	µg/L	<50	60 µg/L	82.8	55	128
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	<50	50 µg/L	107	32	135
EP075I: Organochlorine Pesticides (QCLot: 1724123)								
EP075-EM: alpha-BHC	319-84-6	0.5	µg/L	<0.5	10 µg/L	90.4	59	126
EP075-EM: Heptachlor	76-44-8	0.5	µg/L	<0.5	10 µg/L	96.5	59	131
EP075-EM: Aldrin	309-00-2	0.5	µg/L	<0.5	10 µg/L	91.3	59	133
EP075-EM: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	10 µg/L	94.6	61	133
EP075-EM: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	10 µg/L	93.7	60	132
EP075-EM: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	10 µg/L	97.3	56	130
EP075-EM: Dieldrin	60-57-1	0.5	µg/L	<0.5	10 µg/L	95.3	59	130
EP075-EM: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	10 µg/L	92.9	62	136
EP075-EM: 4.4`-DDT	50-29-3	0.5	µg/L	<0.5	10 µg/L	95.5	57	128
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1723555)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	88.5	68	125
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1724164)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	4331 µg/L	73.7	58	134
EP071: C15 - C28 Fraction	----	100	µg/L	<100	16952 µg/L	76.6	60	133
EP071: C29 - C36 Fraction	----	50	µg/L	<50	8695 µg/L	74.8	54	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1723555)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	85.2	66	123
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1724164)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	6292 µg/L	74.3	58	122
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	22143 µg/L	74.8	56	132
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1677 µg/L	76.3	58	137
EP080: BTEXN (QCLot: 1723555)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	96.7	74	123
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	96.0	77	128
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	98.2	73	126
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	96.0	72	131
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	98.0	74	131
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	90.6	74	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1723443)							
EM1809092-003	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	79.0	78	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	84.4	84	116
		EG005T: Copper	7440-50-8	50 mg/kg	95.1	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	89.4	76	124
		EG005T: Molybdenum	7439-98-7	50 mg/kg	97.0	79	117
		EG005T: Nickel	7440-02-0	50 mg/kg	80.3	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	74.5	71	125
		EG005T: Zinc	7440-66-6	50 mg/kg	96.7	74	128
EG005T: Total Metals by ICP-AES (QCLot: 1723445)							
EM1809233-004	NEL-ENV-BH022_0.5m	EG005T: Arsenic	7440-38-2	50 mg/kg	95.8	78	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	93.1	84	116
		EG005T: Copper	7440-50-8	50 mg/kg	95.9	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	95.1	76	124
		EG005T: Molybdenum	7439-98-7	50 mg/kg	96.9	79	117
		EG005T: Nickel	7440-02-0	50 mg/kg	89.4	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	86.7	71	125
		EG005T: Zinc	7440-66-6	50 mg/kg	90.7	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1723442)							
EM1809092-003	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	82.4	76	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1723444)							
EM1809233-004	NEL-ENV-BH022_0.5m	EG035T: Mercury	7439-97-6	5 mg/kg	91.9	76	116
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1723422)							
EM1809230-068	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	40 mg/kg	76.0	58	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1726921)							
EM1809170-020	Anonymous	EK026SF: Total Cyanide	57-12-5	20 mg/kg	87.1	77	113
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1726922)							
EM1809233-004	NEL-ENV-BH022_0.5m	EK026SF: Total Cyanide	57-12-5	20 mg/kg	91.4	77	113
EK040T: Fluoride Total (QCLot: 1722531)							
EM1809230-052	Anonymous	EK040T: Fluoride	16984-48-8	400 mg/kg	102	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1722432)							
EM1809233-002	NEL-BH165_0.5m	EP066-EM: Total Polychlorinated biphenyls	----	1 mg/kg	110	36	152
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1722246)							
EM1809231-003	Anonymous	EP074-UT: Benzene	71-43-2	2 mg/kg	91.1	50	138
		EP074-UT: Toluene	108-88-3	2 mg/kg	93.4	56	134

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EP074I: Volatile Halogenated Compounds (QCLot: 1722246)							
EM1809231-003	Anonymous	EP074-UT: 1.1-Dichloroethene	75-35-4	2 mg/kg	95.1	26	141
		EP074-UT: Trichloroethene	79-01-6	2 mg/kg	86.5	50	134
		EP074-UT: Chlorobenzene	108-90-7	2 mg/kg	93.0	28	134
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1722430)							
EM1809231-003	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	1 mg/kg	89.9	34	118
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	1 mg/kg	94.0	41	139
		EP075-EM: Pentachlorophenol	87-86-5	1 mg/kg	113	10	144
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1722430)							
EM1809231-003	Anonymous	EP075-EM: Phenol	108-95-2	1 mg/kg	87.1	32	134
		EP075-EM: 2-Nitrophenol	88-75-5	1 mg/kg	82.0	13	129
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1722430)							
EM1809231-003	Anonymous	EP075-EM: Acenaphthene	83-32-9	1 mg/kg	96.1	46	138
		EP075-EM: Pyrene	129-00-0	1 mg/kg	100	27	169
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1722246)							
EM1809231-003	Anonymous	EP074-UT: C6 - C9 Fraction	----	28 mg/kg	99.6	43	111
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1722431)							
EM1809233-001	NEL-BH165_0.2m	EP071-EM: C10 - C14 Fraction	----	806 mg/kg	112	53	123
		EP071-EM: C15 - C28 Fraction	----	3006 mg/kg	118	70	124
		EP071-EM: C29 - C36 Fraction	----	1584 mg/kg	111	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1722246)							
EM1809231-003	Anonymous	EP074-UT: C6 - C10 Fraction	C6_C10	33 mg/kg	97.6	42	106
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1722431)							
EM1809233-001	NEL-BH165_0.2m	EP071-EM: >C10 - C16 Fraction	----	1160 mg/kg	113	65	123
		EP071-EM: >C16 - C34 Fraction	----	3978 mg/kg	116	67	121
		EP071-EM: >C34 - C40 Fraction	----	313 mg/kg	104	44	126

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1725906)							
EM1809233-011	RB117	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	99.6	85	131
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	89.4	81	133
		EG020A-F: Copper	7440-50-8	0.2 mg/L	87.0	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	94.6	75	133
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	96.6	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	97.8	75	131
EG035F: Dissolved Mercury by FIMS (QCLot: 1725905)							

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
EG035F: Dissolved Mercury by FIMS (QCLot: 1725905) - continued							
EM1809233-012	FB117	EG035F: Mercury	7439-97-6	0.01 mg/L	96.4	70	120
EG050F: Dissolved Hexavalent Chromium (QCLot: 1727385)							
EM1808885-007	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.5 mg/L	107	59	127
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1730275)							
EM1808885-007	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	90.2	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1725828)							
EM1809231-006	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	115	70	130
EP074E: Halogenated Aliphatic Compounds (QCLot: 1723557)							
EM1808885-007	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	20 µg/L	68.0	40	124
		EP074: Trichloroethene	79-01-6	20 µg/L	66.6	54	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1723557)							
EM1808885-007	Anonymous	EP074: Chlorobenzene	108-90-7	20 µg/L	75.4	68	132
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1723555)							
EM1808885-007	Anonymous	EP080: C6 - C9 Fraction	----	280 µg/L	61.2	43	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1723555)							
EM1808885-007	Anonymous	EP080: C6 - C10 Fraction	C6_C10	330 µg/L	60.2	44	122
EP080: BTEXN (QCLot: 1723555)							
EM1808885-007	Anonymous	EP080: Benzene	71-43-2	20 µg/L	75.9	68	130
		EP080: Toluene	108-88-3	20 µg/L	77.6	72	132

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1809233**	Page	: 1 of 13
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 07-Jun-2018
Site	: ----	Issue Date	: 19-Jun-2018
Sampler	: GHD	No. of samples received	: 12
Order number	:	No. of samples analysed	: 10

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
RB117,	FB117	----	----	----	14-Jun-2018	06-Jun-2018	**8**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	6	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	6	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	6	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	6	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	6	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	6	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	6	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	6	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**----**	----	----	**13-Jun-2018**	20-Jun-2018	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**14-Jun-2018**	03-Dec-2018	✓	**14-Jun-2018**	03-Dec-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**14-Jun-2018**	04-Jul-2018	✓	**15-Jun-2018**	04-Jul-2018	✓
EG048: Hexavalent Chromium (Alkaline Digest)							
Soil Glass Jar - Unpreserved (EG048G) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**14-Jun-2018**	04-Jul-2018	✓	**14-Jun-2018**	21-Jun-2018	✓
EK026SF: Total CN by Segmented Flow Analyser							
Soil Glass Jar - Unpreserved (EK026SF) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**14-Jun-2018**	20-Jun-2018	✓	**15-Jun-2018**	28-Jun-2018	✓
EK040T: Fluoride Total							
Soil Glass Jar - Unpreserved (EK040T) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**13-Jun-2018**	04-Jul-2018	✓	**15-Jun-2018**	04-Jul-2018	✓
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066-EM) NEL-BH165_0.2m, NEL-BH165_0.5m, NEL-ENV-BH022_0.2m, NEL-ENV-BH022_0.5m, NEL-ENV-BH022_1.5m, NEL-BH162_0.2m, NEL-BH162_1.0m	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**13-Jun-2018**	23-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP074A: Monocyclic Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP074H: Naphthalene								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP074I: Volatile Halogenated Compounds								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP075A: Phenolic Compounds (Halogenated)								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**13-Jun-2018**	23-Jul-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP075A: Phenolic Compounds (Non-halogenated)								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**13-Jun-2018**	23-Jul-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP075B: Polynuclear Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**13-Jun-2018**	23-Jul-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP075I: Organochlorine Pesticides								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**13-Jun-2018**	23-Jul-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH165_0.2m,	NEL-BH165_0.5m,	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**13-Jun-2018**	13-Jun-2018	✓
NEL-ENV-BH022_0.2m,	NEL-ENV-BH022_0.5m,							
NEL-ENV-BH022_1.5m,	NEL-BH162_0.2m,							
NEL-BH162_1.0m								

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**14-Jun-2018**	06-Jun-2018	×
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020B-F)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**15-Jun-2018**	03-Dec-2018	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG035F)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**19-Jun-2018**	20-Jun-2018	✓
EG050F: Dissolved Hexavalent Chromium								
Clear Plastic Bottle - NaOH (EG050F)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**14-Jun-2018**	04-Jul-2018	✓
EK026SF: Total CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH (EK026SF)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**17-Jun-2018**	20-Jun-2018	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
RB117,	FB117	**06-Jun-2018**	**----**	----	----	**14-Jun-2018**	04-Jul-2018	✓
EP066: Polychlorinated Biphenyls (PCB)								
Amber Glass Bottle - Unpreserved (EP066)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
EP074A: Monocyclic Aromatic Hydrocarbons								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP074E: Halogenated Aliphatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓
EP074F: Halogenated Aromatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓
EP074G: Trihalomethanes								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
EP075A: Phenolic Compounds (Halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
EP075A: Phenolic Compounds (Non-halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
EP075I: Organochlorine Pesticides								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
TB117, FB117	RB117,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber Glass Bottle - Unpreserved (EP071)								
RB117,	FB117	**06-Jun-2018**	**13-Jun-2018**	13-Jun-2018	✓	**14-Jun-2018**	23-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
TB117, FB117	RB117,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080)								
TB117, FB117	RB117,	**06-Jun-2018**	**13-Jun-2018**	20-Jun-2018	✓	**14-Jun-2018**	20-Jun-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / *Analytical Methods*	*Method*	*Count QC*	*Count Regular*	*Rate (%) Actual*	*Rate (%) Expected*	*Evaluation*	*Quality Control Specification*
Matrix Spikes (MS) - Continued							
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / *Analytical Methods*	*Method*	*Count QC*	*Count Regular*	*Rate (%) Actual*	*Rate (%) Expected*	*Evaluation*	*Quality Control Specification*
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	6	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	6	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	6	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	6	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	6	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	6	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	6	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	6	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons (2011) 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060A. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.
PCB - VIC EPA 448.3 Screen	EP066-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
TRH - Semivolatile Fraction	EP071-EM	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
Volatile Organic Compounds - Ultra-trace	EP074-UT	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS in partial SIM/Scan mode. Quantification is by comparison against an established multi-point calibration curves. This method is compliant with NEPM (2013) Schedule B(3) (Method 501)

Analytical Methods	Method	Matrix	Method Descriptions
Volatile Organic Compounds - Ultra-trace - Summations	EP074-UT-SUM	SOIL	Summation of MAHs and VHCs
Semivolatile Organic Compounds - Waste Classification	EP075-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
SVOC - Waste Classification (Sums)	EP075-EM-SUM	SOIL	Summations for EP075 (EM variation)
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium - Dissolved	EG050F	WATER	In house: Referenced to APHA 3500 Cr-B. Samples are 0.45µm filtered prior to analysis. Hexavalent chromium is determined on filtered water sample as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
Volatile Organic Compounds	EP074	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Semivolatile Organic Compounds - Waste Classification	EP075-EM	WATER	In house: Referenced to USEPA SW 846 - 8270B Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Higginson 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils - Ultra-trace.	ORG16-UT	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids - VIC EPA Screen	ORG17-EM	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Separatory Funnel Extraction of Liquids	ORG14-EM	WATER	In house: Referenced to USEPA SW 846 - 3510B. 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using dichloromethane. The resultant extracts are combined, dehydrated, concentrated and exchanged into toluene for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.

Preparation Methods	Method	Matrix	Method Descriptions
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

CERTIFICATE OF ANALYSIS

Work Order	: **EM1809532**	Page	: 1 of 24
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 14-Jun-2018 10:45
Order number	:	Date Analysis Commenced	: 19-Jun-2018
C-O-C number	: ----	Issue Date	: 25-Jun-2018 13:53
Sampler	: GHD		
Site	: North East Link		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 22		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Inorganics, Springvale, VIC
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- pH analysis is done under non-stirring condition.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID			NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-BH223_0.2m
	Client sampling date / time			13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-001	EM1809532-002	EM1809532-005	EM1809532-006	EM1809532-008
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.8**	**5.0**	**4.9**	**5.7**	**4.3**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**9.0**	**24.2**	**10.2**	**21.7**	**8.4**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	**7**	<5	**5**	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Copper	7440-50-8	5	mg/kg	**5**	**17**	<5	**18**	<5
Lead	7439-92-1	5	mg/kg	**18**	**15**	**8**	**16**	**7**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**4**	**17**	**4**	**23**	**4**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	**7**	**17**	**6**	**18**	**5**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.3**	**0.5**	<0.1	**0.3**	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	<1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**230**	**530**	**110**	**520**	**140**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-BH223_0.2m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-001	EM1809532-002	EM1809532-005	EM1809532-006	EM1809532-008
				Result	Result	Result	Result	Result
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-BH223_0.2m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-001	EM1809532-002	EM1809532-005	EM1809532-006	EM1809532-008
				Result	Result	Result	Result	Result
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	<1	<1	<1	<1
2-Methylphenol	95-48-7	1	mg/kg	<1	<1	<1	<1	<1
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	<5	<5	<5
4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	<5	<5	<5
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	<5	<5	<5
Dinoseb	88-85-7	5	mg/kg	<5	<5	<5	<5	<5
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	<5	<5	<5
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	<1	<1	<1	<1
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-BH223_0.2m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-001	EM1809532-002	EM1809532-005	EM1809532-006	EM1809532-008
				Result	Result	Result	Result	Result
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH161_0.2m	NEL-BH161_0.5m	NEL-BH224_0.2m	NEL-BH224_0.5m	NEL-BH223_0.2m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
				EM1809532-001	EM1809532-002	EM1809532-005	EM1809532-006	EM1809532-008
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	117	104	102	90.6	95.7
EP074S: VOC Surrogates (Ultra-Trace)								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	81.1	70.2	82.4	79.1	84.8
Toluene-D8	2037-26-5	0.1	%	76.3	63.3	78.5	69.0	76.4
4-Bromofluorobenzene	460-00-4	0.1	%	72.8	63.9	73.2	72.1	72.7
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.025	%	109	104	100	86.6	86.3
2-Chlorophenol-D4	93951-73-6	0.025	%	89.4	84.6	84.5	69.4	74.5
2.4.6-Tribromophenol	118-79-6	0.025	%	94.1	93.8	95.8	73.8	84.6
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.025	%	95.5	98.3	96.4	79.7	82.6
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	93.0	93.9	93.1	77.4	79.5
2-Fluorobiphenyl	321-60-8	0.025	%	100	102	102	86.2	89.5
Anthracene-d10	1719-06-8	0.025	%	106	110	106	93.9	95.4
4-Terphenyl-d14	1718-51-0	0.025	%	129	123	122	110	113

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH223_0.5m	NEL-BH163_0.2m	NEL-BH163_1.0m	NEL-BH164_0.2m	NEL-BH164_0.5m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-009	EM1809532-012	EM1809532-014	EM1809532-015	EM1809532-016
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.5**	**4.9**	**5.7**	**4.9**	**5.1**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**17.6**	**10.0**	**13.7**	**9.7**	**11.6**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**12**	**10**	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Copper	7440-50-8	5	mg/kg	**10**	**6**	**17**	<5	<5
Lead	7439-92-1	5	mg/kg	**26**	**16**	**24**	**8**	**9**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**15**	**13**	**30**	**3**	**4**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	**11**	**16**	**54**	**6**	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.3**	**0.2**	**0.1**	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	<1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**380**	**360**	**740**	**70**	**200**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH223_0.5m	NEL-BH163_0.2m	NEL-BH163_1.0m	NEL-BH164_0.2m	NEL-BH164_0.5m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-009	EM1809532-012	EM1809532-014	EM1809532-015	EM1809532-016
				Result	Result	Result	Result	Result
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH223_0.5m	NEL-BH163_0.2m	NEL-BH163_1.0m	NEL-BH164_0.2m	NEL-BH164_0.5m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-009	EM1809532-012	EM1809532-014	EM1809532-015	EM1809532-016
				Result	Result	Result	Result	Result
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	<1	<1	<1	<1
2-Methylphenol	95-48-7	1	mg/kg	<1	<1	<1	<1	<1
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	<5	<5	<5
4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	<5	<5	<5
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	<5	<5	<5
Dinoseb	88-85-7	5	mg/kg	<5	<5	<5	<5	<5
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	<5	<5	<5
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	<1	<1	<1	<1
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH223_0.5m	NEL-BH163_0.2m	NEL-BH163_1.0m	NEL-BH164_0.2m	NEL-BH164_0.5m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-009	EM1809532-012	EM1809532-014	EM1809532-015	EM1809532-016
				Result	Result	Result	Result	Result
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH223_0.5m	NEL-BH163_0.2m	NEL-BH163_1.0m	NEL-BH164_0.2m	NEL-BH164_0.5m
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809532-009	EM1809532-012	EM1809532-014	EM1809532-015	EM1809532-016
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	106	98.3	99.9	107	105
EP074S: VOC Surrogates (Ultra-Trace)								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	77.0	79.1	82.0	81.1	78.9
Toluene-D8	2037-26-5	0.1	%	72.8	70.6	75.3	76.1	67.4
4-Bromofluorobenzene	460-00-4	0.1	%	68.8	71.2	70.4	71.2	69.5
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.025	%	104	94.1	90.6	102	110
2-Chlorophenol-D4	93951-73-6	0.025	%	90.8	77.6	72.6	84.7	89.8
2.4.6-Tribromophenol	118-79-6	0.025	%	99.7	77.8	70.6	98.0	91.3
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.025	%	99.2	86.2	84.3	97.1	104
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	95.7	82.6	81.2	93.1	98.4
2-Fluorobiphenyl	321-60-8	0.025	%	97.9	90.2	90.1	105	105
Anthracene-d10	1719-06-8	0.025	%	110	96.7	99.7	107	111
4-Terphenyl-d14	1718-51-0	0.025	%	123	113	117	121	123

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	QC1005	----	----	----	----
			Client sampling date / time	13-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809532-019	--------	--------	--------	--------
				Result	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.9**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**11.8**	----	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Copper	7440-50-8	5	mg/kg	**5**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**13**	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Nickel	7440-02-0	2	mg/kg	**9**	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Silver	7440-22-4	2	mg/kg	<2	----	----	----	----
Tin	7440-31-5	5	mg/kg	<5	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**12**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**320**	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	----
Styrene	100-42-5	0.5	mg/kg	<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	----
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	----	----	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	QC1005	----	----	----	----
			Client sampling date / time	13-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809532-019	--------	--------	--------	--------
				Result	----	----	----	----
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	----
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	----	----	----	----
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	----	----	----	----
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	----	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	----	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	----	----	----	----
Chloroform	67-66-3	0.02	mg/kg	<0.02	----	----	----	----
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	----	----	----	----
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	----	----	----	----
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	----	----	----	----
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	----	----	----	----
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	----	----	----	----
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	----	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	----	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	----	----	----	----
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	----	----	----	----
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	----	----	----	----
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	----	----	----	----
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	----	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	----	----	----	----
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	----	----	----	----
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	----	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	----	----	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	----	----	----	----
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	QC1005	----	----	----	----
			Client sampling date / time	13-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809532-019	--------	--------	--------	--------
				Result	----	----	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	----	----	----	----
2-Methylphenol	95-48-7	1	mg/kg	<1	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	1	mg/kg	<1	----	----	----	----
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	----	----	----	----
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	----	----	----	----
4-Nitrophenol	100-02-7	5	mg/kg	<5	----	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	----	----	----	----
Dinoseb	88-85-7	5	mg/kg	<5	----	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	----	----	----	----
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	----	----	----	----
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	QC1005	----	----	----	----
			Client sampling date / time	13-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809532-019	--------	--------	--------	--------
				Result	----	----	----	----
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	----	----	----	----
beta-BHC	319-85-7	0.03	mg/kg	<0.03	----	----	----	----
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	----	----	----	----
delta-BHC	319-86-8	0.03	mg/kg	<0.03	----	----	----	----
Heptachlor	76-44-8	0.03	mg/kg	<0.03	----	----	----	----
Aldrin	309-00-2	0.03	mg/kg	<0.03	----	----	----	----
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	----	----	----	----
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	----	----	----	----
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	----	----	----	----
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.03	mg/kg	<0.03	----	----	----	----
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	----	----	----	----
Endrin	72-20-8	0.03	mg/kg	<0.03	----	----	----	----
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	----	----
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	QC1005	----	----	----	----
			Client sampling date / time	13-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809532-019	--------	--------	--------	--------
				Result	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**104**	----	----	----	----
EP074S: VOC Surrogates (Ultra-Trace)								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**82.2**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%	**78.4**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**73.1**	----	----	----	----
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.025	%	**92.2**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.025	%	**84.8**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.025	%	**77.9**	----	----	----	----
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.025	%	**90.8**	----	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	**87.7**	----	----	----	----
2-Fluorobiphenyl	321-60-8	0.025	%	**92.9**	----	----	----	----
Anthracene-d10	1719-06-8	0.025	%	**105**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.025	%	**123**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	FB119	RB119	TB119	----	----
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809532-020	EM1809532-021	EM1809532-022	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.38**	**8.14**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG050F: Dissolved Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Styrene	100-42-5	5	µg/L	<5	<5	----	----	----
EP074E: Halogenated Aliphatic Compounds								
Vinyl chloride	75-01-4	50	µg/L	<50	<50	----	----	----
1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	----	----	----
Methylene chloride	75-09-2	5	µg/L	<5	<5	----	----	----
trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	----	----	----
cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	----	----	----
1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	----	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	----	----	----
1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	----	----	----
Trichloroethene	79-01-6	5	µg/L	<5	<5	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	FB119	RB119	TB119	----	----
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809532-020	EM1809532-021	EM1809532-022	--------	--------
				Result	Result	Result	----	----
EP074E: Halogenated Aliphatic Compounds - Continued								
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	----	----	----
Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	----	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	----	----	----
1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	----	----	----
1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	----	----	----
1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	----	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	<5	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	2	µg/L	<2	<2	----	----	----
2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	FB119	RB119	TB119	----	----
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809532-020	EM1809532-021	EM1809532-022	--------	--------
				Result	Result	Result	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	----	----	----
4-Chloro-3-methylphenol	59-50-7	4	µg/L	<4	<4	----	----	----
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	----	----	----
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	<2	<2	----	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	2	µg/L	<2	<2	----	----	----
Pentachlorophenol	87-86-5	2	µg/L	<2	<2	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	4	µg/L	<4	<4	----	----	----
2-Methylphenol	95-48-7	4	µg/L	<4	<4	----	----	----
3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	----	----	----
2-Nitrophenol	88-75-5	4	µg/L	<4	<4	----	----	----
2.4-Dimethylphenol	105-67-9	4	µg/L	<4	<4	----	----	----
2.4-Dinitrophenol	51-28-5	100	µg/L	<100	<100	----	----	----
4-Nitrophenol	100-02-7	50	µg/L	<50	<50	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	<50	<50	----	----	----
Dinoseb	88-85-7	50	µg/L	<50	<50	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	<50	<50	----	----	----
EP075I: Organochlorine Pesticides								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	----	----	----
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	----	----	----
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	----	----	----
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDT	50-29-3	0.5	µg/L	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	FB119	RB119	TB119	----	----
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809532-020	EM1809532-021	EM1809532-022	--------	--------
				Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	**84.5**	**105**	----	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	5	%	**91.4**	**86.2**	----	----	----
Toluene-D8	2037-26-5	5	%	**91.6**	**80.2**	----	----	----
4-Bromofluorobenzene	460-00-4	5	%	**102**	**94.5**	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**26.4**	**27.5**	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**60.6**	**59.9**	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**60.7**	**66.8**	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**70.4**	**71.3**	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**78.1**	**87.3**	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**84.1**	**103**	----	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	FB119	RB119	TB119	----	----
			Client sampling date / time	13-Jun-2018 00:00	13-Jun-2018 00:00	13-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809532-020	EM1809532-021	EM1809532-022	--------	--------
				Result	Result	Result	----	----
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.25	%	25.3	21.9	----	----	----
2-Chlorophenol-D4	93951-73-6	0.25	%	64.8	57.8	----	----	----
2.4.6-Tribromophenol	118-79-6	0.25	%	65.0	65.4	----	----	----
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.25	%	60.7	53.5	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.25	%	67.1	60.7	----	----	----
2-Fluorobiphenyl	321-60-8	0.25	%	71.3	62.0	----	----	----
Anthracene-d10	1719-06-8	0.25	%	67.8	70.0	----	----	----
4-Terphenyl-d14	1718-51-0	0.25	%	93.6	87.5	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	88.1	82.9	89.9	----	----
Toluene-D8	2037-26-5	2	%	81.0	70.9	77.0	----	----
4-Bromofluorobenzene	460-00-4	2	%	102	96.4	101	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	122
EP074S: VOC Surrogates (Ultra-Trace)			
1.2-Dichloroethane-D4	17060-07-0	59	119
Toluene-D8	2037-26-5	55	117
4-Bromofluorobenzene	460-00-4	59	123
EP075S: Acid Extractable Surrogates (Waste Classification)			
Phenol-d6	13127-88-3	28	134
2-Chlorophenol-D4	93951-73-6	27	123
2.4.6-Tribromophenol	118-79-6	25	149
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)			
Nitrobenzene-D5	4165-60-0	29	125
1.2-Dichlorobenzene-D4	2199-69-1	31	117
2-Fluorobiphenyl	321-60-8	44	136
Anthracene-d10	1719-06-8	53	133
4-Terphenyl-d14	1718-51-0	59	141

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	125
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	77	132
4-Bromofluorobenzene	460-00-4	67	131
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	46
2-Chlorophenol-D4	93951-73-6	23	104
2.4.6-Tribromophenol	118-79-6	28	130
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	36	114
Anthracene-d10	1719-06-8	51	119
4-Terphenyl-d14	1718-51-0	49	127
EP075S: Acid Extractable Surrogates (Waste Classification)			
Phenol-d6	13127-88-3	13	90
2-Chlorophenol-D4	93951-73-6	42	117
2.4.6-Tribromophenol	118-79-6	52	140
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)			
Nitrobenzene-D5	4165-60-0	49	136

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075T: Base/Neutral Extractable Surrogates (Waste Classification) - Continued			
1.2-Dichlorobenzene-D4	2199-69-1	49	128
2-Fluorobiphenyl	321-60-8	57	137
Anthracene-d10	1719-06-8	67	137
4-Terphenyl-d14	1718-51-0	66	136
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	129
Toluene-D8	2037-26-5	70	125
4-Bromofluorobenzene	460-00-4	71	129

CHAIN OF CUSTODY RECORD

GHD

GHD Melbourne
180 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111

Job Number 31/35006/0910	**GHD Office** Melbourne	**Laboratory:** ALS Springvale
Project North East Link - Contamination		**Address:** 2 - 4 Westall Rd, Springavale
GHD Contact David Quinn	**Contact Email** David.Quinn@ghd.com	**Lab Contact:** Shirley LeCornu
Standard TAT	**Quote No./GHD Reference** ME/124/18	

PLEASE NOTE:
Sign white copy on receipt and release of samples.
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact to sign white copy** and fax/email to GHD Contact.
On completion of analyses please **return white copy with results.**
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results to the GHD Contact with the GHD Job Number in the e-mail subject line.

Results to be provided in ESDAT compatibile format

	Sample I.D.	Date	Time	Composite Sample	Sample Matrix S: Soil SL: Sludge W: Water A: Air GW: Groundwater	Preservative	Container Type J: soil jar B: bag V: vial G: glass bottle P: plastic bottle	Number	Volume (mL)	HOLD	Remarks
1	NEL-BH161_0.2m	13/6/18	AM	/	S	/	J	1	250	X	
2	NEL-BH161_0.5m	"	"	/	S	/	J	1	250	X	
3	NEL-BH161_1.0m	"	"	/	S	/	J	1	250	X	
4	NEL-BH161_1.5m	"	"	/	S	/	J	1	250	X	
5	NEL-BH224_0.2m	"	"	/	S	/	J	1	250	X	
6	NEL-BH224_0.5m	"	"	/	S	/	J	1	250	X	
7	NEL-BH224_1.0m	"	"	/	S	/	J	1	250	X	
8	NEL-BH223_0.2m	"	"	/	S	/	J	1	250	X	
9	NEL-BH223_0.5m	"	"	/	S	/	J	1	250	X	
10	NEL-BH223_1.0m	"	"	/	S	/	J	1	250	X	
11	NEL-BH223_1.5m	"	"	/	S	/	J	1	250	X	
12	NEL-BH163_0.2m	"	"	/	S	/	J	1	250	X	
13	NEL-BH163_0.5m	"	"	/	S	/	J	1	250	X	
14	NEL-BH163_1.0m	"	"	/	S	/	J	1	250	X	
15	NEL-BH164_0.2m	"	"	/	S	/	J	1	250	X	
16	NEL-BH164_0.5m	"	"	/	S	/	J	1	250	X	
17	NEL-BH164_1.0m	"	"	/	S	/	J	1	250	X	
18	NEL-BH164_1.5m	"	"	/	S	/	J	1	250	X	
19	QC100S	"	"	/	S	/	J	1	250	X	
→ 20	QC200S	"	"	/	S	/	J	1	250	X	To BE SENT TO EUROFINS

Environmental Division
Melbourne
Work Order Reference
EM1809532
Telephone : + 61-3-8549 9600

Sampled by:	GHD	**Date/Time:**	13/6/18 Am	**Relinquished by:**	M. Lo Monaco	**Date/Time:**	13/6/18 Pm
Received by:	Core shed fridge	**Date/Time:**	13/6/18 Pm	**Relinquished by:**	Core shed fridge	**Date/Time:**	14/6/18 Am
Received by Courier:		**Date/Time:**		**Relinquished by:**		**Date/Time:**	
Received by Lab:	[signature]	**Date/Time:**	14/6, 10.45				
Remarks:	Please CC reports and correspondence to Mark Davidson (mark.s.davidson@aecom.com) & Nazuha Rosti (nazuha.rosli@aecom.com)						

CHAIN OF CUSTODY RECORD

GHD

GHD Melbourne
180 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111

Job Number 31/35006/0910	**GHD Office** Melbourne	**Laboratory:** ALS Springvale
Project North East Link - Contamination		**Address:** 2 - 4 Westall Rd, Springavale
GHD Contact David Quinn	**Contact Email** David.Quinn@ghd.com	**Lab Contact:** Shirley LeCornu
Standard TAT	**Quote No./GHD Reference** ME/124/18	

PLEASE NOTE:
Sign white copy on receipt and release of samples.
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact to sign white copy** and fax/email to GHD Contact.
On completion of analyses please **return white copy with results.**
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results to the GHD Contact with the GHD Job Number in the e-mail subject line.

Results to be provided in ESDAT compatibile format

	Sample I.D.	Date	Time	Composite Sample	Sample Matrix S: Soil, SL: Sludge W: Water A: Air GW: Groundwater	Preservative	Container Type J: soil jar B: bag V: vial G: glass bottle P: plastic bottle	Container Number	Container Volume (mL)	Analyses Required: HOLD												Remarks
20	FB119	13/6/18	AM	/	W	/	V/G/P	8	/	X												
21	RB119	〃	〃	/	W	/	V/G/P	8	/	X												
22	TB119	〃	〃	/	W	/	V/G/P	1	/	X												

Sampled by:	SEE PREVIOUS PAGE	**Date/Time:**		**Relinquished by:**		**Date/Time:**	
Received by:		**Date/Time:**		**Relinquished by:**		**Date/Time:**	
Received by Courier:		**Date/Time:**		**Relinquished by:**		**Date/Time:**	
Received by Lab:		**Date/Time:**					
Remarks:	Please CC reports and correspondence to Mark Davidson (mark.s.davidson@aecom.com) & Nazuha Rosli (nazuha.rosli@aecom.com)						

Mark (ALS) 14/6 10:45

Shirley LeCornu

From: David Quinn <David.Quinn@ghd.com>
Sent: Monday, 18 June 2018 10:04 AM
To: Shirley LeCornu
Cc: Kory.Auch@ghd.com; Mark Clough
Subject: RE: ON HOLD - EM1809532 - GHDSER North East Link

Hi Shirley

Please analyse the following at standard TAT:

NEL-BH161_0.2m = IWRG621
NEL-BH161_0.5m = IWRG621

NEL-BH224_0.2m = IWRG621
NEL-BH224_0.5m = IWRG621

NEL-BH223_0.2m = IWRG621
NEL-BH223_0.5m = IWRG621

NEL-BH163_0.2m = IWRG621
NEL-BH163_1.0m = IWRG621

NEL-BH164_0.2m = IWRG621
NEL-BH164_0.5m = IWRG621

QC1005 = IWRG621
QC2005 = IWRG621 (send to Eurofins)

RB115 = IWRG621 water equivalent
TB115 = Volatile TPH/BTEX
FB115 = IWRG621 water equivalent

Thanks

David Quinn
Senior Environmental Engineer
Waste Management & Environmental Compliance

GHD
Proudly employee owned
T: +61 3 8687 8627 | M: +61 437 227 626| V: 318 627 | E: david.quinn@ghd.com
Level 18, 180 Lonsdale Street Melbourne VIC 3000 | www.ghd.com

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM1809532**

Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: david.quinn@ghd.com	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: ----	Telephone	: +61-3-8549 9630
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: 31350060910	Page	: 1 of 4
Order number	:	Quote number	: EM2018GHDSER0003 (ME/124/18 - North East Link)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: North East Link		
Sampler	: GHD		

Dates

Date Samples Received	: 14-Jun-2018 10:45	Issue Date	: 19-Jun-2018
Client Requested Due Date	: 25-Jun-2018	Scheduled Reporting Date	: **25-Jun-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 2	Temperature	: 2.2°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 22 / 14

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method Client sample ID	Sample Container Received	Preferred Sample Container for Analysis
Dissolved Mercury by FIMS : EG035F		
FB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
RB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite A : EG020A-F		
FB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
RB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite B : EG020B-F		
FB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
RB119	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	(On Hold) SOIL No analysis requested	SOIL - EA055-103 Moisture Content	SOIL - P-16 IWRG 621
EM1809532-001	13-Jun-2018 00:00	NEL-BH161_0.2m		✓	✓
EM1809532-002	13-Jun-2018 00:00	NEL-BH161_0.5m		✓	✓
EM1809532-003	13-Jun-2018 00:00	NEL-BH161_1.0m	✓		
EM1809532-004	13-Jun-2018 00:00	NEL-BH161_1.5m	✓		
EM1809532-005	13-Jun-2018 00:00	NEL-BH224_0.2m		✓	✓
EM1809532-006	13-Jun-2018 00:00	NEL-BH224_0.5m		✓	✓
EM1809532-007	13-Jun-2018 00:00	NEL-BH224_1.0m	✓		
EM1809532-008	13-Jun-2018 00:00	NEL-BH223_0.2m		✓	✓
EM1809532-009	13-Jun-2018 00:00	NEL-BH223_0.5m		✓	✓
EM1809532-010	13-Jun-2018 00:00	NEL-BH223_1.0m	✓		
EM1809532-011	13-Jun-2018 00:00	NEL-BH223_1.5m	✓		
EM1809532-012	13-Jun-2018 00:00	NEL-BH163_0.2m		✓	✓
EM1809532-013	13-Jun-2018 00:00	NEL-BH163_0.5m	✓		
EM1809532-014	13-Jun-2018 00:00	NEL-BH163_1.0m		✓	✓
EM1809532-015	13-Jun-2018 00:00	NEL-BH164_0.2m		✓	✓
EM1809532-016	13-Jun-2018 00:00	NEL-BH164_0.5m		✓	✓
EM1809532-017	13-Jun-2018 00:00	NEL-BH164_1.0m	✓		
EM1809532-018	13-Jun-2018 00:00	NEL-BH164_1.5m	✓		
EM1809532-019	13-Jun-2018 00:00	QC1005		✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - 448.3 Water VIC EPA IWRG621 - Water Equivalent Suite	WATER - W-18 TRH(C6 - C9)/BTEXN
EM1809532-020	13-Jun-2018 00:00	FB119	✓	
EM1809532-021	13-Jun-2018 00:00	RB119	✓	
EM1809532-022	13-Jun-2018 00:00	TB119		✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA005-P: pH by PC Titrator							
FB119	Clear Plastic Bottle - Natural	----	13-Jun-2018	14-Jun-2018	×	18-Jun-2018	×
RB119	Clear Plastic Bottle - Natural	----	13-Jun-2018	14-Jun-2018	×	18-Jun-2018	×

Requested Deliverables

ALL ACCOUNTS		
- A4 - AU Tax Invoice (INV)	Email	ap-fss@ghd.com
DAVID QUINN		
- *AU Certificate of Analysis - NATA (COA)	Email	david.quinn@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	david.quinn@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	david.quinn@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	david.quinn@ghd.com
- A4 - AU Tax Invoice (INV)	Email	david.quinn@ghd.com
- Chain of Custody (CoC) (COC)	Email	david.quinn@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	david.quinn@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	david.quinn@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	david.quinn@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	david.quinn@ghd.com
GHD LAB REPORTS		
- *AU Certificate of Analysis - NATA (COA)	Email	GHDLabreports@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	GHDLabreports@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	GHDLabreports@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	GHDLabreports@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	GHDLabreports@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	GHDLabreports@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	GHDLabreports@ghd.com
KORY AUCH		
- *AU Certificate of Analysis - NATA (COA)	Email	kory.auch@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	kory.auch@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	kory.auch@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	kory.auch@ghd.com
- Chain of Custody (CoC) (COC)	Email	kory.auch@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	kory.auch@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	kory.auch@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	kory.auch@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	kory.auch@ghd.com
MARK CLOUGH		
- *AU Certificate of Analysis - NATA (COA)	Email	mark.clough@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mark.clough@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mark.clough@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mark.clough@ghd.com
- Chain of Custody (CoC) (COC)	Email	mark.clough@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	mark.clough@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	mark.clough@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	mark.clough@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	mark.clough@ghd.com

QUALITY CONTROL REPORT

Work Order	: **EM1809532**		
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 14-Jun-2018
Order number	:	Date Analysis Commenced	: 19-Jun-2018
C-O-C number	: ----	Issue Date	: 25-Jun-2018
Sampler	: GHD		
Site	: North East Link		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 22		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Inorganics, Springvale, VIC
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 1736394)									
EM1809532-001	NEL-BH161_0.2m	EA001: pH (CaCl2)	----	0.1	pH Unit	4.8	4.8	0.00	0% - 20%
EM1809532-016	NEL-BH164_0.5m	EA001: pH (CaCl2)	----	0.1	pH Unit	5.1	5.1	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1737141)									
EM1809532-001	NEL-BH161_0.2m	EA055: Moisture Content	----	0.1	%	9.0	9.0	0.00	No Limit
EM1809532-019	QC1005	EA055: Moisture Content	----	0.1	%	11.8	13.6	14.6	0% - 50%
EG005T: Total Metals by ICP-AES (QC Lot: 1736229)									
EM1809532-001	NEL-BH161_0.2m	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	4	5	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	5	5	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	18	20	9.74	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	7	9	26.1	No Limit
EM1809532-016	NEL-BH164_0.5m	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	4	5	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	9	10	0.00	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG005T: Total Metals by ICP-AES (QC Lot: 1736229) - continued									
EM1809532-016	NEL-BH164_0.5m	EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	<5	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1736228)									
EM1809532-001	NEL-BH161_0.2m	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.3	0.4	0.00	No Limit
EM1809532-016	NEL-BH164_0.5m	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 1739951)									
EM1809532-001	NEL-BH161_0.2m	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809532-016	NEL-BH164_0.5m	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1740462)									
EM1809532-001	NEL-BH161_0.2m	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1809532-016	NEL-BH164_0.5m	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EK040T: Fluoride Total (QC Lot: 1736452)									
EM1809532-001	NEL-BH161_0.2m	EK040T: Fluoride	16984-48-8	40	mg/kg	230	220	0.00	No Limit
EM1809532-016	NEL-BH164_0.5m	EK040T: Fluoride	16984-48-8	40	mg/kg	200	200	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 1737552)									
EM1809532-001	NEL-BH161_0.2m	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1809532-019	QC1005	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1736311)									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809532-019	QC1005	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP074H: Naphthalene (QC Lot: 1736311)									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EM1809532-019	QC1005	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP074I: Volatile Halogenated Compounds (QC Lot: 1736311)									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP074I: Volatile Halogenated Compounds (QC Lot: 1736311) - continued									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	0.00	No Limit
EM1809532-019	QC1005	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	0.00	No Limit
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1737550)									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1737550) - continued									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EM1809532-019	QC1005	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075A: Phenolic Compounds (Non-halogenated) (QC Lot: 1737550)									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EM1809532-019	QC1005	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1737550)									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1737550) - continued									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809532-019	QC1005	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP075I: Organochlorine Pesticides (QC Lot: 1737550)									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075I: Organochlorine Pesticides (QC Lot: 1737550) - continued									
EM1809532-001	NEL-BH161_0.2m	EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EM1809532-019	QC1005	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1736311)									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EM1809532-019	QC1005	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1737551)									
EM1809532-001	NEL-BH161_0.2m	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EM1809532-019	QC1005	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1737551) - continued									
EM1809532-019	QC1005	EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1736311)									
EM1809532-001	NEL-BH161_0.2m	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	0.00	No Limit
EM1809532-019	QC1005	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1737551)									
EM1809532-001	NEL-BH161_0.2m	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EM1809532-019	QC1005	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit

Laboratory Duplicate (DUP) Report

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005P: pH by PC Titrator (QC Lot: 1739037)									
EM1809433-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.57	6.55	0.305	0% - 20%
EM1809676-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.02	8.06	0.498	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739113)									
EM1809762-003	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	0.001	<0.001	0.00	No Limit
EM1809532-020	FB119	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739115)									
EM1809635-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.007	0.008	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.050	0.050	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809532-020	FB119	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739115) - continued									
EM1809532-020	FB119	EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1739114)									
EM1809635-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1809532-020	FB119	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG050F: Dissolved Hexavalent Chromium (QC Lot: 1737214)									
EM1809532-020	FB119	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809603-033	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1742808)									
EM1809532-020	FB119	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EM1809693-030	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1739039)									
EM1809433-002	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EM1809676-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.6	0.6	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1738890)									
EM1809532-020	FB119	EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.00	No Limit
EP074E: Halogenated Aliphatic Compounds (QC Lot: 1738890)									
EM1809532-020	FB119	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: Methylene chloride	75-09-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	0.00	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.00	No Limit
EP074F: Halogenated Aromatic Compounds (QC Lot: 1738890)									
EM1809532-020	FB119	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	0.00	No Limit
EP074G: Trihalomethanes (QC Lot: 1738890)									
EM1809532-020	FB119	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1738889)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1738889) - continued									
EM1809693-031	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EM1809532-020	FB119	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1738889)									
EM1809693-031	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EM1809532-020	FB119	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 1738889)									
EM1809693-031	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EM1809532-020	FB119	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 1736229)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	90.4	79	113
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	94.4	85	109
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	85.9	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	83.5	78	106
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	103	86	112
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	91.0	82	111
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	101	93	109
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	95.2	80	108
EG005T: Tin	7440-31-5	5	mg/kg	<5	5.2 mg/kg	104	88	116
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	95.8	82	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1736228)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	94.1	77	104
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1739951)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	102	75	112
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1740462)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	91.3	80	110
EK040T: Fluoride Total (QCLot: 1736452)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	96.0	77	106
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1737552)								
EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	96.4	63	118
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1736311)								
EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	2.1 mg/kg	82.0	74	118
EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	2.1 mg/kg	84.2	70	124
EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2.1 mg/kg	82.0	71	122
EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4.2 mg/kg	81.9	70	118
EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	2.1 mg/kg	82.9	76	116
EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2.1 mg/kg	80.8	74	114
EP074H: Naphthalene (QCLot: 1736311)								
EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	0.6 mg/kg	80.1	77	111
EP074I: Volatile Halogenated Compounds (QCLot: 1736311)								
EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	0.1 mg/kg	93.5	49	133
EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	0.1 mg/kg	82.6	62	127

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP074I: Volatile Halogenated Compounds (QCLot: 1736311) - continued								
EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	2.1 mg/kg	82.5	68	107
EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	0.1 mg/kg	79.9	68	124
EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	0.1 mg/kg	82.8	74	118
EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	0.1 mg/kg	82.2	72	118
EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	0.1 mg/kg	89.2	67	119
EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	0.1 mg/kg	83.4	65	119
EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	0.1 mg/kg	90.8	73	120
EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	0.1 mg/kg	83.8	72	124
EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	0.1 mg/kg	86.8	74	122
EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	0.1 mg/kg	80.4	64	124
EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	0.1 mg/kg	91.8	70	119
EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	0.1 mg/kg	85.9	71	125
EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	0.1 mg/kg	84.0	61	125
EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	0.1 mg/kg	82.9	73	117
EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	0.1 mg/kg	85.6	69	118
EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	0.1 mg/kg	84.6	75	114
EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	0.1 mg/kg	81.3	59	124
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1737550)								
EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	2 mg/kg	101	54	122
EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	2 mg/kg	88.4	58	131
EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	2 mg/kg	92.7	55	118
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	2 mg/kg	84.0	62	129
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	2 mg/kg	91.7	53	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	2 mg/kg	81.6	60	126
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	2 mg/kg	86.5	56	118
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	0.05	mg/kg	<0.05	4 mg/kg	84.8	54	125
EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	4 mg/kg	70.0	52	124
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1737550)								
EP075-EM: Phenol	108-95-2	1	mg/kg	<1	2 mg/kg	90.6	56	120
EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	2 mg/kg	96.7	52	131
EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	4 mg/kg	94.0	59	132
EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	2 mg/kg	87.8	53	130
EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	2 mg/kg	100	43	120
EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	12 mg/kg	96.2	23	125
EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	12 mg/kg	114	59	133
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	12 mg/kg	82.0	47	125
EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	12 mg/kg	96.1	51	123
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	10 mg/kg	79.4	12	132

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1737550)								
EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	2 mg/kg	94.0	58	121
EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	2 mg/kg	99.1	55	126
EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	2 mg/kg	99.6	59	120
EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	2 mg/kg	97.0	64	122
EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	2 mg/kg	95.6	70	128
EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	2 mg/kg	65.6	55	127
EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	2 mg/kg	99.7	68	134
EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	2 mg/kg	99.2	69	131
EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	2 mg/kg	95.7	65	133
EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	2 mg/kg	107	68	134
EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	4 mg/kg	106	64	134
EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	2 mg/kg	99.7	62	132
EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	2 mg/kg	105	55	137
EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	2 mg/kg	105	54	136
EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	2 mg/kg	100	55	137
EP075I: Organochlorine Pesticides (QCLot: 1737550)								
EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	2 mg/kg	95.6	68	122
EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	2 mg/kg	96.0	65	122
EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	2 mg/kg	95.1	62	133
EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	2 mg/kg	98.3	68	126
EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	2 mg/kg	96.6	68	133
EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	2 mg/kg	93.1	62	128
EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	2 mg/kg	96.3	66	128
EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	2 mg/kg	99.3	62	133
EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	2 mg/kg	105	62	132
EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	2 mg/kg	101	61	133
EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	2 mg/kg	99.8	63	136
EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	2 mg/kg	102	57	131
EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	2 mg/kg	102	65	137
EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	2 mg/kg	116	24	174
EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	2 mg/kg	88.6	55	148
EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	2 mg/kg	104	66	135
EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	2 mg/kg	108	66	134
EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	2 mg/kg	106	63	139
EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	2 mg/kg	99.2	59	134
EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	2 mg/kg	99.2	61	136
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1736311)								
EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	39.6 mg/kg	74.1	69	114

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1737551)								
EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	806 mg/kg	95.2	73	134
EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	3006 mg/kg	112	81	112
EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	1584 mg/kg	103	77	116
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1736311)								
EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	48.9 mg/kg	73.7	69	112
EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1737551)								
EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	1160 mg/kg	99.9	77	127
EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	3978 mg/kg	109	79	113
EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	313 mg/kg	90.0	68	124

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739113)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	94.8	84	116
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739115)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	102	91	107
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.4	84	104
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.0	82	103
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.1	83	105
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	96.5	83	109
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	100.0	82	106
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	101	82	109
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	101	83	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	104	85	109
EG035F: Dissolved Mercury by FIMS (QCLot: 1739114)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	95.1	81	114
EG050F: Dissolved Hexavalent Chromium (QCLot: 1737214)								
EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	0.5 mg/L	105	90	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1742808)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	93.3	80	110
EK040P: Fluoride by PC Titrator (QCLot: 1739039)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	106	85	112
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1736958)								
EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1	10 µg/L	83.8	54	132
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1738890)								

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1738890) - continued								
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	104	79	114
EP074E: Halogenated Aliphatic Compounds (QCLot: 1738890)								
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	94.5	64	139
EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	92.6	65	124
EP074: Methylene chloride	75-09-2	5	µg/L	<5	20 µg/L	98.0	81	144
EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	98.4	73	121
EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	102	78	120
EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	93.5	68	116
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	88.4	66	119
EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	106	79	118
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	98.8	70	120
EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	105	87	114
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	93.9	75	119
EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	98.0	75	112
EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	103	81	125
EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	20 µg/L	103	63	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1738890)								
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	102	82	114
EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	20 µg/L	102	76	118
EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	20 µg/L	101	82	112
EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	20 µg/L	104	62	119
EP074G: Trihalomethanes (QCLot: 1738890)								
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	104	79	119
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1736959)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	66.9	48	110
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	68.6	49	124
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	70.6	53	117
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	73.8	54	118
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	73.9	57	119
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	88.3	51	113
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	77.2	59	123
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	75.2	58	123
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	71.0	52	126
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	74.7	55	123
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	86.7	52	131
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	89.4	57	126
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	91.4	56	126

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1736959) - continued								
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	78.5	53	123
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	76.9	53	125
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	78.8	53	125
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1736962)								
EP075-EM: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	79.4	44	114
EP075-EM: 2.4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	86.1	53	121
EP075-EM: 2.6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	88.2	55	119
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	4	µg/L	<4	10 µg/L	77.9	57	116
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	89.0	51	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	79.6	56	120
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	<2	10 µg/L	90.1	41	125
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	2	µg/L	<2	20 µg/L	91.7	47	125
EP075-EM: Pentachlorophenol	87-86-5	2	µg/L	<2	20 µg/L	83.2	22	122
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1736962)								
EP075-EM: Phenol	108-95-2	4	µg/L	<4	10 µg/L	29.3	20	57
EP075-EM: 2-Methylphenol	95-48-7	4	µg/L	<4	10 µg/L	79.7	49	107
EP075-EM: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	20 µg/L	70.6	48	101
EP075-EM: 2-Nitrophenol	88-75-5	4	µg/L	<4	10 µg/L	87.9	53	123
EP075-EM: 2.4-Dimethylphenol	105-67-9	4	µg/L	<4	10 µg/L	104	52	128
EP075-EM: 2.4-Dinitrophenol	51-28-5	100	µg/L	<100	60 µg/L	118	21	130
EP075-EM: 4-Nitrophenol	100-02-7	50	µg/L	<50	60 µg/L	26.7	13	60
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	<50	60 µg/L	75.6	56	126
EP075-EM: Dinoseb	88-85-7	50	µg/L	<50	60 µg/L	86.7	55	128
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	<50	50 µg/L	120	32	135
EP075I: Organochlorine Pesticides (QCLot: 1736962)								
EP075-EM: alpha-BHC	319-84-6	0.5	µg/L	<0.5	10 µg/L	91.8	59	126
EP075-EM: Heptachlor	76-44-8	0.5	µg/L	<0.5	10 µg/L	91.1	59	131
EP075-EM: Aldrin	309-00-2	0.5	µg/L	<0.5	10 µg/L	89.8	59	133
EP075-EM: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	10 µg/L	89.9	61	133
EP075-EM: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	10 µg/L	90.8	60	132
EP075-EM: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	10 µg/L	96.8	56	130
EP075-EM: Dieldrin	60-57-1	0.5	µg/L	<0.5	10 µg/L	91.3	59	130
EP075-EM: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	10 µg/L	88.4	62	136
EP075-EM: 4.4`-DDT	50-29-3	0.5	µg/L	<0.5	10 µg/L	92.7	57	128
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1736960)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	4331 µg/L	76.1	58	134
EP071: C15 - C28 Fraction	----	100	µg/L	<100	16952 µg/L	82.9	60	133

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1736960) - continued								
EP071: C29 - C36 Fraction	----	50	µg/L	<50	8695 µg/L	81.9	54	137
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1738889)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	82.4	68	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1736960)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	6292 µg/L	76.4	58	122
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	22143 µg/L	81.3	56	132
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1677 µg/L	82.6	58	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1738889)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	81.3	66	123
EP080: BTEXN (QCLot: 1738889)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	86.9	74	123
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	98.4	77	128
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	95.9	73	126
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	91.3	72	131
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	89.6	74	131
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	96.1	74	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1736229)							
EM1809532-002	NEL-BH161_0.5m	EG005T: Arsenic	7440-38-2	50 mg/kg	101	78	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	97.8	84	116
		EG005T: Copper	7440-50-8	50 mg/kg	103	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	96.9	76	124
		EG005T: Molybdenum	7439-98-7	50 mg/kg	98.6	79	117
		EG005T: Nickel	7440-02-0	50 mg/kg	98.6	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	86.5	71	125
		EG005T: Zinc	7440-66-6	50 mg/kg	98.0	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1736228)							
EM1809532-002	NEL-BH161_0.5m	EG035T: Mercury	7439-97-6	5 mg/kg	92.1	76	116
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1739951)							

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1739951) - continued							
EM1809532-002	NEL-BH161_0.5m	EG048G: Hexavalent Chromium	18540-29-9	40 mg/kg	74.7	58	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1740462)							
EM1809532-002	NEL-BH161_0.5m	EK026SF: Total Cyanide	57-12-5	20 mg/kg	91.2	77	113
EK040T: Fluoride Total (QCLot: 1736452)							
EM1809532-002	NEL-BH161_0.5m	EK040T: Fluoride	16984-48-8	400 mg/kg	87.0	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1737552)							
EM1809532-006	NEL-BH224_0.5m	EP066-EM: Total Polychlorinated biphenyls	----	1 mg/kg	107	36	152
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1736311)							
EM1809532-002	NEL-BH161_0.5m	EP074-UT: Benzene	71-43-2	2 mg/kg	70.6	50	138
		EP074-UT: Toluene	108-88-3	2 mg/kg	69.4	56	134
EP074I: Volatile Halogenated Compounds (QCLot: 1736311)							
EM1809532-002	NEL-BH161_0.5m	EP074-UT: 1.1-Dichloroethene	75-35-4	2 mg/kg	68.0	26	141
		EP074-UT: Trichloroethene	79-01-6	2 mg/kg	68.6	50	134
		EP074-UT: Chlorobenzene	108-90-7	2 mg/kg	72.5	28	134
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1737550)							
EM1809532-002	NEL-BH161_0.5m	EP075-EM: 2-Chlorophenol	95-57-8	1 mg/kg	94.0	34	118
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	1 mg/kg	71.7	41	139
		EP075-EM: Pentachlorophenol	87-86-5	1 mg/kg	47.3	10	144
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1737550)							
EM1809532-002	NEL-BH161_0.5m	EP075-EM: Phenol	108-95-2	1 mg/kg	84.2	32	134
		EP075-EM: 2-Nitrophenol	88-75-5	1 mg/kg	72.3	13	129
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1737550)							
EM1809532-002	NEL-BH161_0.5m	EP075-EM: Acenaphthene	83-32-9	1 mg/kg	98.3	46	138
		EP075-EM: Pyrene	129-00-0	1 mg/kg	87.8	27	169
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1736311)							
EM1809532-002	NEL-BH161_0.5m	EP074-UT: C6 - C9 Fraction	----	28 mg/kg	54.9	43	111
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1737551)							
EM1809532-005	NEL-BH224_0.2m	EP071-EM: C10 - C14 Fraction	----	806 mg/kg	100	53	123
		EP071-EM: C15 - C28 Fraction	----	3006 mg/kg	107	70	124
		EP071-EM: C29 - C36 Fraction	----	1584 mg/kg	96.6	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1736311)							
EM1809532-002	NEL-BH161_0.5m	EP074-UT: C6 - C10 Fraction	C6_C10	33 mg/kg	53.9	42	106
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1737551)							
EM1809532-005	NEL-BH224_0.2m	EP071-EM: >C10 - C16 Fraction	----	1160 mg/kg	100	65	123
		EP071-EM: >C16 - C34 Fraction	----	3978 mg/kg	103	67	121

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1737551) - continued							
EM1809532-005	NEL-BH224_0.2m	EP071-EM: >C34 - C40 Fraction	----	313 mg/kg	92.0	44	126

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739115)							
EM1809532-020	FB119	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	94.0	85	131
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	94.3	81	133
		EG020A-F: Copper	7440-50-8	0.2 mg/L	92.1	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	90.7	75	133
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	96.4	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	94.9	75	131
EG035F: Dissolved Mercury by FIMS (QCLot: 1739114)							
EM1809532-021	RB119	EG035F: Mercury	7439-97-6	0.01 mg/L	96.6	70	120
EG050F: Dissolved Hexavalent Chromium (QCLot: 1737214)							
EM1809532-021	RB119	EG050F: Hexavalent Chromium	18540-29-9	0.5 mg/L	102	59	127
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1742808)							
EM1809532-021	RB119	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	95.4	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1739039)							
EM1809433-006	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	118	70	130
EP074E: Halogenated Aliphatic Compounds (QCLot: 1738890)							
EM1809532-021	RB119	EP074: 1.1-Dichloroethene	75-35-4	20 µg/L	84.8	40	124
		EP074: Trichloroethene	79-01-6	20 µg/L	77.6	54	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1738890)							
EM1809532-021	RB119	EP074: Chlorobenzene	108-90-7	20 µg/L	94.1	68	132
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1738889)							
EM1809532-021	RB119	EP080: C6 - C9 Fraction	----	280 µg/L	63.0	43	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1738889)							
EM1809532-021	RB119	EP080: C6 - C10 Fraction	C6_C10	330 µg/L	63.6	44	122
EP080: BTEXN (QCLot: 1738889)							
EM1809532-021	RB119	EP080: Benzene	71-43-2	20 µg/L	79.8	68	130
		EP080: Toluene	108-88-3	20 µg/L	83.0	72	132

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1809532**	Page	: 1 of 15
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 14-Jun-2018
Site	: North East Link	Issue Date	: 25-Jun-2018
Sampler	: GHD	No. of samples received	: 22
Order number	:	No. of samples analysed	: 14

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
FB119,	RB119	----	----	----	20-Jun-2018	13-Jun-2018	**7**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	5	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	5	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL** — Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
NEL-BH161_0.2m,	NEL-BH161_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**19-Jun-2018**	19-Jun-2018	✓
NEL-BH224_0.2m,	NEL-BH224_0.5m,							
NEL-BH223_0.2m,	NEL-BH223_0.5m,							
NEL-BH163_0.2m,	NEL-BH163_1.0m,							
NEL-BH164_0.2m,	NEL-BH164_0.5m,							
QC1005								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**----**	----	----	**19-Jun-2018**	27-Jun-2018	✓
EG005T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	10-Dec-2018	✓	**20-Jun-2018**	10-Dec-2018	✓
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	11-Jul-2018	✓	**22-Jun-2018**	11-Jul-2018	✓
EG048: Hexavalent Chromium (Alkaline Digest)								
Soil Glass Jar - Unpreserved (EG048G)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	11-Jul-2018	✓	**20-Jun-2018**	27-Jun-2018	✓
EK026SF: Total CN by Segmented Flow Analyser								
Soil Glass Jar - Unpreserved (EK026SF)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	04-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK040T: Fluoride Total								
Soil Glass Jar - Unpreserved (EK040T)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	11-Jul-2018	✓	**21-Jun-2018**	11-Jul-2018	✓
EP066: Polychlorinated Biphenyls (PCB)								
Soil Glass Jar - Unpreserved (EP066-EM)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP074A: Monocyclic Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓
EP074H: Naphthalene								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓
EP074I: Volatile Halogenated Compounds								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP075A: Phenolic Compounds (Halogenated)							
Soil Glass Jar - Unpreserved (EP075-EM) NEL-BH161_0.2m, NEL-BH161_0.5m, NEL-BH224_0.2m, NEL-BH224_0.5m, NEL-BH223_0.2m, NEL-BH223_0.5m, NEL-BH163_0.2m, NEL-BH163_1.0m, NEL-BH164_0.2m, NEL-BH164_0.5m, QC1005	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075A: Phenolic Compounds (Non-halogenated)							
Soil Glass Jar - Unpreserved (EP075-EM) NEL-BH161_0.2m, NEL-BH161_0.5m, NEL-BH224_0.2m, NEL-BH224_0.5m, NEL-BH223_0.2m, NEL-BH223_0.5m, NEL-BH163_0.2m, NEL-BH163_1.0m, NEL-BH164_0.2m, NEL-BH164_0.5m, QC1005	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075-EM) NEL-BH161_0.2m, NEL-BH161_0.5m, NEL-BH224_0.2m, NEL-BH224_0.5m, NEL-BH223_0.2m, NEL-BH223_0.5m, NEL-BH163_0.2m, NEL-BH163_1.0m, NEL-BH164_0.2m, NEL-BH164_0.5m, QC1005	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075I: Organochlorine Pesticides							
Soil Glass Jar - Unpreserved (EP075-EM) NEL-BH161_0.2m, NEL-BH161_0.5m, NEL-BH224_0.2m, NEL-BH224_0.5m, NEL-BH223_0.2m, NEL-BH223_0.5m, NEL-BH163_0.2m, NEL-BH163_1.0m, NEL-BH164_0.2m, NEL-BH164_0.5m, QC1005	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT) NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓
Soil Glass Jar - Unpreserved (EP071-EM) NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP074-UT) NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓
Soil Glass Jar - Unpreserved (EP071-EM) NEL-BH161_0.2m, NEL-BH224_0.2m, NEL-BH223_0.2m, NEL-BH163_0.2m, NEL-BH164_0.2m, QC1005	NEL-BH161_0.5m, NEL-BH224_0.5m, NEL-BH223_0.5m, NEL-BH163_1.0m, NEL-BH164_0.5m,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) FB119,	RB119	**13-Jun-2018**	**----**	----	----	**20-Jun-2018**	13-Jun-2018	×
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020B-F) FB119,	RB119	**13-Jun-2018**	**----**	----	----	**20-Jun-2018**	10-Dec-2018	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG035F) FB119,	RB119	**13-Jun-2018**	**----**	----	----	**25-Jun-2018**	27-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG050F: Dissolved Hexavalent Chromium								
Clear Plastic Bottle - NaOH (EG050F)								
FB119,	RB119	**13-Jun-2018**	**----**	----	----	**19-Jun-2018**	11-Jul-2018	✓
EK026SF: Total CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH (EK026SF)								
FB119,	RB119	**13-Jun-2018**	**----**	----	----	**21-Jun-2018**	27-Jun-2018	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
FB119,	RB119	**13-Jun-2018**	**----**	----	----	**20-Jun-2018**	11-Jul-2018	✓
EP066: Polychlorinated Biphenyls (PCB)								
Amber Glass Bottle - Unpreserved (EP066)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	20-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP074A: Monocyclic Aromatic Hydrocarbons								
Amber VOC Vial - Sulfuric Acid (EP074)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓
EP074E: Halogenated Aliphatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓
EP074F: Halogenated Aromatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓
EP074G: Trihalomethanes								
Amber VOC Vial - Sulfuric Acid (EP074)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	20-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075A: Phenolic Compounds (Halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
FB119,	RB119	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
EP075A: Phenolic Compounds (Non-halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
FB119,	RB119	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
EP075I: Organochlorine Pesticides								
Amber Glass Bottle - Unpreserved (EP075-EM)								
FB119,	RB119	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	20-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
FB119, TB119	RB119,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber Glass Bottle - Unpreserved (EP071)								
FB119,	RB119	**13-Jun-2018**	**20-Jun-2018**	20-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
FB119, TB119	RB119,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080)								
FB119, TB119	RB119,	**13-Jun-2018**	**20-Jun-2018**	27-Jun-2018	✓	**21-Jun-2018**	27-Jun-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / *Analytical Methods*	*Method*	*Count QC*	*Count Regular*	*Rate (%) Actual*	*Rate (%) Expected*	*Evaluation*	*Quality Control Specification*
Matrix Spikes (MS) - Continued							
Total Fluoride	EK040T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / *Analytical Methods*	*Method*	*Count QC*	*Count Regular*	*Rate (%) Actual*	*Rate (%) Expected*	*Evaluation*	*Quality Control Specification*
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	2	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	2	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	2	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	5	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type *Analytical Methods*	*Method*	*Count* QC	Regular	*Rate (%)* **Actual**	**Expected**	*Evaluation*	*Quality Control Specification*
Method Blanks (MB) - Continued							
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	2	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	2	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	2	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	5	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons (2011) 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060A. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.
PCB - VIC EPA 448.3 Screen	EP066-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
TRH - Semivolatile Fraction	EP071-EM	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
Volatile Organic Compounds - Ultra-trace	EP074-UT	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS in partial SIM/Scan mode. Quantification is by comparison against an established multi-point calibration curves. This method is compliant with NEPM (2013) Schedule B(3) (Method 501)

Analytical Methods	Method	Matrix	Method Descriptions
Volatile Organic Compounds - Ultra-trace - Summations	EP074-UT-SUM	SOIL	Summation of MAHs and VHCs
Semivolatile Organic Compounds - Waste Classification	EP075-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
SVOC - Waste Classification (Sums)	EP075-EM-SUM	SOIL	Summations for EP075 (EM variation)
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium - Dissolved	EG050F	WATER	In house: Referenced to APHA 3500 Cr-B. Samples are 0.45µm filtered prior to analysis. Hexavalent chromium is determined on filtered water sample as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
Volatile Organic Compounds	EP074	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Semivolatile Organic Compounds - Waste Classification	EP075-EM	WATER	In house: Referenced to USEPA SW 846 - 8270B Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Higginson 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils - Ultra-trace.	ORG16-UT	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids - VIC EPA Screen	ORG17-EM	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Separatory Funnel Extraction of Liquids	ORG14-EM	WATER	In house: Referenced to USEPA SW 846 - 3510B. 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using dichloromethane. The resultant extracts are combined, dehydrated, concentrated and exchanged into toluene for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

CERTIFICATE OF ANALYSIS

Work Order	: **EM1809614**	Page	: 1 of 19
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 15-Jun-2018 16:15
Order number	:	Date Analysis Commenced	: 18-Jun-2018
C-O-C number	: ----	Issue Date	: 25-Jun-2018 15:28
Sampler	: AS, SH		
Site	: ----		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 15		
No. of samples analysed	: 9		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Organics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- pH analysis is done under non-stirring condition.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH101_0.5	NEL-BH101_1.0	NEL-EF-BH015_0.5	NEL-EF-BH015_1.0	NEL-EF-BH018_0.2
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809614-002	EM1809614-003	EM1809614-006	EM1809614-007	EM1809614-009
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**5.0**	**5.4**	**7.3**	**7.3**	**6.0**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**20.2**	**19.2**	**23.4**	**18.8**	**14.6**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	**5**	**6**	<5	**6**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Copper	7440-50-8	5	mg/kg	**14**	<5	**15**	**10**	**7**
Lead	7439-92-1	5	mg/kg	**12**	**13**	**24**	**16**	**27**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	**20**	**8**	**24**	**11**	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	**23**	**9**	**42**	**19**	**9**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	<1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**610**	**200**	**500**	**250**	**140**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH101_0.5	NEL-BH101_1.0	NEL-EF-BH015_0.5	NEL-EF-BH015_1.0	NEL-EF-BH018_0.2
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809614-002	EM1809614-003	EM1809614-006	EM1809614-007	EM1809614-009
				Result	Result	Result	Result	Result
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH101_0.5	NEL-BH101_1.0	NEL-EF-BH015_0.5	NEL-EF-BH015_1.0	NEL-EF-BH018_0.2
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809614-002	EM1809614-003	EM1809614-006	EM1809614-007	EM1809614-009
				Result	Result	Result	Result	Result
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	<1	<1	<1	<1
2-Methylphenol	95-48-7	1	mg/kg	<1	<1	<1	<1	<1
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	<1	<1	<1
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	<5	<5	<5
4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	<5	<5	<5
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	<5	<5	<5
Dinoseb	88-85-7	5	mg/kg	<5	<5	<5	<5	<5
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	<5	<5	<5
^ Sum of Phenols (non-halogenated)	----	1	mg/kg	<1	<1	<1	<1	<1
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH101_0.5	NEL-BH101_1.0	NEL-EF-BH015_0.5	NEL-EF-BH015_1.0	NEL-EF-BH018_0.2
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809614-002	EM1809614-003	EM1809614-006	EM1809614-007	EM1809614-009
				Result	Result	Result	Result	Result
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH101_0.5	NEL-BH101_1.0	NEL-EF-BH015_0.5	NEL-EF-BH015_1.0	NEL-EF-BH018_0.2
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EM1809614-002	EM1809614-003	EM1809614-006	EM1809614-007	EM1809614-009
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**106**	**98.9**	**111**	**108**	**110**
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**62.3**	**62.0**	**80.3**	**74.2**	**79.6**
Toluene-D8	2037-26-5	0.1	%	**59.9**	**63.2**	**77.0**	**74.4**	**78.6**
4-Bromofluorobenzene	460-00-4	0.1	%	**59.8**	**65.0**	**76.5**	**74.6**	**76.1**
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.025	%	**99.4**	**87.6**	**92.4**	**99.7**	**101**
2-Chlorophenol-D4	93951-73-6	0.025	%	**79.6**	**78.9**	**79.6**	**85.9**	**89.0**
2.4.6-Tribromophenol	118-79-6	0.025	%	**93.9**	**84.0**	**92.9**	**90.1**	**96.8**
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.025	%	**87.7**	**79.3**	**83.2**	**88.8**	**90.6**
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	**83.8**	**77.3**	**81.0**	**86.1**	**87.4**
2-Fluorobiphenyl	321-60-8	0.025	%	**99.1**	**95.7**	**94.3**	**99.2**	**101**
Anthracene-d10	1719-06-8	0.025	%	**105**	**101**	**103**	**105**	**109**
4-Terphenyl-d14	1718-51-0	0.025	%	**121**	**115**	**119**	**120**	**125**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH018_0.5	----	----	----	----
			Client sampling date / time	14-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809614-010	--------	--------	--------	--------
				Result	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**5.5**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**22.9**	----	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Copper	7440-50-8	5	mg/kg	**11**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**11**	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Nickel	7440-02-0	2	mg/kg	**13**	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Silver	7440-22-4	2	mg/kg	<2	----	----	----	----
Tin	7440-31-5	5	mg/kg	<5	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**8**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	**500**	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	----
Styrene	100-42-5	0.5	mg/kg	<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	----
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg	<0.2	----	----	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH018_0.5	----	----	----	----
			Client sampling date / time	14-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809614-010	--------	--------	--------	--------
				Result	----	----	----	----
EP074H: Naphthalene								
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	----
EP074I: Volatile Halogenated Compounds								
Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	----	----	----	----
1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	----	----	----	----
Methylene chloride	75-09-2	0.4	mg/kg	<0.4	----	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	----	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	----	----	----	----
Chloroform	67-66-3	0.02	mg/kg	<0.02	----	----	----	----
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	----	----	----	----
Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	----	----	----	----
1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	----	----	----	----
Trichloroethene	79-01-6	0.02	mg/kg	<0.02	----	----	----	----
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	----	----	----	----
Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	----	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	----	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	----	----	----	----
Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	----	----	----	----
Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	----	----	----	----
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	----	----	----	----
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	----	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	----	----	----	----
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	----	----	----	----
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg	<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	----	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	----	----	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	----	----	----	----
Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Phenols (halogenated)	----	0.03	mg/kg	<0.03	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH018_0.5	----	----	----	----
			Client sampling date / time	14-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809614-010	--------	--------	--------	--------
				Result	----	----	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	1	mg/kg	<1	----	----	----	----
2-Methylphenol	95-48-7	1	mg/kg	<1	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	1	mg/kg	<1	----	----	----	----
2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	----	----	----	----
2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	----	----	----	----
4-Nitrophenol	100-02-7	5	mg/kg	<5	----	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	----	----	----	----
Dinoseb	88-85-7	5	mg/kg	<5	----	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	----	----	----	----
^ **Sum of Phenols (non-halogenated)**	----	1	mg/kg	<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**0.6**	----	----	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**1.2**	----	----	----	----
EP075I: Organochlorine Pesticides								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH018_0.5	----	----	----	----
			Client sampling date / time	14-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809614-010	--------	--------	--------	--------
				Result	----	----	----	----
EP075I: Organochlorine Pesticides - Continued								
alpha-BHC	319-84-6	0.03	mg/kg	<0.03	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	----	----	----	----
beta-BHC	319-85-7	0.03	mg/kg	<0.03	----	----	----	----
gamma-BHC	58-89-9	0.03	mg/kg	<0.03	----	----	----	----
delta-BHC	319-86-8	0.03	mg/kg	<0.03	----	----	----	----
Heptachlor	76-44-8	0.03	mg/kg	<0.03	----	----	----	----
Aldrin	309-00-2	0.03	mg/kg	<0.03	----	----	----	----
Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	----	----	----	----
cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	----	----	----	----
trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	----	----	----	----
Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.03	mg/kg	<0.03	----	----	----	----
Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	----	----	----	----
Endrin	72-20-8	0.03	mg/kg	<0.03	----	----	----	----
Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	----	----	----	----
4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of organochlorine pesticides	----	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
^ Chlordane	57-74-9	0.03	mg/kg	<0.03	----	----	----	----
^ Sum of other organochlorine pesticides	----	0.03	mg/kg	<0.03	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	----	----
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH018_0.5	----	----	----	----
			Client sampling date / time	14-Jun-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1809614-010	--------	--------	--------	--------
				Result	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**110**	----	----	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**78.4**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%	**76.1**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**72.1**	----	----	----	----
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.025	%	**95.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.025	%	**82.7**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.025	%	**91.7**	----	----	----	----
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)								
Nitrobenzene-D5	4165-60-0	0.025	%	**84.7**	----	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%	**83.5**	----	----	----	----
2-Fluorobiphenyl	321-60-8	0.025	%	**93.1**	----	----	----	----
Anthracene-d10	1719-06-8	0.025	%	**106**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.025	%	**122**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RB120	FB120	TB120	----	----
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809614-013	EM1809614-014	EM1809614-015	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.28**	**5.06**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG050F: Dissolved Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	1	µg/L	<1	<1	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Styrene	100-42-5	5	µg/L	<5	<5	----	----	----
EP074E: Halogenated Aliphatic Compounds								
Vinyl chloride	75-01-4	50	µg/L	<50	<50	----	----	----
1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	----	----	----
Methylene chloride	75-09-2	5	µg/L	<5	<5	----	----	----
trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	----	----	----
cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	----	----	----
1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	----	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	----	----	----
1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	----	----	----
Trichloroethene	79-01-6	5	µg/L	<5	<5	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RB120	FB120	TB120	----	----
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809614-013	EM1809614-014	EM1809614-015	--------	--------
				Result	Result	Result	----	----
EP074E: Halogenated Aliphatic Compounds - Continued								
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	----	----	----
Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	----	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	----	----	----
1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	----	----	----
1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	----	----	----
1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	----	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	<5	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP075A: Phenolic Compounds (Halogenated)								
2-Chlorophenol	95-57-8	2	µg/L	<2	<2	----	----	----
2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RB120	FB120	TB120	----	----
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809614-013	EM1809614-014	EM1809614-015	--------	--------
				Result	Result	Result	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued								
2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	----	----	----
4-Chloro-3-methylphenol	59-50-7	4	µg/L	<4	<4	----	----	----
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	----	----	----
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	<2	<2	----	----	----
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	2	µg/L	<2	<2	----	----	----
Pentachlorophenol	87-86-5	2	µg/L	<2	<2	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)								
Phenol	108-95-2	4	µg/L	<4	<4	----	----	----
2-Methylphenol	95-48-7	4	µg/L	<4	<4	----	----	----
3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	----	----	----
2-Nitrophenol	88-75-5	4	µg/L	<4	<4	----	----	----
2.4-Dimethylphenol	105-67-9	4	µg/L	<4	<4	----	----	----
2.4-Dinitrophenol	51-28-5	100	µg/L	<100	<100	----	----	----
4-Nitrophenol	100-02-7	50	µg/L	<50	<50	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	<50	<50	----	----	----
Dinoseb	88-85-7	50	µg/L	<50	<50	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	<50	<50	----	----	----
EP075I: Organochlorine Pesticides								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	----	----	----
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	----	----	----
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	----	----	----
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	----	----	----
4.4`-DDT	50-29-3	0.5	µg/L	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RB120	FB120	TB120	----	----
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809614-013	EM1809614-014	EM1809614-015	--------	--------
				Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	**77.0**	**94.2**	----	----	----
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	5	%	**93.8**	**92.4**	----	----	----
Toluene-D8	2037-26-5	5	%	**86.3**	**83.7**	----	----	----
4-Bromofluorobenzene	460-00-4	5	%	**96.4**	**97.2**	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**12.1**	**25.8**	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**32.8**	**65.3**	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**57.4**	**77.2**	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**49.4**	**77.4**	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**68.2**	**97.7**	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**99.2**	**116**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RB120	FB120	TB120	----	----
			Client sampling date / time	14-Jun-2018 00:00	14-Jun-2018 00:00	14-Jun-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EM1809614-013	EM1809614-014	EM1809614-015	--------	--------
				Result	Result	Result	----	----
EP075S: Acid Extractable Surrogates (Waste Classification)								
Phenol-d6	13127-88-3	0.25	%	35.5	41.3	----	----	----
2-Chlorophenol-D4	93951-73-6	0.25	%	96.4	109	----	----	----
2.4.6-Tribromophenol	118-79-6	0.25	%	74.0	86.8	----	----	----
EP075T: Base/Neutral Extractable Surrogates								
Nitrobenzene-D5	4165-60-0	0.25	%	94.3	103	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.25	%	94.3	108	----	----	----
2-Fluorobiphenyl	321-60-8	0.25	%	95.5	110	----	----	----
Anthracene-d10	1719-06-8	0.25	%	113	111	----	----	----
4-Terphenyl-d14	1718-51-0	0.25	%	126	137	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	95.4	94.3	95.2	----	----
Toluene-D8	2037-26-5	2	%	84.7	82.2	85.4	----	----
4-Bromofluorobenzene	460-00-4	2	%	102	103	105	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	122
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	59	119
Toluene-D8	2037-26-5	55	117
4-Bromofluorobenzene	460-00-4	59	123
EP075S: Acid Extractable Surrogates (Waste Classification)			
Phenol-d6	13127-88-3	28	134
2-Chlorophenol-D4	93951-73-6	27	123
2.4.6-Tribromophenol	118-79-6	25	149
EP075T: Base/Neutral Extractable Surrogates (Waste Classification)			
Nitrobenzene-D5	4165-60-0	29	125
1.2-Dichlorobenzene-D4	2199-69-1	31	117
2-Fluorobiphenyl	321-60-8	44	136
Anthracene-d10	1719-06-8	53	133
4-Terphenyl-d14	1718-51-0	59	141

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	125
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	77	132
4-Bromofluorobenzene	460-00-4	67	131
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	46
2-Chlorophenol-D4	93951-73-6	23	104
2.4.6-Tribromophenol	118-79-6	28	130
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	36	114
Anthracene-d10	1719-06-8	51	119
4-Terphenyl-d14	1718-51-0	49	127
EP075S: Acid Extractable Surrogates (Waste Classification)			
Phenol-d6	13127-88-3	13	90
2-Chlorophenol-D4	93951-73-6	42	117
2.4.6-Tribromophenol	118-79-6	52	140
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	49	136

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075T: Base/Neutral Extractable Surrogates - Continued			
1.2-Dichlorobenzene-D4	2199-69-1	49	128
2-Fluorobiphenyl	321-60-8	57	137
Anthracene-d10	1719-06-8	67	137
4-Terphenyl-d14	1718-51-0	66	136
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	129
Toluene-D8	2037-26-5	70	125
4-Bromofluorobenzene	460-00-4	71	129

CHAIN OF CUSTODY RECORD

GHD

GHD Melbourne
150 Lonsdale Street, Melbourne 3000
Telephone: 613 8687 8000 Facsimile: 613 8687 8111

Job Number	GHD Office	Laboratory: ALS Springvale
31/35006/0910	Melbourne	Address: 2 - 4 Westall Rd, Springvale
Project: North East Link - Contamination		Lab Contact: Shirley LeCornu
GHD Contact: David Quinn	Contact Email: David.Quinn@ghd.com	
Standard TAT	Quote No./GHD Reference: ME/124/18	

PLEASE NOTE:
Sign white copy on receipt and release of samples.
Samples are to be delivered to the Laboratory Address.
On receipt of samples, the **laboratory contact to sign white copy** and fax/email to GHD Contact.
On completion of analyses please **return white copy with results.**
Pink copy is returned to the sampler once the courier has signed for the samples.
E-mail results to the GHD Contact with the GHD Job Number in the e-mail subject line.

Results to be provided in ESDAT compatibile format

	Sample I.D.	Date	Time	Composite Sample	Sample Matrix S: Soil SL: Sludge W: Water A: Air GW: Groundwater	Preservative	Container Type J: soil jar B: bag V: vial G: glass bottle P: plastic bottle	Number	Volume (mL)	HOLD	Analyses Required	Remarks
1	NEL-BH101-0.2m	14/06/18	AM	/	S	/	J	1	250	X		
2	" "-0.5m	14/6/18	AM	/	S	/	J	1	250	X		
3	" "-1.0m	14/6/18	AM	/	S	/	J	1	250	X		
4	" "-1.5m	14/6/18	AM	/	S	/	J	1	250	X		
5	NEL-EF-BH015-0.2	14/6/18	AM	/	S	/	J	1	250	X		
6	" " "-0.5	14/6/18	AM	/	S	/	J	1	250	X		
7	" " "-1.0	14/6/18	AM	/	S	/	J	1	250	X		
8	" " "-1.50	14/6/18	AM	/	S	/	J	1	250	X		
9	NEL-EF-BH016-0.2	14/6/18	AM	/	S	/	J	1	250	X		
10	" " "-0.5	14/6/18	AM	/	S	/	J	1	250	X		
11	" " "-1.0	14/6/18	AM	/	S	/	J	1	250	X		
12	" " "-1.5	14/6/18	AM	/	S	/	J	1	250	X		
13	RB120	14/6/18	AM	/	W	/	VGP	8	/	X		
14	FB120	14/6/18	AM	/	W	/	VGP	8	/	X		
15	TB120	14/6/18	AM	/	W	/	V	1	/	X		

Environmental Division
Melbourne
Work Order Reference
EM1809614

Telephone : + 61-3-8549 9600

Sampled by:	S.H + AS.	Date/Time:	AM 14/6/18	Relinquished by:	S.H + A.S	Date/Time:	PM 14/6/18
Received by:	Coreshed fridge	Date/Time:	PM 14/6/18	Relinquished by:		Date/Time:	
Received by Courier:		Date/Time:		Relinquished by:		Date/Time:	
Received by Lab:	[illegible]	Date/Time:	15/6 16:15				
Remarks:	Please CC reports and correspondence to Mark Davidson (mark.s.davidson@aecom.com) & Nazuha Rosli (nazuha.rosli@aecom.com)						

Shirley LeCornu

From: Kory.Auch@ghd.com
Sent: Monday, 18 June 2018 10:23 AM
To: Shirley LeCornu
Cc: David Quinn
Subject: RE: EM1809613, EM1809614 - GHD - 31350060910
Attachments: EM1809613.pdf; EM1809614.pdf

Hi Shirley,

Please analyse the following at standard TAT:

EM1809613:

TB201 = Volatile TPH/BTEX
RB201 = IWRG621 water equivalent
FB201 = IWRG621 water equivalent

NEL-EF-BH017_2.0m = IWRG621
NEL-EF-BH017_3.0m = IWRG621

EM1809614:

NEL-BH101_0.5m = IWRG621
NEL-BH101_1.0m = IWRG621

NEL-EF-BH015_0.5m = IWRG621
NEL-EF-BH015_1.0m = IWRG621

NEL-EF-BH018_0.2m = IWRG621
NEL-EF-BH018_0.5m = IWRG621

RB120 = IWRG621 water equivalent
FB120 = IWRG621 water equivalent
TB120 = Volatile TPH/BTEX

Regards,

Kory Auch
Contamination Assessment & Remediation

GHD
Proudly employee owned
T: +61 3 8687 8948 | V: 318948 | M: +61 0478 797 000 | E: kory.auch@ghd.com
Level 18, 180 Lonsdale Street Melbourne Victoria 3000 Australia | www.ghd.com

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM1809614**

Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: david.quinn@ghd.com	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: ----	Telephone	: +61-3-8549 9630
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: 31350060910	Page	: 1 of 4
Order number	:	Quote number	: EM2018GHDSER0003 (ME/124/18 - North East Link)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: AS, SH		

Dates

Date Samples Received	: 15-Jun-2018 16:15	Issue Date	: 18-Jun-2018
Client Requested Due Date	: 25-Jun-2018	Scheduled Reporting Date	: **25-Jun-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 2.8°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 15 / 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method *Client sample ID*	Sample Container Received	Preferred Sample Container for Analysis
Dissolved Mercury by FIMS : EG035F		
RB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
FB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite A : EG020A-F		
RB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
FB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
Dissolved Metals by ICP-MS - Suite B : EG020B-F		
RB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered
FB120	- Clear Plastic Bottle - Nitric Acid; Unspecified	- Clear Plastic Bottle - Nitric Acid; Filtered

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA055-103 Moisture Content	SOIL - P-16 IWRG 621
EM1809614-001	14-Jun-2018 00:00	NEL-BH101_0.2	✓		
EM1809614-002	14-Jun-2018 00:00	NEL-BH101_0.5		✓	✓
EM1809614-003	14-Jun-2018 00:00	NEL-BH101_1.0		✓	✓
EM1809614-004	14-Jun-2018 00:00	NEL-BH101_1.5	✓		
EM1809614-005	14-Jun-2018 00:00	NEL-EF-BH015_0.2	✓		
EM1809614-006	14-Jun-2018 00:00	NEL-EF-BH015_0.5		✓	✓
EM1809614-007	14-Jun-2018 00:00	NEL-EF-BH015_1.0		✓	✓
EM1809614-008	14-Jun-2018 00:00	NEL-EF-BH015_1.5	✓		
EM1809614-009	14-Jun-2018 00:00	NEL-EF-BH018_0.2		✓	✓
EM1809614-010	14-Jun-2018 00:00	NEL-EF-BH018_0.5		✓	✓
EM1809614-011	14-Jun-2018 00:00	NEL-EF-BH018_1.0	✓		
EM1809614-012	14-Jun-2018 00:00	NEL-EF-BH018_1.5	✓		

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - 448.3 Water VIC EPA IWRG621 - Water Equivalent Suite	WATER - W-18 TRH(C6 - C9)/BTEXN
EM1809614-013	14-Jun-2018 00:00	RB120	✓	
EM1809614-014	14-Jun-2018 00:00	FB120	✓	
EM1809614-015	14-Jun-2018 00:00	TB120		✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA005-P: pH by PC Titrator							
FB120	Clear Plastic Bottle - Natural	----	14-Jun-2018	15-Jun-2018	×	18-Jun-2018	×
RB120	Clear Plastic Bottle - Natural	----	14-Jun-2018	15-Jun-2018	×	18-Jun-2018	×

Requested Deliverables

ALL ACCOUNTS		
- A4 - AU Tax Invoice (INV)	Email	ap-fss@ghd.com
DAVID QUINN		
- *AU Certificate of Analysis - NATA (COA)	Email	david.quinn@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	david.quinn@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	david.quinn@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	david.quinn@ghd.com
- A4 - AU Tax Invoice (INV)	Email	david.quinn@ghd.com
- Chain of Custody (CoC) (COC)	Email	david.quinn@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	david.quinn@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	david.quinn@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	david.quinn@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	david.quinn@ghd.com
GHD LAB REPORTS		
- *AU Certificate of Analysis - NATA (COA)	Email	GHDLabreports@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	GHDLabreports@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	GHDLabreports@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	GHDLabreports@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	GHDLabreports@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	GHDLabreports@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	GHDLabreports@ghd.com
KORY AUCH		
- *AU Certificate of Analysis - NATA (COA)	Email	kory.auch@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	kory.auch@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	kory.auch@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	kory.auch@ghd.com
- Chain of Custody (CoC) (COC)	Email	kory.auch@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	kory.auch@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	kory.auch@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	kory.auch@ghd.com
- EPA Waste Classification & Categorisation Guideline Report (COA_GL_EPA_WASTE)	Email	kory.auch@ghd.com

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1809614**	Page	: 1 of 19
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 15-Jun-2018
Order number	:	Date Analysis Commenced	: 18-Jun-2018
C-O-C number	: ----	Issue Date	: 25-Jun-2018
Sampler	: AS, SH		
Site	: ----		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 15		
No. of samples analysed	: 9		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	2IC Organic Chemist	Melbourne Organics, Springvale, VIC
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 1739264)									
EM1809614-002	NEL-BH101_0.5	EA001: pH (CaCl2)	----	0.1	pH Unit	5.0	4.9	2.02	0% - 20%
EM1809674-004	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	7.8	7.8	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1734594)									
EM1809614-002	NEL-BH101_0.5	EA055: Moisture Content	----	0.1	%	20.2	20.7	2.68	0% - 20%
EM1809686-005	Anonymous	EA055: Moisture Content	----	0.1	%	25.7	25.3	1.80	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 1739879)									
EM1809560-001	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	67	69	3.19	0% - 20%
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	45	46	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	108	102	5.30	0% - 20%
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	35	32	7.63	No Limit
EM1809614-006	NEL-EF-BH015_0.5	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	24	24	0.00	0% - 50%
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	6	8	27.7	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	15	15	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	24	37	44.1	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005T: Total Metals by ICP-AES (QC Lot: 1739879) - continued									
EM1809614-006	NEL-EF-BH015_0.5	EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	42	39	6.47	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1739880)									
EM1809560-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.1	0.1	0.00	No Limit
EM1809614-006	NEL-EF-BH015_0.5	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 1739951)									
EM1809532-001	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809532-016	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1740462)									
EM1809532-001	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1809532-016	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EK040T: Fluoride Total (QC Lot: 1734385)									
EM1809592-001	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	260	250	6.25	No Limit
EM1809592-020	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	160	150	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 1735916)									
EM1809613-004	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1809719-003	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1734310)									
EM1809614-002	NEL-BH101_0.5	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809667-037	Anonymous	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP074H: Naphthalene (QC Lot: 1734310)									
EM1809614-002	NEL-BH101_0.5	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EM1809667-037	Anonymous	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP074I: Volatile Halogenated Compounds (QC Lot: 1734310)									
EM1809614-002	NEL-BH101_0.5	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP074I: Volatile Halogenated Compounds (QC Lot: 1734310) - continued									
EM1809614-002	NEL-BH101_0.5	EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	0.00	No Limit
EM1809667-037	Anonymous	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	<0.4	0.00	No Limit
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1735914)									
EM1809613-004	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 1735914) - continued									
EM1809613-004	Anonymous	EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EM1809719-003	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075A: Phenolic Compounds (Non-halogenated) (QC Lot: 1735914)									
EM1809613-004	Anonymous	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EM1809719-003	Anonymous	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1735914)									
EM1809613-004	Anonymous	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1735914) - continued									
EM1809613-004	Anonymous	EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1809719-003	Anonymous	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP075I: Organochlorine Pesticides (QC Lot: 1735914)									
EM1809613-004	Anonymous	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP075I: Organochlorine Pesticides (QC Lot: 1735914) - continued									
EM1809613-004	Anonymous	EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EM1809719-003	Anonymous	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1734310)									
EM1809614-002	NEL-BH101_0.5	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EM1809667-037	Anonymous	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1735915)									
EM1809613-004	Anonymous	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EM1809719-003	Anonymous	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1735915) - continued									
EM1809719-003	Anonymous	EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1734310)									
EM1809614-002	NEL-BH101_0.5	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	0.00	No Limit
EM1809667-037	Anonymous	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1735915)									
EM1809613-004	Anonymous	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EM1809719-003	Anonymous	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA005P: pH by PC Titrator (QC Lot: 1735709)									
EM1809597-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.70	7.67	0.390	0% - 20%
EM1809617-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.65	6.63	0.301	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739113)									
EM1809762-003	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	0.001	<0.001	0.00	No Limit
EM1809532-020	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739115)									
EM1809635-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.007	0.008	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.050	0.050	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809532-020	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1739115) - continued									
EM1809532-020	Anonymous	EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1739114)									
EM1809635-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1809532-020	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG050F: Dissolved Hexavalent Chromium (QC Lot: 1737214)									
EM1809532-020	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EM1809603-033	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1742808)									
EM1809532-020	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EM1809693-030	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1735705)									
EM1809572-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EM1809617-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 1735516)									
EM1809613-002	Anonymous	EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.00	No Limit
EP074E: Halogenated Aliphatic Compounds (QC Lot: 1735516)									
EM1809613-002	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: Methylene chloride	75-09-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.00	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.00	No Limit
		EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	<5	0.00	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.00	No Limit
EP074F: Halogenated Aromatic Compounds (QC Lot: 1735516)									
EM1809613-002	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	<5	0.00	No Limit
		EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	<5	0.00	No Limit
EP074G: Trihalomethanes (QC Lot: 1735516)									
EM1809613-002	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1735515)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1735515) - continued									
EM1809662-060	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EM1809613-002	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1735515)									
EM1809662-060	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EM1809613-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 1735515)									
EM1809662-060	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EM1809613-002	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1739879)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	88.0	79	113
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	86.1	85	109
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	87.7	78	108
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	84.7	78	106
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	103	86	112
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	91.5	82	111
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	100	93	109
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	93.2	80	108
EG005T: Tin	7440-31-5	5	mg/kg	<5	5.2 mg/kg	90.6	88	116
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	92.2	82	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1739880)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	86.4	77	104
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1739951)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	102	75	112
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1740462)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	91.3	80	110
EK040T: Fluoride Total (QCLot: 1734385)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	89.5	77	106
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1735916)								
EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	117	63	118
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1734310)								
EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	2.1 mg/kg	91.1	74	118
EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	2.1 mg/kg	91.4	70	124
EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2.1 mg/kg	91.2	71	122
EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4.2 mg/kg	89.4	70	118
EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	2.1 mg/kg	91.2	76	116
EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2.1 mg/kg	88.6	74	114
EP074H: Naphthalene (QCLot: 1734310)								
EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	0.6 mg/kg	91.8	77	111
EP074I: Volatile Halogenated Compounds (QCLot: 1734310)								
EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	0.1 mg/kg	88.3	49	133
EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	0.1 mg/kg	88.5	62	127

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP074I: Volatile Halogenated Compounds (QCLot: 1734310) - continued								
EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	2.1 mg/kg	89.8	68	107
EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	0.1 mg/kg	86.3	68	124
EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	0.1 mg/kg	90.7	74	118
EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	0.1 mg/kg	87.7	72	118
EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	0.1 mg/kg	98.8	67	119
EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	0.1 mg/kg	90.2	65	119
EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	0.1 mg/kg	95.9	73	120
EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	0.1 mg/kg	93.0	72	124
EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	0.1 mg/kg	99.3	74	122
EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	0.1 mg/kg	83.6	64	124
EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	0.1 mg/kg	96.4	70	119
EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	0.1 mg/kg	93.0	71	125
EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	0.1 mg/kg	86.2	61	125
EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	0.1 mg/kg	91.0	73	117
EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	0.1 mg/kg	92.9	69	118
EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	0.1 mg/kg	91.8	75	114
EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	0.1 mg/kg	89.4	59	124
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1735914)								
EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	2 mg/kg	99.3	54	122
EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	2 mg/kg	87.5	58	131
EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	2 mg/kg	93.7	55	118
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	2 mg/kg	84.0	62	129
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	2 mg/kg	89.8	53	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	2 mg/kg	80.7	60	126
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	2 mg/kg	98.4	56	118
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	0.05	mg/kg	<0.05	4 mg/kg	100	54	125
EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	4 mg/kg	86.9	52	124
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1735914)								
EP075-EM: Phenol	108-95-2	1	mg/kg	<1	2 mg/kg	87.1	56	120
EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	2 mg/kg	97.2	52	131
EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	4 mg/kg	91.8	59	132
EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	2 mg/kg	85.8	53	130
EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	2 mg/kg	101	43	120
EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	12 mg/kg	91.0	23	125
EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	12 mg/kg	93.0	59	133
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	12 mg/kg	89.2	47	125
EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	12 mg/kg	106	51	123
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	10 mg/kg	91.8	12	132

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1735914)								
EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	2 mg/kg	100	58	121
EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	2 mg/kg	104	55	126
EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	2 mg/kg	96.5	59	120
EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	2 mg/kg	105	64	122
EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	2 mg/kg	106	70	128
EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	2 mg/kg	71.2	55	127
EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	2 mg/kg	108	68	134
EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	2 mg/kg	110	69	131
EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	2 mg/kg	102	65	133
EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	2 mg/kg	112	68	134
EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	4 mg/kg	112	64	134
EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	2 mg/kg	106	62	132
EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	2 mg/kg	111	55	137
EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	2 mg/kg	111	54	136
EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	2 mg/kg	108	55	137
EP075I: Organochlorine Pesticides (QCLot: 1735914)								
EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	2 mg/kg	105	68	122
EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	2 mg/kg	106	65	122
EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	2 mg/kg	106	62	133
EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	2 mg/kg	107	68	126
EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	2 mg/kg	104	68	133
EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	2 mg/kg	104	62	128
EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	2 mg/kg	107	66	128
EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	2 mg/kg	111	62	133
EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	2 mg/kg	117	62	132
EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	2 mg/kg	112	61	133
EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	2 mg/kg	116	63	136
EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	2 mg/kg	109	57	131
EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	2 mg/kg	108	65	137
EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	2 mg/kg	167	24	174
EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	2 mg/kg	92.6	55	148
EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	2 mg/kg	110	66	135
EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	2 mg/kg	115	66	134
EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	2 mg/kg	113	63	139
EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	2 mg/kg	104	59	134
EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	2 mg/kg	104	61	136
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1734310)								
EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	39.6 mg/kg	80.1	69	114

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735915)								
EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	806 mg/kg	79.4	73	134
EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	3006 mg/kg	95.2	81	112
EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	1584 mg/kg	87.8	77	116
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1734310)								
EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	48.9 mg/kg	79.2	69	112
EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1735915)								
EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	1160 mg/kg	84.6	77	127
EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	3978 mg/kg	93.1	79	113
EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	313 mg/kg	77.2	68	124

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739113)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	94.8	84	116
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739115)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	102	91	107
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.4	84	104
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.0	82	103
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.1	83	105
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	96.5	83	109
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	100.0	82	106
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	101	82	109
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	101	83	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	104	85	109
EG035F: Dissolved Mercury by FIMS (QCLot: 1739114)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	95.1	81	114
EG050F: Dissolved Hexavalent Chromium (QCLot: 1737214)								
EG050F: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	0.5 mg/L	105	90	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1742808)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	93.3	80	110
EK040P: Fluoride by PC Titrator (QCLot: 1735705)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	109	85	112
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1735841)								
EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1.0	10 µg/L	86.4	54	132
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1735516)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1735516) - continued								
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	94.9	79	114
EP074E: Halogenated Aliphatic Compounds (QCLot: 1735516)								
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	84.2	64	139
EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	100	65	124
EP074: Methylene chloride	75-09-2	5	µg/L	<5	20 µg/L	96.6	81	144
EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	89.2	73	121
EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	92.2	78	120
EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	85.2	68	116
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	85.8	66	119
EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	97.1	79	118
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	87.4	70	120
EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	101	87	114
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	86.2	75	119
EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	91.0	75	112
EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	106	81	125
EP074: Hexachlorobutadiene	87-68-3	5	µg/L	<5	20 µg/L	88.3	63	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1735516)								
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	92.3	82	114
EP074: 1.4-Dichlorobenzene	106-46-7	5	µg/L	<5	20 µg/L	94.2	76	118
EP074: 1.2-Dichlorobenzene	95-50-1	5	µg/L	<5	20 µg/L	98.4	82	112
EP074: 1.2.4-Trichlorobenzene	120-82-1	5	µg/L	<5	20 µg/L	90.2	62	119
EP074G: Trihalomethanes (QCLot: 1735516)								
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	93.9	79	119
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1735842)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	67.1	48	110
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	70.6	49	124
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	71.5	53	117
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	74.1	54	118
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	78.1	57	119
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	92.0	51	113
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	85.9	59	123
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	84.5	58	123
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	88.1	52	126
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	83.8	55	123
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	86.9	52	131
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	84.0	57	126
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	86.0	56	126

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1735842) - continued								
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	83.8	53	123
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	82.2	53	125
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	84.2	53	125
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1735939)								
EP075-EM: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	86.5	44	114
EP075-EM: 2.4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	70.2	53	121
EP075-EM: 2.6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	78.8	55	119
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	4	µg/L	<4	10 µg/L	70.6	57	116
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	76.5	51	121
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	67.9	56	120
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	2	µg/L	<2	10 µg/L	78.8	41	125
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	2	µg/L	<2	20 µg/L	80.8	47	125
EP075-EM: Pentachlorophenol	87-86-5	2	µg/L	<2	20 µg/L	72.8	22	122
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1735939)								
EP075-EM: Phenol	108-95-2	4	µg/L	<4	10 µg/L	31.0	20	57
EP075-EM: 2-Methylphenol	95-48-7	4	µg/L	<4	10 µg/L	76.2	49	107
EP075-EM: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	20 µg/L	61.4	48	101
EP075-EM: 2-Nitrophenol	88-75-5	4	µg/L	<4	10 µg/L	71.0	53	123
EP075-EM: 2.4-Dimethylphenol	105-67-9	4	µg/L	<4	10 µg/L	88.2	52	128
EP075-EM: 2.4-Dinitrophenol	51-28-5	100	µg/L	<100	60 µg/L	110	21	130
EP075-EM: 4-Nitrophenol	100-02-7	50	µg/L	<50	60 µg/L	33.3	13	60
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	50	µg/L	<50	60 µg/L	83.2	56	126
EP075-EM: Dinoseb	88-85-7	50	µg/L	<50	60 µg/L	96.0	55	128
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	50	µg/L	<50	50 µg/L	91.1	32	135
EP075I: Organochlorine Pesticides (QCLot: 1735939)								
EP075-EM: alpha-BHC	319-84-6	0.5	µg/L	<0.5	10 µg/L	80.7	59	126
EP075-EM: Heptachlor	76-44-8	0.5	µg/L	<0.5	10 µg/L	81.3	59	131
EP075-EM: Aldrin	309-00-2	0.5	µg/L	<0.5	10 µg/L	79.7	59	133
EP075-EM: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	10 µg/L	81.3	61	133
EP075-EM: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	10 µg/L	85.6	60	132
EP075-EM: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	10 µg/L	86.1	56	130
EP075-EM: Dieldrin	60-57-1	0.5	µg/L	<0.5	10 µg/L	81.9	59	130
EP075-EM: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	10 µg/L	84.1	62	136
EP075-EM: 4.4`-DDT	50-29-3	0.5	µg/L	<0.5	10 µg/L	80.1	57	128
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735515)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	90.1	68	125
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735843)								

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735843) - continued								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	4331 µg/L	90.5	58	134
EP071: C15 - C28 Fraction	----	100	µg/L	<100	16952 µg/L	102	60	133
EP071: C29 - C36 Fraction	----	50	µg/L	<50	8695 µg/L	99.8	54	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1735515)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	87.7	66	123
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1735843)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	6292 µg/L	93.6	58	122
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	22143 µg/L	101	56	132
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1677 µg/L	104	58	137
EP080: BTEXN (QCLot: 1735515)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	88.1	74	123
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	95.3	77	128
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	93.6	73	126
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	99.1	72	131
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	104	74	131
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	110	74	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1739879)							
EM1809611-002	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	101	78	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	88.4	84	116
		EG005T: Copper	7440-50-8	50 mg/kg	99.5	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	90.5	76	124
		EG005T: Molybdenum	7439-98-7	50 mg/kg	97.6	79	117
		EG005T: Nickel	7440-02-0	50 mg/kg	89.5	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	90.7	71	125
		EG005T: Zinc	7440-66-6	50 mg/kg	78.8	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1739880)							
EM1809611-002	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	76.2	76	116
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1739951)							
EM1809532-002	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	40 mg/kg	74.7	58	114

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	High
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1740462)							
EM1809532-002	Anonymous	EK026SF: Total Cyanide	57-12-5	20 mg/kg	91.2	77	113
EK040T: Fluoride Total (QCLot: 1734385)							
EM1809592-004	Anonymous	EK040T: Fluoride	16984-48-8	400 mg/kg	95.8	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1735916)							
EM1809614-003	NEL-BH101_1.0	EP066-EM: Total Polychlorinated biphenyls	----	1 mg/kg	121	36	152
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 1734310)							
EM1809614-003	NEL-BH101_1.0	EP074-UT: Benzene	71-43-2	2 mg/kg	89.8	50	138
		EP074-UT: Toluene	108-88-3	2 mg/kg	88.8	56	134
EP074I: Volatile Halogenated Compounds (QCLot: 1734310)							
EM1809614-003	NEL-BH101_1.0	EP074-UT: 1.1-Dichloroethene	75-35-4	2 mg/kg	96.4	26	141
		EP074-UT: Trichloroethene	79-01-6	2 mg/kg	88.8	50	134
		EP074-UT: Chlorobenzene	108-90-7	2 mg/kg	88.7	28	134
EP075A: Phenolic Compounds (Halogenated) (QCLot: 1735914)							
EM1809613-005	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	1 mg/kg	90.3	34	118
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	1 mg/kg	68.9	41	139
		EP075-EM: Pentachlorophenol	87-86-5	1 mg/kg	43.3	10	144
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 1735914)							
EM1809613-005	Anonymous	EP075-EM: Phenol	108-95-2	1 mg/kg	78.1	32	134
		EP075-EM: 2-Nitrophenol	88-75-5	1 mg/kg	64.0	13	129
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 1735914)							
EM1809613-005	Anonymous	EP075-EM: Acenaphthene	83-32-9	1 mg/kg	95.2	46	138
		EP075-EM: Pyrene	129-00-0	1 mg/kg	91.6	27	169
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1734310)							
EM1809614-003	NEL-BH101_1.0	EP074-UT: C6 - C9 Fraction	----	28 mg/kg	64.9	43	111
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735915)							
EM1809614-002	NEL-BH101_0.5	EP071-EM: C10 - C14 Fraction	----	806 mg/kg	88.1	53	123
		EP071-EM: C15 - C28 Fraction	----	3006 mg/kg	101	70	124
		EP071-EM: C29 - C36 Fraction	----	1584 mg/kg	92.7	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1734310)							
EM1809614-003	NEL-BH101_1.0	EP074-UT: C6 - C10 Fraction	C6_C10	33 mg/kg	64.5	42	106
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1735915)							
EM1809614-002	NEL-BH101_0.5	EP071-EM: >C10 - C16 Fraction	----	1160 mg/kg	91.4	65	123
		EP071-EM: >C16 - C34 Fraction	----	3978 mg/kg	98.3	67	121
		EP071-EM: >C34 - C40 Fraction	----	313 mg/kg	80.8	44	126

Sub-Matrix: **WATER**

Matrix Spike (MS) Report

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1739115)							
EM1809532-020	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	94.0	85	131
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	94.3	81	133
		EG020A-F: Copper	7440-50-8	0.2 mg/L	92.1	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	90.7	75	133
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	96.4	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	94.9	75	131
EG035F: Dissolved Mercury by FIMS (QCLot: 1739114)							
EM1809532-021	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	96.6	70	120
EG050F: Dissolved Hexavalent Chromium (QCLot: 1737214)							
EM1809532-021	Anonymous	EG050F: Hexavalent Chromium	18540-29-9	0.5 mg/L	102	59	127
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1742808)							
EM1809532-021	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	95.4	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1735705)							
EM1809575-001	Anonymous	EK040P: Fluoride	16984-48-8	50 mg/L	103	70	130
EP074E: Halogenated Aliphatic Compounds (QCLot: 1735516)							
EM1809613-003	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	20 µg/L	96.2	40	124
		EP074: Trichloroethene	79-01-6	20 µg/L	85.2	54	126
EP074F: Halogenated Aromatic Compounds (QCLot: 1735516)							
EM1809613-003	Anonymous	EP074: Chlorobenzene	108-90-7	20 µg/L	90.5	68	132
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1735515)							
EM1809613-003	Anonymous	EP080: C6 - C9 Fraction	----	280 µg/L	65.3	43	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1735515)							
EM1809613-003	Anonymous	EP080: C6 - C10 Fraction	C6_C10	330 µg/L	63.5	44	122
EP080: BTEXN (QCLot: 1735515)							
EM1809613-003	Anonymous	EP080: Benzene	71-43-2	20 µg/L	87.1	68	130
		EP080: Toluene	108-88-3	20 µg/L	92.9	72	132

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1809614**	Page	: 1 of 14
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Telephone	: +61-3-8549 9630
Project	: 31350060910	Date Samples Received	: 15-Jun-2018
Site	: ----	Issue Date	: 25-Jun-2018
Sampler	: AS, SH	No. of samples received	: 15
Order number	:	No. of samples analysed	: 9

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Surrogate recovery outliers exist for all regular sample matrices - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Regular Sample Surrogates

Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Samples Submitted							
EP075T: Base/Neutral Extractable Surrogates (Waste C	EM1809614-014	FB120	**4-Terphenyl-d14**	1718-51-0	137 %	66-136 %	**Recovery greater than upper data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
RB120, FB120	----	----	----	19-Jun-2018	14-Jun-2018	**5**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	9	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	4	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	4	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	15	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	9	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	15	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		**Date extracted**	Due for extraction	Evaluation	**Date analysed**	Due for analysis	Evaluation

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	20-Jun-2018	✓
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**----**	----	----	**18-Jun-2018**	28-Jun-2018	✓
EG005T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**21-Jun-2018**	11-Dec-2018	✓	**21-Jun-2018**	11-Dec-2018	✓
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**21-Jun-2018**	12-Jul-2018	✓	**22-Jun-2018**	12-Jul-2018	✓
EG048: Hexavalent Chromium (Alkaline Digest)								
Soil Glass Jar - Unpreserved (EG048G)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**20-Jun-2018**	12-Jul-2018	✓	**20-Jun-2018**	27-Jun-2018	✓
EK026SF: Total CN by Segmented Flow Analyser								
Soil Glass Jar - Unpreserved (EK026SF)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**20-Jun-2018**	28-Jun-2018	✓	**21-Jun-2018**	04-Jul-2018	✓
EK040T: Fluoride Total								
Soil Glass Jar - Unpreserved (EK040T)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**18-Jun-2018**	12-Jul-2018	✓	**20-Jun-2018**	12-Jul-2018	✓
EP066: Polychlorinated Biphenyls (PCB)								
Soil Glass Jar - Unpreserved (EP066-EM)								
NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP074A: Monocyclic Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**18-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	21-Jun-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP074H: Naphthalene								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**18-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	21-Jun-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP074I: Volatile Halogenated Compounds								
Soil Glass Jar - Unpreserved (EP074-UT)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**18-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	21-Jun-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP075A: Phenolic Compounds (Halogenated)								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP075A: Phenolic Compounds (Non-halogenated)								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP075B: Polynuclear Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							
EP075I: Organochlorine Pesticides								
Soil Glass Jar - Unpreserved (EP075-EM)								
NEL-BH101_0.5,	NEL-BH101_1.0,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
NEL-EF-BH015_0.5,	NEL-EF-BH015_1.0,							
NEL-EF-BH018_0.2,	NEL-EF-BH018_0.5							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP074-UT) NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**18-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	21-Jun-2018	✓
Soil Glass Jar - Unpreserved (EP071-EM) NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP074-UT) NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**18-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	21-Jun-2018	✓
Soil Glass Jar - Unpreserved (EP071-EM) NEL-BH101_0.5, NEL-EF-BH015_0.5, NEL-EF-BH018_0.2,	NEL-BH101_1.0, NEL-EF-BH015_1.0, NEL-EF-BH018_0.5	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**19-Jun-2018**	14-Jun-2018	×
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020B-F) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**20-Jun-2018**	11-Dec-2018	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG035F) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**25-Jun-2018**	28-Jun-2018	✓
EG050F: Dissolved Hexavalent Chromium								
Clear Plastic Bottle - NaOH (EG050F) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**19-Jun-2018**	12-Jul-2018	✓
EK026SF: Total CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH (EK026SF) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**21-Jun-2018**	28-Jun-2018	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P) RB120,	FB120	**14-Jun-2018**	**----**	----	----	**19-Jun-2018**	12-Jul-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP066: Polychlorinated Biphenyls (PCB)								
Amber Glass Bottle - Unpreserved (EP066)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**22-Jun-2018**	30-Jul-2018	✓
EP074A: Monocyclic Aromatic Hydrocarbons								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB120,	FB120	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓
EP074E: Halogenated Aliphatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB120,	FB120	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓
EP074F: Halogenated Aromatic Compounds								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB120,	FB120	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓
EP074G: Trihalomethanes								
Amber VOC Vial - Sulfuric Acid (EP074)								
RB120,	FB120	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**22-Jun-2018**	30-Jul-2018	✓
EP075A: Phenolic Compounds (Halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075A: Phenolic Compounds (Non-halogenated)								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP075I: Organochlorine Pesticides								
Amber Glass Bottle - Unpreserved (EP075-EM)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**21-Jun-2018**	30-Jul-2018	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**22-Jun-2018**	30-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
RB120, TB120	FB120,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber Glass Bottle - Unpreserved (EP071)								
RB120,	FB120	**14-Jun-2018**	**20-Jun-2018**	21-Jun-2018	✓	**22-Jun-2018**	30-Jul-2018	✓
Amber VOC Vial - Sulfuric Acid (EP080)								
RB120, TB120	FB120,	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) RB120, FB120, TB120	**14-Jun-2018**	**19-Jun-2018**	28-Jun-2018	✓	**20-Jun-2018**	28-Jun-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	9	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	4	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	4	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	15	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium - Dissolved	EG050F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	9	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	4	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	0	4	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	15	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds	EP074	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons (2011) 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060A. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.
PCB - VIC EPA 448.3 Screen	EP066-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
TRH - Semivolatile Fraction	EP071-EM	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
Volatile Organic Compounds - Ultra-trace	EP074-UT	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS in partial SIM/Scan mode. Quantification is by comparison against an established multi-point calibration curves. This method is compliant with NEPM (2013) Schedule B(3) (Method 501)

Analytical Methods	Method	Matrix	Method Descriptions
Volatile Organic Compounds - Ultra-trace - Summations	EP074-UT-SUM	SOIL	Summation of MAHs and VHCs
Semivolatile Organic Compounds - Waste Classification	EP075-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
SVOC - Waste Classification (Sums)	EP075-EM-SUM	SOIL	Summations for EP075 (EM variation)
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium - Dissolved	EG050F	WATER	In house: Referenced to APHA 3500 Cr-B. Samples are 0.45µm filtered prior to analysis. Hexavalent chromium is determined on filtered water sample as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
Volatile Organic Compounds	EP074	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Semivolatile Organic Compounds - Waste Classification	EP075-EM	WATER	In house: Referenced to USEPA SW 846 - 8270B Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Higginson 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils - Ultra-trace.	ORG16-UT	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids - VIC EPA Screen	ORG17-EM	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Separatory Funnel Extraction of Liquids	ORG14-EM	WATER	In house: Referenced to USEPA SW 846 - 3510B. 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using dichloromethane. The resultant extracts are combined, dehydrated, concentrated and exchanged into toluene for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.

Preparation Methods	Method	Matrix	Method Descriptions
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1805796**	Page	: 1 of 35
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350060803	Date Samples Received	: 06-Apr-2018 10:25
Order number	:	Date Analysis Commenced	: 12-Apr-2018
C-O-C number	: ----	Issue Date	: 30-Apr-2018 12:17
Sampler	: GHD		
Site	: ----		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 63		
No. of samples analysed	: 63		

NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Samantha Smith	Laboratory Coordinator	WRG Subcontracting, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA031 (Saturated Paste pH): NATA accreditation does not cover the performance of this service.
- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.
- ALS is not NATA accredited for the calculation of saturated resistivity in a soil.

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH114_5.22-5.30 m	NEL-BH008_10.0-10.1 m	NEL-BH099_10.0-10.1 0m	NEL-BH099_20.04-20. 18m	NEL-BH095_9.97-10.1 1m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-001	EM1805796-002	EM1805796-003	EM1805796-004	EM1805796-007
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-4.6**	**-6.5**	**-6.8**	**-1.9**	**-5.9**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**6.9**	**6.3**	**6.3**	**4.1**	**6.7**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	**0.6**	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**0.8**	**5.1**	**4.8**	**3.9**	**1.7**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**4.6**	**6.5**	**6.8**	**5.9**	**5.9**
ANC as CaCO3	----	0.1	% CaCO3	**0.5**	**0.7**	**0.7**	**0.6**	**0.6**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**6.8**	**7.3**	**7.6**	**7.3**	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.2**	**6.3**	**6.4**	**6.4**	**6.2**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	**0.007**	**0.006**	**0.122**	**0.007**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	**76**	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**0.12**	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	**76**	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	**6**	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**0.12**	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	**76**	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	**6**	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**1040**	**1100**	**1860**	**1800**	----
ED040S : Soluble Sulfate by ICPAES								

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH114_5.22-5.30 m	NEL-BH008_10.0-10.1 m	NEL-BH099_10.0-10.10m	NEL-BH099_20.04-20.18m	NEL-BH095_9.97-10.11m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-001	EM1805796-002	EM1805796-003	EM1805796-004	EM1805796-007
				Result	Result	Result	Result	Result
ED040S : Soluble Sulfate by ICPAES - Continued								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**10**	**20**	<10	**230**	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	**0.13**	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**350**	**310**	**120**	**20**	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	----
Sodium	7440-23-5	10	mg/kg	**260**	**250**	**110**	**110**	----
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	**30**	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH122_4.56-4.64 m	NEL-BH093_5.05-5.17 m	NEL-BH108_5.7-5.79m	NEL-BH092_5.0-5.10m	NEL-BH092_9.85-10.0 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-008	EM1805796-009	EM1805796-010	EM1805796-011	EM1805796-012
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-6.6	-3.0	-4.7	-6.2	-4.7
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.6	7.1	7.2	7.9	7.4
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.6	3.0	5.3	6.2	4.7
ANC as CaCO3	----	0.1	% CaCO3	0.7	0.3	0.5	0.6	0.5
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	7.3	----	----	7.5
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.6	6.4	6.4	7.5	6.8
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.005	0.006	0.013	0.007	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.51	----	----	0.67	0.31
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	102	----	----	134	62
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.16	----	----	0.21	0.10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH122_4.56-4.64 m	NEL-BH093_5.05-5.17 m	NEL-BH108_5.7-5.79m	NEL-BH092_5.0-5.10m	NEL-BH092_9.85-10.0 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-008	EM1805796-009	EM1805796-010	EM1805796-011	EM1805796-012
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	<1.0	----	----	**21.4**
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	----	**1530**	----	----	**910**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	**10**	----	----	**20**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	**0.02**	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	**320**	----	----	**520**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	----	----	<10
Magnesium	7439-95-4	10	mg/kg	----	<10	----	----	<10
Sodium	7440-23-5	10	mg/kg	----	**240**	----	----	**390**
Potassium	7440-09-7	10	mg/kg	----	<10	----	----	<10

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH089_8.70-8.90 m	NEL-BH089_15.0-15.7 m	NEL-BH087_5.60-5.79 m	NEL-BH087_14.90-15.10m	NEL-BH100_5.10-5.30 m
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-013	EM1805796-014	EM1805796-015	EM1805796-016	EM1805796-017
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.9	-5.0	-3.6	-6.6	-6.0
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.7	6.7	7.0	7.8	7.4
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.8	1.1	0.2	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.9	5.0	3.6	6.6	6.0
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.5	0.4	0.7	0.6
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	7.4	7.4	7.6	7.8	8.0
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.6	6.2	6.5	6.8	6.4
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.005	0.008	0.007	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.24	----	0.28	0.64	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	49	----	56	128	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.08	----	0.09	0.20	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH089_8.70-8.90 m	NEL-BH089_15.0-15.7 m	NEL-BH087_5.60-5.79 m	NEL-BH087_14.90-15.10m	NEL-BH100_5.10-5.30 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-013	EM1805796-014	EM1805796-015	EM1805796-016	EM1805796-017
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	1130	1370	1200	1320	2430
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	30	30	30	50
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	460	460	300	160	150
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	320	320	250	160	150
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH100_17.34-17.44m	NEL-BH031_10.04-10.11m	NEL-BH031_20.03-20.13m	NEL-BH083_14.84-15.0m	NEL-BH083_25.0-25.22m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-018	EM1805796-019	EM1805796-020	EM1805796-021	EM1805796-022
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-4.9**	**-5.3**	**-7.4**	<0.5	<0.5
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**6.9**	**7.3**	**6.8**	**3.6**	**3.6**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	**1.6**	**2.0**
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**0.4**	<0.1	**0.4**	**3.6**	**4.1**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**8.9**	**5.3**	**14.7**	**7.0**	**7.0**
ANC as CaCO3	----	0.1	% CaCO3	**0.9**	**0.5**	**1.5**	**0.7**	**0.7**
Fizz Rating	----	0	Fizz Unit	**1**	**0**	**1**	**0**	**0**
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**7.6**	**7.6**	**8.3**	**8.0**	**8.4**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.7**	**6.4**	**8.6**	**6.7**	**6.7**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.131**	**0.012**	**0.222**	**0.182**	**0.222**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**82**	<10	**139**	**113**	**138**
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**3.29**	----	**0.38**	**0.57**	**0.54**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**657**	----	**75**	**113**	**107**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**1.05**	----	**0.12**	**0.18**	**0.17**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	**0.14**	**0.06**	**0.11**
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	**88**	**38**	**67**
Liming Rate	----	1	kg CaCO3/t	<1	<1	**7**	**3**	**5**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.13**	<0.02	**0.22**	**0.18**	**0.22**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**82**	<10	**139**	**113**	**138**
Liming Rate excluding ANC	----	1	kg CaCO3/t	**6**	<1	**10**	**8**	**10**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH100_17.34-17.44m	NEL-BH031_10.04-10.11m	NEL-BH031_20.03-20.13m	NEL-BH083_14.84-15.0m	NEL-BH083_25.0-25.22m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-018	EM1805796-019	EM1805796-020	EM1805796-021	EM1805796-022
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**1040**	**1220**	**1630**	**1860**	**3460**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**260**	**40**	**200**	**140**	**70**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.13**	<0.01	**0.24**	**0.23**	**0.24**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**160**	**210**	**60**	**40**	**20**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	**260**	**180**	**170**	**110**	**60**
Potassium	7440-09-7	10	mg/kg	**20**	<10	**30**	**20**	<10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH084_15.3-15.40m	NEL-BH084_20.0-20.08m	NEL-BH084_29.63-29.79m	NEL-BH084_37.95-38.05m	NEL-BH076_19.88-20.03m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-023	EM1805796-024	EM1805796-025	EM1805796-026	EM1805796-027
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-6.6	----	-1.2	10.1	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.1	----	4.0	3.0	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	2.0	8.0	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	4.9	10.2	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.6	----	4.9	4.6	----
ANC as CaCO3	----	0.1	% CaCO3	0.7	----	0.5	0.5	----
Fizz Rating	----	0	Fizz Unit	0	----	0	0	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	6.2	----	----
pH OX (23B)	----	0.1	pH Unit	----	----	3.3	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	<2	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	87	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	87	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	<0.020	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	0.140	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	0.140	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	<0.020	----	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	0.110	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	0.110	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	69	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	<0.020	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	<0.020	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	<0.020	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	<10	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	<0.020	----	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH084_15.3-15.40m	NEL-BH084_20.0-20.08m	NEL-BH084_29.63-29.79m	NEL-BH084_37.95-38.05m	NEL-BH076_19.88-20.03m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-023	EM1805796-024	EM1805796-025	EM1805796-026	EM1805796-027
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	<0.020	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	0.020	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	0.020	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	16	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	0.026	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	1.5	----	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	0.11	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	69	----	----
Liming Rate	----	1	kg CaCO3/t	----	----	5	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	0.11	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	69	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	5	----	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	6.4	6.9	6.9	5.6
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.3	----	6.2	5.3	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	<2	2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	<0.02	<0.02	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.011	----	0.114	0.364	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	71	227	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	----	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	0.11	0.37	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	72	230	----
Liming Rate	----	1	kg CaCO3/t	<1	----	5	17	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	0.11	0.37	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	72	230	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	5	17	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	<1.0	<1.0	<1.0	<1.0

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

			Client sample ID	NEL-BH084_15.3-15.40m	NEL-BH084_20.0-20.08m	NEL-BH084_29.63-29.79m	NEL-BH084_37.95-38.05m	NEL-BH076_19.88-20.03m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-023	EM1805796-024	EM1805796-025	EM1805796-026	EM1805796-027
				Result	Result	Result	Result	Result
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	----	1110	1530	780	770
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	530	260	850	810
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	----	0.12	0.48	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	100	80	50	110
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	20	<10	30	60
Magnesium	7439-95-4	10	mg/kg	----	50	20	100	90
Sodium	7440-23-5	10	mg/kg	----	190	110	170	210
Potassium	7440-09-7	10	mg/kg	----	50	40	80	40

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH076_30.0-30.13m	NEL-BH076_39.79-40.02m	NEL-BH074_20.0-20.14m	NEL-BH074_30.0m	NEL-BH074_41.89-42.0m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-028	EM1805796-029	EM1805796-030	EM1805796-031	EM1805796-032
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-29.0	----	-4.6	-5.4	-6.1
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.7	----	6.6	6.4	6.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	0.9	0.7	0.8
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	31.8	----	7.1	7.8	10.4
ANC as CaCO3	----	0.1	% CaCO3	3.2	----	0.7	0.8	1.1
Fizz Rating	----	0	Fizz Unit	2	----	0	0	1
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	6.7	----
pH OX (23B)	----	0.1	pH Unit	----	----	----	4.5	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	<2	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	----	26	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	----	26	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	----	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	----	0.042	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	----	0.042	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	----	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	----	0.065	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	----	0.065	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	----	40	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	----	<0.020	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	----	<0.020	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	----	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	----	<0.020	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH076_30.0-30.1 3m	NEL-BH076_39.79-40. 02m	NEL-BH074_20.0-20.1 4m	NEL-BH074_30.0m	NEL-BH074_41.89-42. 0m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-028	EM1805796-029	EM1805796-030	EM1805796-031	EM1805796-032
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	----	**0.040**	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	----	**0.044**	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	----	<0.020	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	----	<0.020	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	**0.05**	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	**31**	----
Liming Rate	----	1	kg CaCO3/t	----	----	----	**2**	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	**0.05**	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	**31**	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	**2**	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**8.1**	**7.5**	**7.6**	**7.7**	**7.7**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**7.0**	----	**6.5**	**6.7**	**6.7**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.075**	----	**0.080**	**0.072**	**0.138**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**47**	----	**50**	**45**	**86**
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**5.27**	----	**0.66**	**0.77**	**0.68**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**1050**	----	**132**	**154**	**136**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**1.69**	----	**0.21**	**0.25**	**0.22**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	----	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	<10	<10	<10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH076_30.0-30.13m	NEL-BH076_39.79-40.02m	NEL-BH074_20.0-20.14m	NEL-BH074_30.0m	NEL-BH074_41.89-42.0m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-028	EM1805796-029	EM1805796-030	EM1805796-031	EM1805796-032
				Result	Result	Result	Result	Result
EA033-E: Acid Base Accounting - Continued								
Liming Rate	----	1	kg CaCO3/t	<1	----	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.08**	----	**0.08**	**0.07**	**0.14**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**47**	----	**50**	**45**	**86**
Liming Rate excluding ANC	----	1	kg CaCO3/t	**4**	----	**4**	**3**	**6**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**4.7**	<1.0	<1.0	<1.0	<1.0
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**840**	**510**	**1520**	**1770**	**1880**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**530**	**320**	**160**	**130**	**150**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.09**	----	**0.08**	**0.08**	**0.14**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**220**	**40**	**70**	**80**	**50**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	**490**	**180**	**130**	**130**	**120**
Potassium	7440-09-7	10	mg/kg	**10**	**20**	**10**	<10	<10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH073_24.90-25.06m	NEL-BH059_5.5m	NEL-BH059_10.04-10.18m	NEL-BH059_20.0-20.21m	NEL-BH137_14.87-15.0m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-033	EM1805796-034	EM1805796-035	EM1805796-036	EM1805796-038
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.7	----	-7.6	-5.6	-5.9
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.7	----	7.6	6.7	6.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.9	----	<0.1	0.9	0.7
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.2	----	7.6	7.7	5.9
ANC as CaCO3	----	0.1	% CaCO3	0.8	----	0.8	0.8	0.6
Fizz Rating	----	0	Fizz Unit	1	----	0	0	0
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	6.6	6.8	----	----	----
pH OX (23B)	----	0.1	pH Unit	3.3	7.1	----	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	----	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	90	<2	----	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	90	<2	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	----	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	0.145	<0.020	----	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	0.145	<0.020	----	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	----	----	----
Peroxide Sulfur (23De)	----	0.020	% S	0.152	<0.020	----	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	0.152	<0.020	----	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	95	<10	----	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	<0.020	0.049	----	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	<0.020	0.050	----	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	----	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	----	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	----	----	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH073_24.90-25.06m	NEL-BH059_5.5m	NEL-BH059_10.04-10.18m	NEL-BH059_20.0-20.21m	NEL-BH137_14.87-15.0m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-033	EM1805796-034	EM1805796-035	EM1805796-036	EM1805796-038
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.020**	**0.067**	----	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.034**	**0.079**	----	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	----	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**12**	<10	----	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	----	----	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	**0.039**	----	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	<10	----	----	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	<0.020	----	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	**0.15**	<0.02	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	**92**	<10	----	----	----
Liming Rate	----	1	kg CaCO3/t	**7**	<1	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.15**	<0.02	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**92**	<10	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	**7**	<1	----	----	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**7.4**	**7.4**	**7.8**	**7.7**	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.6**	----	**7.0**	**6.6**	**6.1**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.182**	----	**0.017**	**0.066**	**0.010**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**113**	----	**11**	**41**	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**0.89**	----	**0.72**	**0.57**	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**178**	----	**143**	**113**	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH073_24.90-25.06m	NEL-BH059_5.5m	NEL-BH059_10.04-10.18m	NEL-BH059_20.0-20.21m	NEL-BH137_14.87-15.0m
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-033	EM1805796-034	EM1805796-035	EM1805796-036	EM1805796-038
				Result	Result	Result	Result	Result
EA033-C: Acid Neutralising Capacity - Continued								
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.28**	----	**0.23**	**0.18**	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	----	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	----	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.18**	----	<0.02	**0.07**	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**113**	----	**11**	**41**	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	**8**	----	<1	**3**	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	**19.1**	**1.1**	<1.0	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**2160**	**540**	**1320**	**1150**	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**160**	**80**	**30**	**130**	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.18**	----	<0.01	**0.07**	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	**690**	**190**	**200**	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	----
Sodium	7440-23-5	10	mg/kg	**80**	**590**	**170**	**220**	----
Potassium	7440-09-7	10	mg/kg	**20**	<10	<10	<10	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH037_5m	NEL-BH037_14.98-15.10m	NEL-BH037_25.0-25.08m	NEL-BH124_25.0-25.12m	NEL-BH124_35.03-35.12m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-039	EM1805796-040	EM1805796-041	EM1805796-043	EM1805796-044
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	----	-2.6	3.9	-3.5	-7.6
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	7.1	3.3	6.7	7.1
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	3.7	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	6.6	0.8	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	2.6	4.4	3.5	9.4
ANC as CaCO3	----	0.1	% CaCO3	----	0.3	0.4	0.4	1.0
Fizz Rating	----	0	Fizz Unit	----	0	0	0	1
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	7.5	6.9	6.3	7.2	7.4
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	6.4	6.0	6.1	6.6
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	0.009	0.213	0.011	0.064
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	<10	133	<10	40
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	----	1.24
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	----	247
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	----	0.40
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	----	<0.02	0.21	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	----	<10	133	<10	<10
Liming Rate	----	1	kg CaCO3/t	----	<1	10	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	<0.02	0.21	<0.02	0.06
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	<10	133	<10	40
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	<1	10	<1	3

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH037_5m	NEL-BH037_14.98-15.10m	NEL-BH037_25.0-25.08m	NEL-BH124_25.0-25.12m	NEL-BH124_35.03-35.12m
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-039	EM1805796-040	EM1805796-041	EM1805796-043	EM1805796-044
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.4	<1.0	<1.0	<1.0	<1.0
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	1340	2100	790	1420	1720
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	40	620	40	90
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	<0.01	0.27	<0.01	0.06
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	200	130	260	180	90
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	30	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	70	<10	<10
Sodium	7440-23-5	10	mg/kg	190	140	280	170	120
Potassium	7440-09-7	10	mg/kg	<10	<10	40	<10	10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH124_45.0-45.1 m	NEL-BH067_12.06-12.21m	NEL-BH067_25.0-25.1 3m	NEL-BH068_8.20-8.30 m	NEL-BH068_14.96-15.06m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-045	EM1805796-046	EM1805796-047	EM1805796-048	EM1805796-049
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-3.8	-3.2	0.9	-1.8	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.6	6.9	6.7	7.0	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.7	0.4	0.6	<0.1	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.5	3.2	4.0	1.8	----
ANC as CaCO3	----	0.1	% CaCO3	0.8	0.3	0.4	0.2	----
Fizz Rating	----	0	Fizz Unit	1	0	0	0	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	7.1	5.2	5.8	5.2	6.9
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.4	4.9	5.7	4.8	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	6	<2	6	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.112	0.007	0.118	0.014	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	70	<10	74	<10	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	0.11	<0.02	0.12	0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	70	10	74	15	----
Liming Rate	----	1	kg CaCO3/t	5	<1	6	1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.11	<0.02	0.12	0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	70	10	74	15	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	5	<1	6	1	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	1570	5680	670	11200	2650
ED040S : Soluble Sulfate by ICPAES								

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH124_45.0-45.1 m	NEL-BH067_12.06-12.21m	NEL-BH067_25.0-25.1 3m	NEL-BH068_8.20-8.30 m	NEL-BH068_14.96-15.06m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-045	EM1805796-046	EM1805796-047	EM1805796-048	EM1805796-049
				Result	Result	Result	Result	Result
ED040S : Soluble Sulfate by ICPAES - Continued								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**220**	<10	**1210**	**20**	**100**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.12**	<0.01	**0.16**	<0.01	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**60**	**30**	**30**	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	**40**	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	**260**	<10	<10
Sodium	7440-23-5	10	mg/kg	**140**	**20**	**50**	<10	**20**
Potassium	7440-09-7	10	mg/kg	**20**	<10	**50**	<10	**20**
EP004: Organic Matter								
Total Organic Carbon	----	0.5	%	----	----	----	<0.5	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH068_19.97-20.05m	NEL-BH039_2.40m	NEL-BH004_2.0-2.45m	NEL-BH004_9.05m	NEL-BH004_15.0-15.45m
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-050	EM1805796-051	EM1805796-054	EM1805796-055	EM1805796-056
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	6.7	----
pH OX (23B)	----	0.1	pH Unit	----	----	----	6.8	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	<2	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	----	<2	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	----	<2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	----	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	----	<0.020	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	----	<0.020	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	----	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	----	0.065	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	----	0.065	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	----	41	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	----	0.052	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	----	0.057	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	----	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	----	<0.020	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	----	0.097	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	----	0.116	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	----	<0.020	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	----	15	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	----	0.024	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	----	----	0.029	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	----	<10	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH068_19.97-20.05m	NEL-BH039_2.40m	NEL-BH004_2.0-2.45m	NEL-BH004_9.05m	NEL-BH004_15.0-15.45m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-050	EM1805796-051	EM1805796-054	EM1805796-055	EM1805796-056
				Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity - Continued								
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	----	----	<0.020	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	<10	----
Liming Rate	----	1	kg CaCO3/t	----	----	----	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	0.06	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	41	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	3	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	7.5	----	----	7.0	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	7.1	6.8	----	6.4
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	<2	<2	----	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	<0.02	<0.02	----	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	0.011	0.011	----	0.024
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	<10	<10	----	15
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	1.07	0.40	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	214	80	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	0.34	0.13	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	1.5	1.5	----	1.5
Net Acidity (sulfur units)	----	0.02	% S	----	<0.02	<0.02	----	0.02
Net Acidity (acidity units)	----	10	mole H+ / t	----	<10	<10	----	15
Liming Rate	----	1	kg CaCO3/t	----	<1	<1	----	1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	<0.02	<0.02	----	0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	<10	<10	----	15
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	<1	<1	----	1

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH068_19.97-20.05m	NEL-BH039_2.40m	NEL-BH004_2.0-2.45m	NEL-BH004_9.05m	NEL-BH004_15.0-15.45m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-050	EM1805796-051	EM1805796-054	EM1805796-055	EM1805796-056
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	----	----	20.6	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	1850	----	----	560	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	240	----	----	120	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	----	----	380	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	20	----	----	<10	----
Magnesium	7439-95-4	10	mg/kg	20	----	----	<10	----
Sodium	7440-23-5	10	mg/kg	20	----	----	350	----
Potassium	7440-09-7	10	mg/kg	110	----	----	<10	----
EP004: Organic Matter								
Total Organic Carbon	----	0.5	%	----	----	----	0.8	----

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH004_19.5-19.95m	NEL-BH070_5.0m	NEL-BH085_5.0-5.12m	NEL-BH085_15.0-15.1m	NEL-BH042_14.97-15.08m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-057	EM1805796-060	EM1805796-061	EM1805796-062	EM1805796-063
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	----	----	----	----	**-7.1**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	----	----	----	**7.2**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	----	----	----	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	----	----	----	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	----	----	----	**7.7**
ANC as CaCO3	----	0.1	% CaCO3	----	----	----	----	**0.8**
Fizz Rating	----	0	Fizz Unit	----	----	----	----	**0**
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**6.5**	**5.1**	----	----	----
pH OX (23B)	----	0.1	pH Unit	**6.4**	**4.9**	----	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	**9**	----	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**2**	**15**	----	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	**2**	**6**	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	----	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	**0.024**	----	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	----	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	----	----	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	----	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	----	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	----	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	<0.020	**0.026**	----	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	<0.020	**0.033**	----	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	----	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	----	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	----	----	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH004_19.5-19.95m	NEL-BH070_5.0m	NEL-BH085_5.0-5.12m	NEL-BH085_15.0-15.1m	NEL-BH042_14.97-15.08m
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
				EM1805796-057	EM1805796-060	EM1805796-061	EM1805796-062	EM1805796-063
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.037**	**0.044**	----	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.037**	**0.049**	----	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	----	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	----	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	----	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	----	----	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	**5.2**	**7.3**	**7.2**	**7.6**
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	----	**1890**	**1410**	**1260**	**3160**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	**90**	**70**	**260**	**20**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	----	----	----	**0.02**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	**30**	**110**	**80**	**10**
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	----	**20**	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	----	**120**	**160**	**180**	**50**
Potassium	7440-09-7	10	mg/kg	----	**10**	<10	**30**	<10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-BH042_25.15-25.25m	----	----	----	----
			Client sampling date / time	06-Apr-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM1805796-064	--------	--------	--------	--------
				Result	----	----	----	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**6.9**	----	----	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**830**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**680**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
Sodium	7440-23-5	10	mg/kg	**270**	----	----	----	----
Potassium	7440-09-7	10	mg/kg	**70**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH110_5.0-5.20m	NEL-BH095_5.45-5.55 m	NEL-BH137_5.0m	NEL-BH005_4.11-4.56 m	NEL-BH068_8.20-8.30 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-005	EM1805796-006	EM1805796-037	EM1805796-042	EM1805796-048
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	----	-5.8	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	7.4	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	6.4	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	----	0.6	----	----	----
Fizz Rating	----	0	Fizz Unit	----	0	----	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	6.6	----
pH OX (23B)	----	0.1	pH Unit	----	----	----	7.3	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	<2	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	----	<2	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	----	<2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	----	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	----	<0.020	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	----	<0.020	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	----	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	----	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	----	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	----	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	----	0.041	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	----	0.041	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	----	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	----	<0.020	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH110_5.0-5.20m	NEL-BH095_5.45-5.55 m	NEL-BH137_5.0m	NEL-BH005_4.11-4.56 m	NEL-BH068_8.20-8.30 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-005	EM1805796-006	EM1805796-037	EM1805796-042	EM1805796-048
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	----	**0.087**	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	----	**0.087**	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	----	<0.020	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	----	<0.020	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	----	----	<0.020	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	----	----	<0.020	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	<10	----
Liming Rate	----	1	kg CaCO3/t	----	----	----	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	<1	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	**7.4**	----	----	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.3**	**6.3**	**7.0**	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.007**	**0.006**	**0.010**	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	**0.22**	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	**44**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH110_5.0-5.20m	NEL-BH095_5.45-5.55 m	NEL-BH137_5.0m	NEL-BH005_4.11-4.56 m	NEL-BH068_8.20-8.30 m
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00
Compound	CAS Number	LOR	Unit	EM1805796-005	EM1805796-006	EM1805796-037	EM1805796-042	EM1805796-048
				Result	Result	Result	Result	Result
EA033-C: Acid Neutralising Capacity - Continued								
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	0.07	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	18.3	----	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	----	2310	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	100	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	0.02	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	100	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	----	----	----
Magnesium	7439-95-4	10	mg/kg	----	<10	----	----	----
Sodium	7440-23-5	10	mg/kg	----	140	----	----	----
Potassium	7440-09-7	10	mg/kg	----	<10	----	----	----
MM820: Sulphate Reducing Bacteria								
Sulphate Reducing Bacteria Population Estimate	----	200	pac/g	----	----	----	----	<200
Aggressivity	----	1	-	----	----	----	----	Low to Medium

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	NEL-BH039_5.9m	NEL-BH039_9.80m	NEL-BH004_9.05m	NEL-BH070_2.0m	----
Client sampling date / time				06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	----
				EM1805796-052	EM1805796-053	EM1805796-055	EM1805796-059	--------
				Result	Result	Result	Result	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**6.6**	----	----	**8.6**	----
pH OX (23B)	----	0.1	pH Unit	**7.0**	----	----	**7.7**	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	<2	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	<2	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	<2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	----	----	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	----	----	<0.020	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	----	----	<0.020	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	----	----	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	----	----	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	----	----	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.120**	----	----	**0.202**	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.120**	----	----	**0.246**	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	----	----	**0.044**	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	**22**	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	----	----	**0.035**	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.118**	----	----	**0.038**	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.118**	----	----	**0.074**	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	----	----	**0.036**	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	**30**	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	----	----	**0.048**	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	<0.020	----	----	**0.369**	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	<10	----	----	**74**	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	<0.020	----	----	**0.118**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH039_5.9m	NEL-BH039_9.80m	NEL-BH004_9.05m	NEL-BH070_2.0m	----
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	----
Compound	CAS Number	LOR	Unit	EM1805796-052	EM1805796-053	EM1805796-055	EM1805796-059	--------
				Result	Result	Result	Result	----
EA029-F: Excess Acid Neutralising Capacity - Continued								
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	----	----	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	<10	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	<1	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**7.0**	**6.2**	----	----	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	**5.9**	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	**5**	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	<0.02	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	**0.244**	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	**152**	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	**1.5**	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	----	**0.25**	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	**158**	----	----	----
Liming Rate	----	1	kg CaCO3/t	----	**12**	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	**0.25**	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	**158**	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	**12**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**15.5**	**21.1**	----	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**1040**	**1110**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**30**	**90**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**140**	**50**	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-BH039_5.9m	NEL-BH039_9.80m	NEL-BH004_9.05m	NEL-BH070_2.0m	----
			Client sampling date / time	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	06-Apr-2018 00:00	----
Compound	CAS Number	LOR	Unit	EM1805796-052	EM1805796-053	EM1805796-055	EM1805796-059	--------
				Result	Result	Result	Result	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	<10	----	----	----
Sodium	7440-23-5	10	mg/kg	**290**	**80**	----	----	----
Potassium	7440-09-7	10	mg/kg	<10	<10	----	----	----
EP004: Organic Matter								
Total Organic Carbon	----	0.5	%	**0.6**	----	----	----	----
MM820: Sulphate Reducing Bacteria								
Sulphate Reducing Bacteria Population Estimate	----	200	pac/g	<200	----	<200	----	----
Aggressivity	----	1	-	**Low to Medium**	----	**Low to Medium**	----	----

ANZ

AECOM

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: GHD Pty Ltd	ADDRESS / OFFICE:	SAMPLER: GHD	**Destination Laboratory**
PROJECT MANAGER (PM): David Quinn	SITE: Melbourne	MOBILE: S.Hilliard 0430 344 657 PHONE:	ALS Springvale
PROJECT NUMBER & TASK COI 31350060803	P.O. NO.:	EMAIL REPORT TO: nazuha.rosli@aecom.co marcin.wieloch@ghd.com	ATT: Shirley LeCornu
RESULTS REQUIRED (Date): ASAP	QUOTE NO.:	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Extra volume for QC or trace LORs etc.
NEL-Suite 1 inc. testing of concentration of: Ca2+, Na+, Mg2+, K+, SO42-, Cl-
NEL-Suite 2 inc. testing of soil resistivity (to AS 1289.4.4.1) and pH (to AS 1289.4.3.1).
NEL-Suite 3 inc. acid sulphate soil testing to include pHKCl, TAA and pHOx as per AS 4969.12 and net acidity as per AS 4969.14. Where sample at designated depth is rock not soil, undertake NAG and NAP testing instead.
NEL-Suite 4 inc. NAPP (ASS-1) and NAG (EA011) testing.
NEL-Suite 5 inc. testing of total organic carbon (TOC) content and sulphate reducing bacteria (SRB). TOC testing to be carried out to (AS 1289.4.1.1).

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total ~~bottles~~ BAGS	NAPP (ASS-1)	NAG (EA011)	Chromium Suite (EA033)	SPOCAS Suite (EA029)	NEL-Suite 1	NEL-Suite 2	NEL-Suite 3	NEL-Suite 4	NEL-Suite 5
1	NEL-BH114_5.22-5.30m	S			Bag	1	1	1	1		1	1			
2	NEL-BH008_10.0-10.1m	S			Bag	1	1	1	1		1	1			
3	NEL-BH099_10.0-10.10m	S			Bag	1	1	1	1		1	1			
4	NEL-BH099_20.04-20.18m	S			Bag	1	1	1	1		1	1			
5	NEL-BH110_5.0-5.20m	S			Bag	1			1						
6	NEL-BH095_5.45-5.55m	S			Bag	1	1	1	1		1	1			
7	NEL-BH095_9.97-10.11m	S			Bag	1	1	1	1						
8	NEL-BH122_4.56-4.64m	S			Bag	1	1	1	1						
9	NEL-BH093_5.05-5.17m	S			Bag	1	1	1	1		1	1			
10	NEL-BH108_5.7-5.79m	S			Bag	1	1	1	1						
11	NEL-BH092_5.0-5.10m	S			Bag	1	1	1	1						
12	NEL-BH092_9.85-10.0m	S			Bag	1	1	1	1		1	1			
13	NEL-BH089_8.70-8.90m	S			Bag	1	1	1	1		1	1			
14	NEL-BH089_15.0-15.17m	S			Bag	1	1	1	1		1	1			
15	NEL-BH087_5.60-5.79m	S			Bag	1	1	1	1		1	1			
16	NEL-BH087_14.90-15.10m	S			Bag	1	1	1	1		1	1			
18															

Environmental Division
Melbourne
Work Order Reference
EM1805796

Telephone : + 61-3-8549 9600

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name: ANDY SHEO	Date: 6/4/18	Name: SHANE 24	Date:	Name: Nisla	Date: 6/4/18	Con' Note No:
Of: GHD	Time:	Of:	Time:	Of: ALS	Time: 10:25 am	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

COC Page 1 of 4

AECOM

ANZ

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: GHD Pty Ltd	ADDRESS / OFFICE:	SAMPLER: GHD	**Destination Laboratory**
PROJECT MANAGER (PM): David Quinn	SITE: Melbourne	MOBILE: S.Hilliard 0430 344 657 PHONE:	ALS Springvale
PROJECT NUMBER & TASK CO 3135006080	P.O. NO.:	EMAIL REPORT TO: nazuha.rosli@aecom.co marcin.wieloch@ghd.com	ATT: Shirley LeCornu
RESULTS REQUIRED (Date): ASAP	QUOTE NO.:	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Extra volume for QC or trace LORs etc.
NEL-Suite 1 inc. testing of concentration of: Ca^{2+}, Na^{+}, Mg^{2+}, K^{+}, SO_4^{2-}, Cl^{-}.
NEL-Suite 2 inc. testing of soil resistivity (to AS 1289.4.4.1) and pH (to AS 1289.4.3.1).
NEL-Suite 3 inc. acid sulphate soil testing to include pHKCl, TAA and pHOx as per AS 4969.12 and net acidity as per AS 4969.14. Where sample at designated depth is rock not soil, undertake NAG and NAP testing instead.
NEL-Suite 4 inc. NAPP (ASS-1) and NAG (EA011) testing.
NEL-Suite 5 inc. testing of total organic carbon (TOC) content and sulphate reducing bacteria (SRB). TOC testing to be carried out to (AS 1289.4.1.1).

SAMPLE INFORMATION (note: S = Soil, W=Water) / CONTAINER INFORMATION

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total ~~bottles~~ BAGS	NAPP (ASS-1)	NAG (EA011)	Chromium Suite (EA033)	SPOCAS Suite (EA029)	NEL-Suite 1	NEL-Suite 2	NEL-Suite 3	NEL-Suite 4	NEL-Suite 5
17	NEL-BH100_5.10-5.30m	S			Bag	1	1	1	1		1	1			
18	NEL-BH100_17.34-17.44m	S			Bag	1	1	1	1		1	1			
19	NEL-BH031_10.04-10.11m	S			Bag	1	1	1	1		1	1			
20	NEL-BH031_20.03-20.13m	S			Bag	1	1	1	1		1	1			
21	NEL-BH083_14.84-15.0m	S			Bag	1	1	1	1		1	1			
22	NEL-BH083_25.0-25.22m	S			Bag	1	1	1	1		1	1			
23	NEL-BH084_15.3-15.40m	S			Bag	1	1	1	1						
24	NEL-BH084_20.0-20.08m	S			Bag	1					1	1			
25	NEL-BH084_29.63-29.79m	S			Bag	1	1	1	1		1	1	1		
26	NEL-BH084_37.95-38.05m	S			Bag	1	1	1	1		1	1			
27	NEL-BH076_19.88-20.03m	S			Bag	1					1	1			
28	NEL-BH076_30.0-30.13m	S			Bag	1	1	1	1		1	1		1	
29	NEL-BH076_39.79-40.02m	S			Bag	1					1	1			
30	NEL-BH074_20.0-20.14m	S			Bag	1	1	1	1		1	1			
31	NEL-BH074_30.0m	S			Bag	1	1	1	1		1	1	1		
32	NEL-BH074_41.89-42.0m	S			Bag	1	1	1	1		1	1			
33	NEL-BH073_24.90-25.06m	S			Bag	1	1	1	1		1	1	1		
34	NEL-BH059_5.5m	S			Bag	1				1	1	1			
35	NEL-BH059_10.04-10.18m	S			Bag	1	1	1	1		1	1			
36	NEL-BH059_20.0-20.21m	S			Bag	1	1	1	1		1	1			

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name:	Date:	Name:	Date:	Name: Nisekhar	Date: 6/4/18	Con' Note No:
Of:	Time:	Of:	Time:	Of: ALS	Time: 10.25	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

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ANZ

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: GHD Pty Ltd	ADDRESS / OFFICE:	SAMPLER: GHD	**Destination Laboratory**
PROJECT MANAGER (PM): David Quinn	SITE: Melbourne	MOBILE: S.Hilliard 0430 344 657 PHONE:	ALS Springvale
PROJECT NUMBER & TASK COI 3135006 0803	P.O. NO.:	EMAIL REPORT TO: nazuha.rosli@aecom.co marcin.wieloch@ghd.com	ATT: Shirley LeCornu
RESULTS REQUIRED (Date): ASAP	QUOTE NO.:	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Extra volume for QC or trace LORs etc.
NEL-Suite 1 inc. testing of concentration of: Ca2+, Na+, Mg2+, K+, SO42-, Cl-.
NEL-Suite 2 inc. testing of soil resistivity (to AS 1289.4.4.1) and pH (to AS 1289.4.3.1).
NEL-Suite 3 inc. acid sulphate soil testing to include pHKCl, TAA and pHOx as per AS 4969.12 and net acidity as per AS 4969.14. Where sample at designated depth is rock not soil, undertake NAG and NAP testing instead.
NEL-Suite 4 inc. NAPP (ASS-1) and NAG (EA011) testing.
NEL-Suite 5 inc. testing of total organic carbon (TOC) content and sulphate reducing bacteria (SRB). TOC testing to be carried out to (AS 1289.4.1.1).

SAMPLE INFORMATION (note: S = Soil, W=Water) / CONTAINER INFORMATION

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total ~~bottles~~ BAGS	NAPP (ASS-1)	NAG (EA011)	Chromium Suite (EA033)	SPOCAS Suite (EA029)	NEL-Suite 1	NEL-Suite 2	NEL-Suite 3	NEL-Suite 4	NEL-Suite 5
37	NEL-BH137_5.0m	S			Bag	1			1						
38	NEL-BH137_14.87-15.0m	S			Bag	1	1	1	1						
39	NEL-BH037_5m	S			Bag	1					1	1			
40	NEL-BH037_14.98-15.10m	S			Bag	1	1	1	1		1	1			
41	NEL-BH037_25.0-25.08m	S			Bag	1	1	1	1		1	1			
42	NEL-BH005_4.11-4.56m	S			Bag	1				1					
43	NEL-BH124_25.0-25.12m	S			Bag	1	1	1	1		1	1			
44	NEL-BH124_35.03-35.12m	S			Bag	1	1	1	1		1	1			
45	NEL-BH124_45.0-45.1m	S			Bag	1	1	1	1		1	1			
46	NEL-BH067_12.06-12.21m	S			Bag	1	1	1	1		1	1			
47	NEL-BH067_25.0-25.13m	S			Bag	1	1	1	1		1	1			
48	NEL-BH068_8.20-8.30m	S			Bag	1	1	1	1		1	1		1	1
49	NEL-BH068_14.96-15.06m	S			Bag	1					1	1			
50	NEL-BH068_19.97-20.05m	S			Bag	1					1	1			
51	NEL-BH039_2.40m	S			Bag	1			1						
52	NEL-BH039_5.9m				Bag	1					1	1	1		1
53	NEL-BH039_9.80m	S			Bag	1			1		1	1			

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name:	Date:	Name:	Date:	Name: Nisalwo	Date: 6/4/18	Con' Note No:
Of:	Time:	Of:	Time:	Of: ALS	Time: 10:25 am	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

COC Page 3 of 4

ANZ

FQM - Generic Chain of Custody Form

AECOM

Q4AN(EV)-007-FM1

CONSULTANT: GHD Pty Ltd	ADDRESS / OFFICE:	SAMPLER: GHD	**Destination Laboratory**
PROJECT MANAGER (PM): David Quinn	SITE: **Melbourne**	MOBILE: S.Hilliard 0430 344 657 PHONE:	ALS Springvale
PROJECT NUMBER & TASK COI 31350060803	P.O. NO.:	EMAIL REPORT TO: nazuha.rosli@aecom.co marcin.wieloch@ghd.com	ATT: Shirley LeCornu
RESULTS REQUIRED (Date): **ASAP**	QUOTE NO.:	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Extra volume for QC or trace LORs etc.
NEL-Suite 1 inc. testing of concentration of: Ca2+, Na+, Mg2+, K+, SO42-, Cl-.
NEL-Suite 2 inc. testing of soil resistivity (to AS 1289.4.4.1) and pH (to AS 1289.4.3.1).
NEL-Suite 3 inc. acid sulphate soil testing to include pHKCl, TAA and pHOx as per AS 4969.12 and net acidity as per AS 4969.14. Where sample at designated depth is rock not soil, undertake NAG and NAP testing instead.
NEL-Suite 4 inc. NAPP (ASS-1) and NAG (EA011) testing.
NEL-Suite 5 inc. testing of total organic carbon (TOC) content and sulphate reducing bacteria (SRB). TOC testing to be carried out to (AS 1289.4.1.1).

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION										
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total Bags	NAPP (ASS-1)	NAG (EA011)	Chromium Suite (EA033)	SPOCAS Suite (EA029)	NEL-Suite 1	NEL-Suite 2	NEL-Suite 3 Note 1	NEL-Suite 4	NEL-Suite 5
54	NEL-BH004_2.0-2.45m	S			Bag	1			1						
55	NEL-BH004_9.05m	S			Bag	1					1	1	1		1
56	NEL-BH004_15.0-15.45m	S			Bag	1			1						
57	NEL-BH004_19.5-19.95m	S			Bag	1				1					
N/R→ ~~58~~	NEL-BH004_24m	S			Bag	1					1	1			
59	NEL-BH070_2.0m	S			Bag	1				1					
60	NEL-BH070_5.0m	S			Bag	1				1	1	1			
61	NEL-BH085_5.0-5.12m	S			Bag	1					1	1			
62	NEL-BH085_15.0-15.1m	S			Bag	1					1	1			
63	NEL-BH042_14.97-15.08m	S			Bag	1					1	1		1	
64	NEL-BH042_25.15-25.25m	S			Bag	1					1	1			

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name:	Date:	Name: Nicole	Date: 6/4/18	Name:	Date:	Con' Note No:
Of:	Time:	Of: ALS	Time: 10:25	Of:	Time:	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

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Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM1805796**

Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: david.quinn@ghd.com	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: ----	Telephone	: +61-3-8549 9630
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: 31350060803	Page	: 1 of 8
Order number	:	Quote number	: EM2018GHDSER0003 (ME/124/18 - North East Link)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: GHD		

Dates

Date Samples Received	: 06-Apr-2018 10:25	Issue Date	: 12-Apr-2018
Client Requested Due Date	: 23-Apr-2018	Scheduled Reporting Date	: **23-Apr-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 3	Temperature	: -0.2°C
Receipt Detail	:	No. of samples received / analysed	: 63 / 63

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method *Client sample ID*	Sample Container Received	Preferred Sample Container for Analysis
pH (Saturated Paste) : EA031		
NEL-BH114_5.22-5.30m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH008_10.0-10.1m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH099_10.0-10.10m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH099_20.04-20.18m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH095_5.45-5.55m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH093_5.05-5.17m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH092_9.85-10.0m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH089_8.70-8.90m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH089_15.0-15.7m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH087_5.60-5.79m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH087_14.90-15.10m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH100_5.10-5.30m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH100_17.34-17.44m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH031_10.04-10.11m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH031_20.03-20.13m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH083_14.84-15.0m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH083_25.0-25.22m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH084_20.0-20.08m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH084_29.63-29.79m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH084_37.95-38.05m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH076_19.88-20.03m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH076_30.0-30.13m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH076_39.79-40.02m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH074_20.0-20.14m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH074_30.0m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH074_41.89-42.0m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH073_24.90-25.06m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH059_5.5m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH059_10.04-10.18m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH059_20.0-20.21m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH037_5m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH037_14.98-15.10m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH037_25.0-25.08m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH124_25.0-25.12m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH124_35.03-35.12m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH124_45.0-45.1m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH067_12.06-12.21m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH067_25.0-25.13m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH068_8.20-8.30m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH068_14.96-15.06m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH068_19.97-20.05m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH039_5.9m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH039_9.80m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH004_9.05m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH070_5.0m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH085_5.0-5.12m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH085_15.0-15.1m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH042_14.97-15.08m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH042_25.15-25.25m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
Sulfur - Total as S (LECO) : ED042T		
NEL-BH114_5.22-5.30m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH008_10.0-10.1m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH099_10.0-10.10m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH099_20.04-20.18m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH095_5.45-5.55m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH095_9.97-10.11m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH122_4.56-4.64m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH093_5.05-5.17m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH108_5.7-5.79m	- Snap Lock Bag - frozen	- Pulp Bag

Method / *Client sample ID*	Sample Container Received	Preferred Sample Container for Analysis
Sulfur - Total as S (LECO) : ED042T		
NEL-BH092_5.0-5.10m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH092_9.85-10.0m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH089_8.70-8.90m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH089_15.0-15.7m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH087_5.60-5.79m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH087_14.90-15.10m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH100_5.10-5.30m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH100_17.34-17.44m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH031_10.04-10.11m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH031_20.03-20.13m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH083_14.84-15.0m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH083_25.0-25.22m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH084_15.3-15.40m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH084_29.63-29.79m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH084_37.95-38.05m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH076_30.0-30.13m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH074_20.0-20.14m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH074_30.0m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH074_41.89-42.0m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH073_24.90-25.06m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH059_10.04-10.18m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH059_20.0-20.21m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH037_14.98-15.10m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH037_25.0-25.08m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH124_25.0-25.12m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH124_35.03-35.12m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH124_45.0-45.1m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH067_12.06-12.21m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH067_25.0-25.13m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH068_8.20-8.30m	- Snap Lock Bag - frozen	- Pulp Bag
NEL-BH042_14.97-15.08m	- Snap Lock Bag - frozen	- Pulp Bag

Any sample identifications that cannot be displayed entirely in the analysis summary table will be listed below.

EM1805796-001	: [06-Apr-2018]	: NEL-BH114_5.22-5.30m
EM1805796-002	: [06-Apr-2018]	: NEL-BH008_10.0-10.1m
EM1805796-003	: [06-Apr-2018]	: NEL-BH099_10.0-10.10m
EM1805796-004	: [06-Apr-2018]	: NEL-BH099_20.04-20.18m
EM1805796-006	: [06-Apr-2018]	: NEL-BH095_5.45-5.55m
EM1805796-007	: [06-Apr-2018]	: NEL-BH095_9.97-10.11m
EM1805796-008	: [06-Apr-2018]	: NEL-BH122_4.56-4.64m
EM1805796-009	: [06-Apr-2018]	: NEL-BH093_5.05-5.17m
EM1805796-012	: [06-Apr-2018]	: NEL-BH092_9.85-10.0m
EM1805796-013	: [06-Apr-2018]	: NEL-BH089_8.70-8.90m
EM1805796-014	: [06-Apr-2018]	: NEL-BH089_15.0-15.7m
EM1805796-015	: [06-Apr-2018]	: NEL-BH087_5.60-5.79m
EM1805796-016	: [06-Apr-2018]	: NEL-BH087_14.90-15.10m
EM1805796-017	: [06-Apr-2018]	: NEL-BH100_5.10-5.30m
EM1805796-018	: [06-Apr-2018]	: NEL-BH100_17.34-17.44m
EM1805796-019	: [06-Apr-2018]	: NEL-BH031_10.04-10.11m
EM1805796-020	: [06-Apr-2018]	: NEL-BH031_20.03-20.13m
EM1805796-021	: [06-Apr-2018]	: NEL-BH083_14.84-15.0m
EM1805796-022	: [06-Apr-2018]	: NEL-BH083_25.0-25.22m
EM1805796-023	: [06-Apr-2018]	: NEL-BH084_15.3-15.40m
EM1805796-024	: [06-Apr-2018]	: NEL-BH084_20.0-20.08m
EM1805796-025	: [06-Apr-2018]	: NEL-BH084_29.63-29.79m
EM1805796-026	: [06-Apr-2018]	: NEL-BH084_37.95-38.05m
EM1805796-027	: [06-Apr-2018]	: NEL-BH076_19.88-20.03m
EM1805796-028	: [06-Apr-2018]	: NEL-BH076_30.0-30.13m
EM1805796-029	: [06-Apr-2018]	: NEL-BH076_39.79-40.02m
EM1805796-030	: [06-Apr-2018]	: NEL-BH074_20.0-20.14m

EM1805796-032	: [06-Apr-2018]	: NEL-BH074_41.89-42.0m
EM1805796-033	: [06-Apr-2018]	: NEL-BH073_24.90-25.06m
EM1805796-035	: [06-Apr-2018]	: NEL-BH059_10.04-10.18m
EM1805796-036	: [06-Apr-2018]	: NEL-BH059_20.0-20.21m
EM1805796-038	: [06-Apr-2018]	: NEL-BH137_14.87-15.0m
EM1805796-040	: [06-Apr-2018]	: NEL-BH037_14.98-15.10m
EM1805796-041	: [06-Apr-2018]	: NEL-BH037_25.0-25.08m
EM1805796-042	: [06-Apr-2018]	: NEL-BH005_4.11-4.56m
EM1805796-043	: [06-Apr-2018]	: NEL-BH124_25.0-25.12m
EM1805796-044	: [06-Apr-2018]	: NEL-BH124_35.03-35.12m
EM1805796-045	: [06-Apr-2018]	: NEL-BH124_45.0-45.1m
EM1805796-046	: [06-Apr-2018]	: NEL-BH067_12.06-12.21m
EM1805796-047	: [06-Apr-2018]	: NEL-BH067_25.0-25.13m
EM1805796-048	: [06-Apr-2018]	: NEL-BH068_8.20-8.30m
EM1805796-049	: [06-Apr-2018]	: NEL-BH068_14.96-15.06m
EM1805796-050	: [06-Apr-2018]	: NEL-BH068_19.97-20.05m
EM1805796-056	: [06-Apr-2018]	: NEL-BH004_15.0-15.45m
EM1805796-057	: [06-Apr-2018]	: NEL-BH004_19.5-19.95m
EM1805796-062	: [06-Apr-2018]	: NEL-BH085_15.0-15.1m
EM1805796-063	: [06-Apr-2018]	: NEL-BH042_14.97-15.08m
EM1805796-064	: [06-Apr-2018]	: NEL-BH042_25.15-25.25m

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - ASS1 NAPP	SOIL - EA011 Net Acid Generation (NAG)	SOIL - EA031 pH (Saturated Paste)	SOIL - EA033 Chromium Suite for Acid Sulphate Soils	SOIL - EA055-103 Moisture Content	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S Major Anions (Cl, SO4)
EM1805796-001	06-Apr-2018 00:00	NEL-BH114_5.22-5.30m	✓	✓	✓	✓	✓	✓	✓
EM1805796-002	06-Apr-2018 00:00	NEL-BH008_10.0-10.1m	✓	✓	✓	✓	✓	✓	✓
EM1805796-003	06-Apr-2018 00:00	NEL-BH099_10.0-10.10m	✓	✓	✓	✓	✓	✓	✓
EM1805796-004	06-Apr-2018 00:00	NEL-BH099_20.04-20.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-005	06-Apr-2018 00:00	NEL-BH110_5.0-5.20m				✓			
EM1805796-006	06-Apr-2018 00:00	NEL-BH095_5.45-5.55m	✓	✓	✓	✓	✓	✓	✓
EM1805796-007	06-Apr-2018 00:00	NEL-BH095_9.97-10.11m	✓	✓		✓			
EM1805796-008	06-Apr-2018 00:00	NEL-BH122_4.56-4.64m	✓	✓		✓			
EM1805796-009	06-Apr-2018 00:00	NEL-BH093_5.05-5.17m	✓	✓	✓	✓	✓	✓	✓
EM1805796-010	06-Apr-2018 00:00	NEL-BH108_5.7-5.79m	✓	✓		✓			
EM1805796-011	06-Apr-2018 00:00	NEL-BH092_5.0-5.10m	✓	✓		✓			
EM1805796-012	06-Apr-2018 00:00	NEL-BH092_9.85-10.0m	✓	✓	✓	✓	✓	✓	✓
EM1805796-013	06-Apr-2018 00:00	NEL-BH089_8.70-8.90m	✓	✓	✓	✓	✓	✓	✓
EM1805796-014	06-Apr-2018 00:00	NEL-BH089_15.0-15.7m	✓	✓	✓	✓	✓	✓	✓
EM1805796-015	06-Apr-2018 00:00	NEL-BH087_5.60-5.79m	✓	✓	✓	✓	✓	✓	✓
EM1805796-016	06-Apr-2018 00:00	NEL-BH087_14.90-15.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-017	06-Apr-2018 00:00	NEL-BH100_5.10-5.30m	✓	✓	✓	✓	✓	✓	✓
EM1805796-018	06-Apr-2018 00:00	NEL-BH100_17.34-17.4...	✓	✓	✓	✓	✓	✓	✓
EM1805796-019	06-Apr-2018 00:00	NEL-BH031_10.04-10.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-020	06-Apr-2018 00:00	NEL-BH031_20.03-20.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-021	06-Apr-2018 00:00	NEL-BH083_14.84-15.0m	✓	✓	✓	✓	✓	✓	✓

			SOIL - ASS1 NAPP	SOIL - EA011 Net Acid Generation (NAG)	SOIL - EA031 pH (Saturated Paste)	SOIL - EA033 Chromium Suite for Acid Sulphate Soils	SOIL - EA055-103 Moisture Content	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S Major Anions (Cl, SO4)
EM1805796-022	06-Apr-2018 00:00	NEL-BH083_25.0-25.22m	✓	✓	✓	✓	✓	✓	✓
EM1805796-023	06-Apr-2018 00:00	NEL-BH084_15.3-15.40m	✓	✓		✓			
EM1805796-024	06-Apr-2018 00:00	NEL-BH084_20.0-20.08m			✓		✓	✓	✓
EM1805796-025	06-Apr-2018 00:00	NEL-BH084_29.63-29.7...	✓	✓	✓	✓	✓	✓	✓
EM1805796-026	06-Apr-2018 00:00	NEL-BH084_37.95-38.0...	✓	✓	✓	✓	✓	✓	✓
EM1805796-027	06-Apr-2018 00:00	NEL-BH076_19.88-20.0...			✓		✓	✓	✓
EM1805796-028	06-Apr-2018 00:00	NEL-BH076_30.0-30.13m	✓	✓	✓	✓	✓	✓	✓
EM1805796-029	06-Apr-2018 00:00	NEL-BH076_39.79-40.0...			✓		✓	✓	✓
EM1805796-030	06-Apr-2018 00:00	NEL-BH074_20.0-20.14m	✓	✓	✓	✓	✓	✓	✓
EM1805796-031	06-Apr-2018 00:00	NEL-BH074_30.0m	✓	✓	✓	✓	✓	✓	✓
EM1805796-032	06-Apr-2018 00:00	NEL-BH074_41.89-42.0m	✓	✓	✓	✓	✓	✓	✓
EM1805796-033	06-Apr-2018 00:00	NEL-BH073_24.90-25.0...	✓	✓	✓	✓	✓	✓	✓
EM1805796-034	06-Apr-2018 00:00	NEL-BH059_5.5m			✓		✓	✓	✓
EM1805796-035	06-Apr-2018 00:00	NEL-BH059_10.04-10.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-036	06-Apr-2018 00:00	NEL-BH059_20.0-20.21m	✓	✓	✓	✓	✓	✓	✓
EM1805796-037	06-Apr-2018 00:00	NEL-BH137_5.0m				✓			
EM1805796-038	06-Apr-2018 00:00	NEL-BH137_14.87-15.0m	✓	✓		✓			
EM1805796-039	06-Apr-2018 00:00	NEL-BH037_5m			✓		✓	✓	✓
EM1805796-040	06-Apr-2018 00:00	NEL-BH037_14.98-15.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-041	06-Apr-2018 00:00	NEL-BH037_25.0-25.08m	✓	✓	✓	✓	✓	✓	✓
EM1805796-043	06-Apr-2018 00:00	NEL-BH124_25.0-25.12m	✓	✓	✓	✓	✓	✓	✓
EM1805796-044	06-Apr-2018 00:00	NEL-BH124_35.03-35.1...	✓	✓	✓	✓	✓	✓	✓
EM1805796-045	06-Apr-2018 00:00	NEL-BH124_45.0-45.1m	✓	✓	✓	✓	✓	✓	✓
EM1805796-046	06-Apr-2018 00:00	NEL-BH067_12.06-12.2...	✓	✓	✓	✓	✓	✓	✓
EM1805796-047	06-Apr-2018 00:00	NEL-BH067_25.0-25.13m	✓	✓	✓	✓	✓	✓	✓
EM1805796-048	06-Apr-2018 00:00	NEL-BH068_8.20-8.30m	✓	✓	✓	✓	✓	✓	✓
EM1805796-049	06-Apr-2018 00:00	NEL-BH068_14.96-15.0...			✓		✓	✓	✓
EM1805796-050	06-Apr-2018 00:00	NEL-BH068_19.97-20.0...			✓		✓	✓	✓
EM1805796-051	06-Apr-2018 00:00	NEL-BH039_2.40m				✓			
EM1805796-052	06-Apr-2018 00:00	NEL-BH039_5.9m			✓		✓	✓	✓
EM1805796-053	06-Apr-2018 00:00	NEL-BH039_9.80m			✓	✓	✓	✓	✓
EM1805796-054	06-Apr-2018 00:00	NEL-BH004_2.0-2.45m				✓			
EM1805796-055	06-Apr-2018 00:00	NEL-BH004_9.05m			✓		✓	✓	✓
EM1805796-056	06-Apr-2018 00:00	NEL-BH004_15.0-15.45m				✓			
EM1805796-060	06-Apr-2018 00:00	NEL-BH070_5.0m			✓		✓	✓	✓
EM1805796-061	06-Apr-2018 00:00	NEL-BH085_5.0-5.12m			✓		✓	✓	✓
EM1805796-062	06-Apr-2018 00:00	NEL-BH085_15.0-15.1m			✓		✓	✓	✓
EM1805796-063	06-Apr-2018 00:00	NEL-BH042_14.97-15.0...	✓	✓	✓		✓	✓	✓
EM1805796-064	06-Apr-2018 00:00	NEL-BH042_25.15-25.2...			✓		✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA029 SPOCAS	SOIL - EA084 Saturated Resistivity	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)	SOIL - MM820 (Subcontracted) Sulphate Reducing Bacteria (BART)
EM1805796-001	06-Apr-2018 00:00	NEL-BH114_5.22-5.30m		✓		
EM1805796-002	06-Apr-2018 00:00	NEL-BH008_10.0-10.1m		✓		
EM1805796-003	06-Apr-2018 00:00	NEL-BH099_10.0-10.10m		✓		
EM1805796-004	06-Apr-2018 00:00	NEL-BH099_20.04-20.1...		✓		
EM1805796-006	06-Apr-2018 00:00	NEL-BH095_5.45-5.55m		✓		
EM1805796-009	06-Apr-2018 00:00	NEL-BH093_5.05-5.17m		✓		
EM1805796-012	06-Apr-2018 00:00	NEL-BH092_9.85-10.0m		✓		
EM1805796-013	06-Apr-2018 00:00	NEL-BH089_8.70-8.90m		✓		
EM1805796-014	06-Apr-2018 00:00	NEL-BH089_15.0-15.7m		✓		
EM1805796-015	06-Apr-2018 00:00	NEL-BH087_5.60-5.79m		✓		
EM1805796-016	06-Apr-2018 00:00	NEL-BH087_14.90-15.1...		✓		
EM1805796-017	06-Apr-2018 00:00	NEL-BH100_5.10-5.30m		✓		
EM1805796-018	06-Apr-2018 00:00	NEL-BH100_17.34-17.4...		✓		
EM1805796-019	06-Apr-2018 00:00	NEL-BH031_10.04-10.1...		✓		
EM1805796-020	06-Apr-2018 00:00	NEL-BH031_20.03-20.1...		✓		
EM1805796-021	06-Apr-2018 00:00	NEL-BH083_14.84-15.0m		✓		
EM1805796-022	06-Apr-2018 00:00	NEL-BH083_25.0-25.22m		✓		
EM1805796-024	06-Apr-2018 00:00	NEL-BH084_20.0-20.08m		✓		
EM1805796-025	06-Apr-2018 00:00	NEL-BH084_29.63-29.7...	✓	✓		
EM1805796-026	06-Apr-2018 00:00	NEL-BH084_37.95-38.0...		✓		
EM1805796-027	06-Apr-2018 00:00	NEL-BH076_19.88-20.0...		✓		
EM1805796-028	06-Apr-2018 00:00	NEL-BH076_30.0-30.13m		✓		
EM1805796-029	06-Apr-2018 00:00	NEL-BH076_39.79-40.0...		✓		
EM1805796-030	06-Apr-2018 00:00	NEL-BH074_20.0-20.14m		✓		
EM1805796-031	06-Apr-2018 00:00	NEL-BH074_30.0m	✓	✓		
EM1805796-032	06-Apr-2018 00:00	NEL-BH074_41.89-42.0m		✓		
EM1805796-033	06-Apr-2018 00:00	NEL-BH073_24.90-25.0...	✓	✓		
EM1805796-034	06-Apr-2018 00:00	NEL-BH059_5.5m	✓	✓		
EM1805796-035	06-Apr-2018 00:00	NEL-BH059_10.04-10.1...		✓		
EM1805796-036	06-Apr-2018 00:00	NEL-BH059_20.0-20.21m		✓		
EM1805796-039	06-Apr-2018 00:00	NEL-BH037_5m		✓		
EM1805796-040	06-Apr-2018 00:00	NEL-BH037_14.98-15.1...		✓		
EM1805796-041	06-Apr-2018 00:00	NEL-BH037_25.0-25.08m		✓		
EM1805796-042	06-Apr-2018 00:00	NEL-BH005_4.11-4.56m	✓			
EM1805796-043	06-Apr-2018 00:00	NEL-BH124_25.0-25.12m		✓		
EM1805796-044	06-Apr-2018 00:00	NEL-BH124_35.03-35.1...		✓		
EM1805796-045	06-Apr-2018 00:00	NEL-BH124_45.0-45.1m		✓		
EM1805796-046	06-Apr-2018 00:00	NEL-BH067_12.06-12.2...		✓		
EM1805796-047	06-Apr-2018 00:00	NEL-BH067_25.0-25.13m		✓		
EM1805796-048	06-Apr-2018 00:00	NEL-BH068_8.20-8.30m		✓	✓	✓
EM1805796-049	06-Apr-2018 00:00	NEL-BH068_14.96-15.0...		✓		

			SOIL - EA029 SPOCAS	SOIL - EA084 Saturated Resistivity	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)	SOIL - MM820 (Subcontracted) Sulphate Reducing Bacteria (BART)
EM1805796-050	06-Apr-2018 00:00	NEL-BH068_19.97-20.0...		✓		
EM1805796-052	06-Apr-2018 00:00	NEL-BH039_5.9m	✓	✓	✓	✓
EM1805796-053	06-Apr-2018 00:00	NEL-BH039_9.80m		✓		
EM1805796-055	06-Apr-2018 00:00	NEL-BH004_9.05m	✓	✓	✓	✓
EM1805796-057	06-Apr-2018 00:00	NEL-BH004_19.5-19.95m	✓			
EM1805796-059	06-Apr-2018 00:00	NEL-BH070_2.0m	✓			
EM1805796-060	06-Apr-2018 00:00	NEL-BH070_5.0m	✓	✓		
EM1805796-061	06-Apr-2018 00:00	NEL-BH085_5.0-5.12m		✓		
EM1805796-062	06-Apr-2018 00:00	NEL-BH085_15.0-15.1m		✓		
EM1805796-063	06-Apr-2018 00:00	NEL-BH042_14.97-15.0...		✓		
EM1805796-064	06-Apr-2018 00:00	NEL-BH042_25.15-25.2...		✓		

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ALL ACCOUNTS		
- A4 - AU Tax Invoice (INV)	Email	ap-fss@ghd.com
DAVID QUINN		
- *AU Certificate of Analysis - NATA (COA)	Email	david.quinn@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	david.quinn@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	david.quinn@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	david.quinn@ghd.com
- A4 - AU Tax Invoice (INV)	Email	david.quinn@ghd.com
- Chain of Custody (CoC) (COC)	Email	david.quinn@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	david.quinn@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	david.quinn@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	david.quinn@ghd.com
GHD LAB REPORTS		
- *AU Certificate of Analysis - NATA (COA)	Email	GHDLabreports@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	GHDLabreports@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	GHDLabreports@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	GHDLabreports@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	GHDLabreports@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	GHDLabreports@ghd.com
MARCIN WIELOCH		
- *AU Certificate of Analysis - NATA (COA)	Email	marcin.wieloch@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	marcin.wieloch@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	marcin.wieloch@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	marcin.wieloch@ghd.com
- Chain of Custody (CoC) (COC)	Email	marcin.wieloch@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	marcin.wieloch@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	marcin.wieloch@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	marcin.wieloch@ghd.com
NAZUHA ROSLI		
- *AU Certificate of Analysis - NATA (COA)	Email	nazuha.rosli@aecom.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	nazuha.rosli@aecom.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	nazuha.rosli@aecom.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	nazuha.rosli@aecom.com
- Chain of Custody (CoC) (COC)	Email	nazuha.rosli@aecom.com
- EDI Format - ENMRG (ENMRG)	Email	nazuha.rosli@aecom.com
- EDI Format - ESDAT (ESDAT)	Email	nazuha.rosli@aecom.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	nazuha.rosli@aecom.com

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1805796**		Page	: 1 of 13
Client	: **GHD PTY LTD**		Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN		Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001		Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----		Telephone	: +61-3-8549 9630
Project	: 31350060803		Date Samples Received	: 06-Apr-2018
Order number	:		Date Analysis Commenced	: 12-Apr-2018
C-O-C number	: ----		Issue Date	: 30-Apr-2018
Sampler	: GHD			
Site	: ----			
Quote number	: ME/124/18 - North East Link			
No. of samples received	: 63			
No. of samples analysed	: 63			

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Samantha Smith	Laboratory Coordinator	WRG Subcontracting, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA011: Net Acid Generation (QC Lot: 1569068)									
EM1805796-013	NEL-BH089_8.70-8.90m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.8	0.8	0.00	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	6.7	6.7	0.00	0% - 20%
EM1805796-001	NEL-BH114_5.22-5.30m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.8	0.7	0.00	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	6.9	6.9	0.00	0% - 20%
EA011: Net Acid Generation (QC Lot: 1569073)									
EM1805796-022	NEL-BH083_25.0-25.22m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	2.0	2.0	0.00	0% - 20%
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	4.1	4.1	0.00	0% - 20%
		EA011: pH (OX)	----	0.1	pH Unit	3.6	3.6	0.00	0% - 20%
EM1805796-038	NEL-BH137_14.87-15.0m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.7	0.6	0.00	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	6.8	6.8	0.00	0% - 20%
EA011: Net Acid Generation (QC Lot: 1569076)									
EM1805796-063	NEL-BH042_14.97-15.08m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	7.2	7.1	1.40	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 1569069)									
EM1805796-013	NEL-BH089_8.70-8.90m	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.9	2.7	7.35	No Limit
EM1805796-001	NEL-BH114_5.22-5.30m	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	4.6	4.3	6.44	No Limit
EA013: Acid Neutralising Capacity (QC Lot: 1569072)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA013: Acid Neutralising Capacity (QC Lot: 1569072) - continued									
EM1805796-022	NEL-BH083_25.0-25.22m	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.0	7.1	0.00	0% - 50%
EM1805796-038	NEL-BH137_14.87-15.0m	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.9	5.6	5.23	0% - 50%
EA013: Acid Neutralising Capacity (QC Lot: 1569077)									
EM1805796-063	NEL-BH042_14.97-15.08m	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.7	7.5	2.39	0% - 50%
EA029-A: pH Measurements (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: pH KCl (23A)	----	0.1	pH Unit	6.2	6.2	0.00	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	3.3	3.2	3.08	0% - 20%
EA029-A: pH Measurements (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: pH KCl (23A)	----	0.1	pH Unit	5.1	5.1	0.00	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	4.9	4.9	0.00	0% - 20%
EA029-B: Acidity Trail (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	0.140	0.149	6.26	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	0.140	0.149	6.26	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	87	93	6.26	0% - 20%
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	87	93	6.26	0% - 20%
EA029-B: Acidity Trail (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	0.024	0.025	0.00	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	10	0.00	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	15	16	0.00	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	6	6	0.00	No Limit
EA029-C: Sulfur Trail (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	0.110	0.113	2.33	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	0.110	0.113	2.33	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	69	70	2.33	No Limit
EA029-C: Sulfur Trail (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA029-C: Sulfur Trail (QC Lot: 1576022) - continued									
EM1805796-060	NEL-BH070_5.0m	EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-D: Calcium Values (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-D: Calcium Values (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.026	0.022	15.8	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.033	0.033	0.00	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-E: Magnesium Values (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.020	0.020	0.00	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	0.020	0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	0.026	0.027	0.00	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	16	17	0.00	No Limit
EA029-E: Magnesium Values (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.044	0.039	13.4	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.049	0.058	16.4	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	0.025	22.5	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	16	44.0	No Limit
EA029-H: Acid Base Accounting (QC Lot: 1569074)									
EM1805796-025	NEL-BH084_29.63-29.79m	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.00	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	0.11	0.11	0.00	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.11	0.11	0.00	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	5	5	0.00	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	5	5	0.00	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	69	70	2.33	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	69	70	2.33	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA029-H: Acid Base Accounting (QC Lot: 1576022)									
EM1805796-060	NEL-BH070_5.0m	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.00	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.00	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.00	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.00	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.00	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.00	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA031: pH (saturated paste) (QC Lot: 1562746)									
EM1805796-001	NEL-BH114_5.22-5.30m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	6.8	7.0	2.03	0% - 20%
EM1805796-016	NEL-BH087_14.90-15.10m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	7.8	7.9	0.00	0% - 20%
EA031: pH (saturated paste) (QC Lot: 1562747)									
EM1805796-027	NEL-BH076_19.88-20.03m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	5.6	5.9	4.87	0% - 20%
EM1805796-039	NEL-BH037_5m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	7.5	7.5	0.00	0% - 20%
EA031: pH (saturated paste) (QC Lot: 1562748)									
EM1805796-050	NEL-BH068_19.97-20.05m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	7.5	7.5	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 1569070)									
EM1805796-011	NEL-BH092_5.0-5.10m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	7.5	7.7	2.63	0% - 20%
EM1805796-001	NEL-BH114_5.22-5.30m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	6.2	6.3	1.60	0% - 20%
EA033-A: Actual Acidity (QC Lot: 1569071)									
EM1805796-021	NEL-BH083_14.84-15.0m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	6.7	6.8	1.48	0% - 20%
EM1805796-035	NEL-BH059_10.04-10.18m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	7.0	7.2	2.82	0% - 20%
EA033-A: Actual Acidity (QC Lot: 1569075)									
EM1805796-047	NEL-BH067_25.0-25.13m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	5.7	5.8	1.74	0% - 20%
EA033-B: Potential Acidity (QC Lot: 1569070)									
EM1805796-011	NEL-BH092_5.0-5.10m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.007	0.006	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EM1805796-001	NEL-BH114_5.22-5.30m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.006	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA033-B: Potential Acidity (QC Lot: 1569070) - continued									
EM1805796-001	NEL-BH114_5.22-5.30m	EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-B: Potential Acidity (QC Lot: 1569071)									
EM1805796-021	NEL-BH083_14.84-15.0m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.182	0.188	3.58	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	113	117	3.58	0% - 50%
EM1805796-035	NEL-BH059_10.04-10.18m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.017	0.017	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	11	11	0.00	No Limit
EA033-B: Potential Acidity (QC Lot: 1569075)									
EM1805796-047	NEL-BH067_25.0-25.13m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.118	0.114	3.56	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	74	71	3.56	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 1569070)									
EM1805796-011	NEL-BH092_5.0-5.10m	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.67	0.62	6.90	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.21	0.20	6.90	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	134	125	6.90	0% - 50%
EA033-C: Acid Neutralising Capacity (QC Lot: 1569071)									
EM1805796-021	NEL-BH083_14.84-15.0m	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.57	0.52	8.22	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.18	0.17	8.22	0% - 50%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	113	104	8.22	0% - 50%
EM1805796-035	NEL-BH059_10.04-10.18m	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.72	0.75	4.74	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.23	0.24	4.74	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	143	150	4.74	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1568349)									
EM1805796-001	NEL-BH114_5.22-5.30m	EA055: Moisture Content	----	0.1	%	<1.0	<1.0	0.00	No Limit
EM1805796-016	NEL-BH087_14.90-15.10m	EA055: Moisture Content	----	0.1	%	<1.0	1.2	17.5	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1568350)									
EM1805796-027	NEL-BH076_19.88-20.03m	EA055: Moisture Content	----	0.1	%	<1.0	<1.0	0.00	No Limit
EM1805796-039	NEL-BH037_5m	EA055: Moisture Content	----	0.1	%	9.4	9.7	3.15	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1568354)									
EM1805796-052	NEL-BH039_5.9m	EA055: Moisture Content	----	0.1	%	15.5	15.3	1.22	0% - 50%
ED040S: Soluble Major Anions (QC Lot: 1568345)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
ED040S: Soluble Major Anions (QC Lot: 1568345) - continued									
EM1805796-015	NEL-BH087_5.60-5.79m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	30	0.00	No Limit
EM1805796-001	NEL-BH114_5.22-5.30m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	10	0.00	No Limit
ED040S: Soluble Major Anions (QC Lot: 1568348)									
EM1805796-036	NEL-BH059_20.0-20.21m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	130	0.00	0% - 50%
EM1805796-027	NEL-BH076_19.88-20.03m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	810	830	2.56	0% - 20%
ED040S: Soluble Major Anions (QC Lot: 1568353)									
EM1805796-050	NEL-BH068_19.97-20.05m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	240	230	0.00	0% - 20%
ED042T: Total Sulfur by LECO (QC Lot: 1580886)									
EM1805796-001	NEL-BH114_5.22-5.30m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	0.00	No Limit
EM1805796-011	NEL-BH092_5.0-5.10m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	0.00	No Limit
ED042T: Total Sulfur by LECO (QC Lot: 1580887)									
EM1805796-022	NEL-BH083_25.0-25.22m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.24	0.24	0.00	0% - 20%
EM1805796-035	NEL-BH059_10.04-10.18m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.02	0.00	No Limit
ED042T: Total Sulfur by LECO (QC Lot: 1580888)									
EM1805796-063	NEL-BH042_14.97-15.08m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 1568344)									
EM1805796-016	NEL-BH087_14.90-15.10m	ED045G: Chloride	16887-00-6	10	mg/kg	160	170	0.00	0% - 50%
EM1805796-001	NEL-BH114_5.22-5.30m	ED045G: Chloride	16887-00-6	10	mg/kg	350	350	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 1568347)									
EM1805796-039	NEL-BH037_5m	ED045G: Chloride	16887-00-6	10	mg/kg	200	200	0.00	0% - 20%
EM1805796-027	NEL-BH076_19.88-20.03m	ED045G: Chloride	16887-00-6	10	mg/kg	110	110	0.00	0% - 50%
ED045G: Chloride by Discrete Analyser (QC Lot: 1568352)									
EM1805796-050	NEL-BH068_19.97-20.05m	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.00	No Limit
ED093S: Soluble Major Cations (QC Lot: 1568343)									
EM1805796-015	NEL-BH087_5.60-5.79m	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	250	250	0.00	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.00	No Limit
EM1805796-001	NEL-BH114_5.22-5.30m	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	260	260	0.00	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.00	No Limit
ED093S: Soluble Major Cations (QC Lot: 1568346)									
EM1805796-036	NEL-BH059_20.0-20.21m	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	220	220	0.00	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.00	No Limit
EM1805796-027	NEL-BH076_19.88-20.03m	ED093S: Calcium	7440-70-2	10	mg/kg	60	70	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED093S: Soluble Major Cations (QC Lot: 1568346) - continued									
EM1805796-027	NEL-BH076_19.88-20.03m	ED093S: Magnesium	7439-95-4	10	mg/kg	90	90	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	210	220	0.00	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	40	40	0.00	No Limit
ED093S: Soluble Major Cations (QC Lot: 1568351)									
EM1805796-050	NEL-BH068_19.97-20.05m	ED093S: Calcium	7440-70-2	10	mg/kg	20	20	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	20	20	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	20	20	0.00	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	110	110	0.00	0% - 50%
EP004: Organic Matter (QC Lot: 1568848)									
EB1809230-001	Anonymous	EP004: Total Organic Carbon	----	0.5	%	6.1	6.2	0.00	0% - 50%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA011: Net Acid Generation (QCLot: 1569068)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.5 kg H2SO4/t	96.4	70	130
EA011: Net Acid Generation (QCLot: 1569073)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.5 kg H2SO4/t	93.7	70	130
EA011: Net Acid Generation (QCLot: 1569076)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.5 kg H2SO4/t	97.1	70	130
EA013: Acid Neutralising Capacity (QCLot: 1569069)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	9.9 kg H2SO4 equiv./t	103	82	120
EA013: Acid Neutralising Capacity (QCLot: 1569072)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	9.9 kg H2SO4 equiv./t	103	82	120
EA013: Acid Neutralising Capacity (QCLot: 1569077)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	9.9 kg H2SO4 equiv./t	103	82	120
EA029-A: pH Measurements (QCLot: 1569074)								
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.6 pH Unit	100	70	130
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.3 pH Unit	102	70	130
EA029-A: pH Measurements (QCLot: 1576022)								
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.6 pH Unit	102	70	130
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.3 pH Unit	100	70	130
EA029-B: Acidity Trail (QCLot: 1569074)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	88.2	70	130
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	35.2 mole H+ / t	99.6	70	130
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029-B: Acidity Trail (QCLot: 1576022)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	83.2	70	130
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	35.2 mole H+ / t	114	70	130
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 1569074)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.052 % S	91.3	70	130

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA029-C: Sulfur Trail (QCLot: 1569074) - continued								
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.158 % S	85.3	70	130
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 1576022)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.052 % S	91.4	70	130
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.158 % S	86.1	70	130
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-D: Calcium Values (QCLot: 1569074)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.097 % Ca	103	70	130
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.22 % Ca	86.8	70	130
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----
EA029-D: Calcium Values (QCLot: 1576022)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.097 % Ca	117	70	130
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.22 % Ca	92.4	70	130
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----
EA029-E: Magnesium Values (QCLot: 1569074)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.25 % Mg	88.3	70	130
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.234 % Mg	82.1	70	130
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----
EA029-E: Magnesium Values (QCLot: 1576022)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.25 % Mg	84.7	70	130
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.234 % Mg	94.8	70	130
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----
EA029-F: Excess Acid Neutralising Capacity (QCLot: 1569074)								
EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	<0.020	----	----	----	----
EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	<0.020	----	----	----	----
EA029-H: Acid Base Accounting (QCLot: 1569074)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	High
EA029-H: Acid Base Accounting (QCLot: 1569074) - continued								
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----
EA029-H: Acid Base Accounting (QCLot: 1576022)								
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----
EA031: pH (saturated paste) (QCLot: 1562746)								
EA031: pH (Saturated Paste)	----	----	pH Unit	----	4 pH Unit	100	99	101
				----	7 pH Unit	100	99	101
EA031: pH (saturated paste) (QCLot: 1562747)								
EA031: pH (Saturated Paste)	----	----	pH Unit	----	4 pH Unit	100	99	101
				----	7 pH Unit	100	99	101
EA031: pH (saturated paste) (QCLot: 1562748)								
EA031: pH (Saturated Paste)	----	----	pH Unit	----	4 pH Unit	100	99	101
				----	7 pH Unit	100	99	101
EA033-A: Actual Acidity (QCLot: 1569070)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.6 pH Unit	102	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	88.2	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 1569071)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.6 pH Unit	100	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	92.6	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 1569075)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.6 pH Unit	100	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	92.6	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1569070)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	84.2	70	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EA033-B: Potential Acidity (QCLot: 1569070) - continued								
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1569071)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	87.5	70	130
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1569075)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	93.3	70	130
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1569070)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	101	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1569071)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	101	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1569075)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	100	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
ED040S: Soluble Major Anions (QCLot: 1568345)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	500 mg/kg	101	90	114
ED040S: Soluble Major Anions (QCLot: 1568348)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	500 mg/kg	101	90	114
ED040S: Soluble Major Anions (QCLot: 1568353)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	500 mg/kg	102	90	114
ED042T: Total Sulfur by LECO (QCLot: 1580886)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.16 %	101	70	130
ED042T: Total Sulfur by LECO (QCLot: 1580887)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.16 %	100	70	130
ED042T: Total Sulfur by LECO (QCLot: 1580888)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.16 %	96.4	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 1568344)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	100	83	119
				<10	5000 mg/kg	103	83	119
ED045G: Chloride by Discrete Analyser (QCLot: 1568347)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	102	83	119
				<10	5000 mg/kg	103	83	119

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
ED045G: Chloride by Discrete Analyser (QCLot: 1568352)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	98.1	83	119
				<10	5000 mg/kg	99.8	83	119
ED093S: Soluble Major Cations (QCLot: 1568343)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	500 mg/kg	104	80	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	500 mg/kg	103	80	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	500 mg/kg	105	80	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	500 mg/kg	103	80	120
ED093S: Soluble Major Cations (QCLot: 1568346)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	500 mg/kg	102	80	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	500 mg/kg	102	80	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	500 mg/kg	105	80	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	500 mg/kg	104	80	120
ED093S: Soluble Major Cations (QCLot: 1568351)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	500 mg/kg	100	80	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	500 mg/kg	104	80	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	500 mg/kg	98.7	80	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	500 mg/kg	100	80	120
EP004: Organic Matter (QCLot: 1568848)								
EP004: Total Organic Carbon	----	0.5	%	<0.5	46.4 %	101	85	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
EP004: Organic Matter (QCLot: 1568848)							
EB1809230-002	Anonymous	EP004: Total Organic Carbon	----	2.32 %	101	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1805796**	Page	: 1 of 20
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Telephone	: +61-3-8549 9630
Project	: 31350060803	Date Samples Received	: 06-Apr-2018
Site	: ----	Issue Date	: 30-Apr-2018
Sampler	: GHD	No. of samples received	: 63
Order number	:	No. of samples analysed	: 63

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
ED042T: Total Sulfur by LECO							
Snap Lock Bag - frozen							
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	19-Apr-2018	13-Apr-2018	**6**	----	----	----
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,						
NEL-BH095_5.45-5.55m,	NEL-BH095_9.97-10.11m,						
NEL-BH122_4.56-4.64m,	NEL-BH093_5.05-5.17m,						
NEL-BH108_5.7-5.79m,	NEL-BH092_5.0-5.10m,						
NEL-BH092_9.85-10.0m,	NEL-BH089_8.70-8.90m,						
NEL-BH089_15.0-15.7m,	NEL-BH087_5.60-5.79m,						
NEL-BH087_14.90-15.10m,	NEL-BH100_5.10-5.30m,						
NEL-BH100_17.34-17.44m,	NEL-BH031_10.04-10.11m,						
NEL-BH031_20.03-20.13m,	NEL-BH083_14.84-15.0m,						
NEL-BH083_25.0-25.22m,	NEL-BH084_15.3-15.40m,						
NEL-BH084_29.63-29.79m,	NEL-BH084_37.95-38.05m,						
NEL-BH076_30.0-30.13m,	NEL-BH074_20.0-20.14m,						
NEL-BH074_30.0m,	NEL-BH074_41.89-42.0m,						
NEL-BH073_24.90-25.06m,	NEL-BH059_10.04-10.18m,						
NEL-BH059_20.0-20.21m,	NEL-BH037_14.98-15.10m,						
NEL-BH037_25.0-25.08m,	NEL-BH124_25.0-25.12m,						
NEL-BH124_35.03-35.12m,	NEL-BH124_45.0-45.1m,						
NEL-BH067_12.06-12.21m,	NEL-BH067_25.0-25.13m,						
NEL-BH068_8.20-8.30m,	NEL-BH042_14.97-15.08m						

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA011: Net Acid Generation								
Snap Lock Bag - frozen (EA011)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	14-Oct-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH095_5.45-5.55m,	NEL-BH095_9.97-10.11m,							
NEL-BH122_4.56-4.64m,	NEL-BH093_5.05-5.17m,							
NEL-BH108_5.7-5.79m,	NEL-BH092_5.0-5.10m,							
NEL-BH092_9.85-10.0m,	NEL-BH089_8.70-8.90m,							
NEL-BH089_15.0-15.7m,	NEL-BH087_5.60-5.79m,							
NEL-BH087_14.90-15.10m,	NEL-BH100_5.10-5.30m,							
NEL-BH100_17.34-17.44m,	NEL-BH031_10.04-10.11m,							
NEL-BH031_20.03-20.13m,	NEL-BH083_14.84-15.0m,							
NEL-BH083_25.0-25.22m,	NEL-BH084_15.3-15.40m,							
NEL-BH084_29.63-29.79m,	NEL-BH084_37.95-38.05m,							
NEL-BH076_30.0-30.13m,	NEL-BH074_20.0-20.14m,							
NEL-BH074_30.0m,	NEL-BH074_41.89-42.0m,							
NEL-BH073_24.90-25.06m,	NEL-BH059_10.04-10.18m,							
NEL-BH059_20.0-20.21m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH042_14.97-15.08m								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation Date extracted	Due for extraction	Evaluation	Analysis Date analysed	Due for analysis	Evaluation
EA013: Acid Neutralising Capacity							
Snap Lock Bag - frozen (EA013) NEL-BH114_5.22-5.30m, NEL-BH008_10.0-10.1m, NEL-BH099_10.0-10.10m, NEL-BH099_20.04-20.18m, NEL-BH095_5.45-5.55m, NEL-BH095_9.97-10.11m, NEL-BH122_4.56-4.64m, NEL-BH093_5.05-5.17m, NEL-BH108_5.7-5.79m, NEL-BH092_5.0-5.10m, NEL-BH092_9.85-10.0m, NEL-BH089_8.70-8.90m, NEL-BH089_15.0-15.7m, NEL-BH087_5.60-5.79m, NEL-BH087_14.90-15.10m, NEL-BH100_5.10-5.30m, NEL-BH100_17.34-17.44m, NEL-BH031_10.04-10.11m, NEL-BH031_20.03-20.13m, NEL-BH083_14.84-15.0m, NEL-BH083_25.0-25.22m, NEL-BH084_15.3-15.40m, NEL-BH084_29.63-29.79m, NEL-BH084_37.95-38.05m, NEL-BH076_30.0-30.13m, NEL-BH074_20.0-20.14m, NEL-BH074_30.0m, NEL-BH074_41.89-42.0m, NEL-BH073_24.90-25.06m, NEL-BH059_10.04-10.18m, NEL-BH059_20.0-20.21m, NEL-BH137_14.87-15.0m, NEL-BH037_14.98-15.10m, NEL-BH037_25.0-25.08m, NEL-BH124_25.0-25.12m, NEL-BH124_35.03-35.12m, NEL-BH124_45.0-45.1m, NEL-BH067_12.06-12.21m, NEL-BH067_25.0-25.13m, NEL-BH068_8.20-8.30m, NEL-BH042_14.97-15.08m	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	14-Oct-2018	✓
EA029-A: pH Measurements							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓
EA029-B: Acidity Trail							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA029-C: Sulfur Trail							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓
EA029-D: Calcium Values							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓
EA029-E: Magnesium Values							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓
EA029-F: Excess Acid Neutralising Capacity							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA029-G: Retained Acidity							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓
EA029-H: Acid Base Accounting							
Snap Lock Bag - frozen (EA029) NEL-BH084_29.63-29.79m, NEL-BH074_30.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH005_4.11-4.56m, NEL-BH039_5.9m, NEL-BH004_9.05m, NEL-BH004_19.5-19.95m, NEL-BH070_2.0m	**06-Apr-2018**	**17-Apr-2018**	30-Dec-2020	✓	**17-Apr-2018**	16-Jul-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH070_5.0m	**06-Apr-2018**	**19-Apr-2018**	30-Dec-2020	✓	**19-Apr-2018**	18-Jul-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA031: pH (saturated paste)							
Snap Lock Bag - frozen (EA031)							
NEL-BH114_5.22-5.30m, NEL-BH008_10.0-10.1m, NEL-BH099_10.0-10.10m, NEL-BH099_20.04-20.18m, NEL-BH095_5.45-5.55m, NEL-BH093_5.05-5.17m, NEL-BH092_9.85-10.0m, NEL-BH089_8.70-8.90m, NEL-BH089_15.0-15.7m, NEL-BH087_5.60-5.79m, NEL-BH087_14.90-15.10m, NEL-BH100_5.10-5.30m, NEL-BH100_17.34-17.44m, NEL-BH031_10.04-10.11m, NEL-BH031_20.03-20.13m, NEL-BH083_14.84-15.0m, NEL-BH083_25.0-25.22m, NEL-BH084_20.0-20.08m, NEL-BH084_29.63-29.79m, NEL-BH084_37.95-38.05m, NEL-BH076_19.88-20.03m, NEL-BH074_30.0m, NEL-BH076_30.0-30.13m, NEL-BH076_39.79-40.02m, NEL-BH074_20.0-20.14m, NEL-BH074_41.89-42.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH059_10.04-10.18m, NEL-BH059_20.0-20.21m, NEL-BH037_5m, NEL-BH037_14.98-15.10m, NEL-BH037_25.0-25.08m, NEL-BH124_25.0-25.12m, NEL-BH124_35.03-35.12m, NEL-BH124_45.0-45.1m, NEL-BH067_12.06-12.21m, NEL-BH067_25.0-25.13m, NEL-BH068_8.20-8.30m, NEL-BH068_14.96-15.06m, NEL-BH068_19.97-20.05m, NEL-BH039_5.9m, NEL-BH039_9.80m, NEL-BH004_9.05m, NEL-BH070_5.0m, NEL-BH085_5.0-5.12m, NEL-BH085_15.0-15.1m, NEL-BH042_14.97-15.08m, NEL-BH042_25.15-25.25m	**06-Apr-2018**	**----**	----	----	**12-Apr-2018**	03-Oct-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-A: Actual Acidity								
Snap Lock Bag - frozen (EA033)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	16-Jul-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH110_5.0-5.20m,	NEL-BH095_5.45-5.55m,							
NEL-BH095_9.97-10.11m,	NEL-BH122_4.56-4.64m,							
NEL-BH093_5.05-5.17m,	NEL-BH108_5.7-5.79m,							
NEL-BH092_5.0-5.10m,	NEL-BH092_9.85-10.0m,							
NEL-BH089_8.70-8.90m,	NEL-BH089_15.0-15.7m,							
NEL-BH087_5.60-5.79m,	NEL-BH087_14.90-15.10m,							
NEL-BH100_5.10-5.30m,	NEL-BH100_17.34-17.44m,							
NEL-BH031_10.04-10.11m,	NEL-BH031_20.03-20.13m,							
NEL-BH083_14.84-15.0m,	NEL-BH083_25.0-25.22m,							
NEL-BH084_15.3-15.40m,	NEL-BH084_29.63-29.79m,							
NEL-BH084_37.95-38.05m,	NEL-BH076_30.0-30.13m,							
NEL-BH074_20.0-20.14m,	NEL-BH074_30.0m,							
NEL-BH074_41.89-42.0m,	NEL-BH073_24.90-25.06m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH137_5.0m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH039_2.40m,	NEL-BH039_9.80m,							
NEL-BH004_2.0-2.45m,	NEL-BH004_15.0-15.45m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity								
Snap Lock Bag - frozen (EA033)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	16-Jul-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH110_5.0-5.20m,	NEL-BH095_5.45-5.55m,							
NEL-BH095_9.97-10.11m,	NEL-BH122_4.56-4.64m,							
NEL-BH093_5.05-5.17m,	NEL-BH108_5.7-5.79m,							
NEL-BH092_5.0-5.10m,	NEL-BH092_9.85-10.0m,							
NEL-BH089_8.70-8.90m,	NEL-BH089_15.0-15.7m,							
NEL-BH087_5.60-5.79m,	NEL-BH087_14.90-15.10m,							
NEL-BH100_5.10-5.30m,	NEL-BH100_17.34-17.44m,							
NEL-BH031_10.04-10.11m,	NEL-BH031_20.03-20.13m,							
NEL-BH083_14.84-15.0m,	NEL-BH083_25.0-25.22m,							
NEL-BH084_15.3-15.40m,	NEL-BH084_29.63-29.79m,							
NEL-BH084_37.95-38.05m,	NEL-BH076_30.0-30.13m,							
NEL-BH074_20.0-20.14m,	NEL-BH074_30.0m,							
NEL-BH074_41.89-42.0m,	NEL-BH073_24.90-25.06m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH137_5.0m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH039_2.40m,	NEL-BH039_9.80m,							
NEL-BH004_2.0-2.45m,	NEL-BH004_15.0-15.45m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-C: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA033)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	16-Jul-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH110_5.0-5.20m,	NEL-BH095_5.45-5.55m,							
NEL-BH095_9.97-10.11m,	NEL-BH122_4.56-4.64m,							
NEL-BH093_5.05-5.17m,	NEL-BH108_5.7-5.79m,							
NEL-BH092_5.0-5.10m,	NEL-BH092_9.85-10.0m,							
NEL-BH089_8.70-8.90m,	NEL-BH089_15.0-15.7m,							
NEL-BH087_5.60-5.79m,	NEL-BH087_14.90-15.10m,							
NEL-BH100_5.10-5.30m,	NEL-BH100_17.34-17.44m,							
NEL-BH031_10.04-10.11m,	NEL-BH031_20.03-20.13m,							
NEL-BH083_14.84-15.0m,	NEL-BH083_25.0-25.22m,							
NEL-BH084_15.3-15.40m,	NEL-BH084_29.63-29.79m,							
NEL-BH084_37.95-38.05m,	NEL-BH076_30.0-30.13m,							
NEL-BH074_20.0-20.14m,	NEL-BH074_30.0m,							
NEL-BH074_41.89-42.0m,	NEL-BH073_24.90-25.06m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH137_5.0m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH039_2.40m,	NEL-BH039_9.80m,							
NEL-BH004_2.0-2.45m,	NEL-BH004_15.0-15.45m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-D: Retained Acidity								
Snap Lock Bag - frozen (EA033)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	16-Jul-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH110_5.0-5.20m,	NEL-BH095_5.45-5.55m,							
NEL-BH095_9.97-10.11m,	NEL-BH122_4.56-4.64m,							
NEL-BH093_5.05-5.17m,	NEL-BH108_5.7-5.79m,							
NEL-BH092_5.0-5.10m,	NEL-BH092_9.85-10.0m,							
NEL-BH089_8.70-8.90m,	NEL-BH089_15.0-15.7m,							
NEL-BH087_5.60-5.79m,	NEL-BH087_14.90-15.10m,							
NEL-BH100_5.10-5.30m,	NEL-BH100_17.34-17.44m,							
NEL-BH031_10.04-10.11m,	NEL-BH031_20.03-20.13m,							
NEL-BH083_14.84-15.0m,	NEL-BH083_25.0-25.22m,							
NEL-BH084_15.3-15.40m,	NEL-BH084_29.63-29.79m,							
NEL-BH084_37.95-38.05m,	NEL-BH076_30.0-30.13m,							
NEL-BH074_20.0-20.14m,	NEL-BH074_30.0m,							
NEL-BH074_41.89-42.0m,	NEL-BH073_24.90-25.06m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH137_5.0m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH039_2.40m,	NEL-BH039_9.80m,							
NEL-BH004_2.0-2.45m,	NEL-BH004_15.0-15.45m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**17-Apr-2018**	06-Apr-2019	✓	**17-Apr-2018**	16-Jul-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH110_5.0-5.20m,	NEL-BH095_5.45-5.55m,							
NEL-BH095_9.97-10.11m,	NEL-BH122_4.56-4.64m,							
NEL-BH093_5.05-5.17m,	NEL-BH108_5.7-5.79m,							
NEL-BH092_5.0-5.10m,	NEL-BH092_9.85-10.0m,							
NEL-BH089_8.70-8.90m,	NEL-BH089_15.0-15.7m,							
NEL-BH087_5.60-5.79m,	NEL-BH087_14.90-15.10m,							
NEL-BH100_5.10-5.30m,	NEL-BH100_17.34-17.44m,							
NEL-BH031_10.04-10.11m,	NEL-BH031_20.03-20.13m,							
NEL-BH083_14.84-15.0m,	NEL-BH083_25.0-25.22m,							
NEL-BH084_15.3-15.40m,	NEL-BH084_29.63-29.79m,							
NEL-BH084_37.95-38.05m,	NEL-BH076_30.0-30.13m,							
NEL-BH074_20.0-20.14m,	NEL-BH074_30.0m,							
NEL-BH074_41.89-42.0m,	NEL-BH073_24.90-25.06m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH137_5.0m,	NEL-BH137_14.87-15.0m,							
NEL-BH037_14.98-15.10m,	NEL-BH037_25.0-25.08m,							
NEL-BH124_25.0-25.12m,	NEL-BH124_35.03-35.12m,							
NEL-BH124_45.0-45.1m,	NEL-BH067_12.06-12.21m,							
NEL-BH067_25.0-25.13m,	NEL-BH068_8.20-8.30m,							
NEL-BH039_2.40m,	NEL-BH039_9.80m,							
NEL-BH004_2.0-2.45m,	NEL-BH004_15.0-15.45m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EA055: Moisture Content (Dried @ 105-110°C)							
Snap Lock Bag - frozen (EA055) NEL-BH114_5.22-5.30m, NEL-BH008_10.0-10.1m, NEL-BH099_10.0-10.10m, NEL-BH099_20.04-20.18m, NEL-BH095_5.45-5.55m, NEL-BH093_5.05-5.17m, NEL-BH092_9.85-10.0m, NEL-BH089_8.70-8.90m, NEL-BH089_15.0-15.7m, NEL-BH087_5.60-5.79m, NEL-BH087_14.90-15.10m, NEL-BH100_5.10-5.30m, NEL-BH100_17.34-17.44m, NEL-BH031_10.04-10.11m, NEL-BH031_20.03-20.13m, NEL-BH083_14.84-15.0m, NEL-BH083_25.0-25.22m, NEL-BH084_20.0-20.08m, NEL-BH084_29.63-29.79m, NEL-BH084_37.95-38.05m, NEL-BH076_19.88-20.03m, NEL-BH074_30.0m, NEL-BH076_30.0-30.13m, NEL-BH076_39.79-40.02m, NEL-BH074_20.0-20.14m, NEL-BH074_41.89-42.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH059_10.04-10.18m, NEL-BH059_20.0-20.21m, NEL-BH037_5m, NEL-BH037_14.98-15.10m, NEL-BH037_25.0-25.08m, NEL-BH124_25.0-25.12m, NEL-BH124_35.03-35.12m, NEL-BH124_45.0-45.1m, NEL-BH067_12.06-12.21m, NEL-BH067_25.0-25.13m, NEL-BH068_8.20-8.30m, NEL-BH068_14.96-15.06m, NEL-BH039_5.9m, NEL-BH039_9.80m, NEL-BH004_9.05m	**06-Apr-2018**	**----**	----	----	**16-Apr-2018**	20-Apr-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)			Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
ED040S : Soluble Sulfate by ICPAES									
Snap Lock Bag - frozen (ED040S)									
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,		**06-Apr-2018**	**19-Apr-2018**	04-May-2018	✓	**20-Apr-2018**	17-May-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,								
NEL-BH095_5.45-5.55m,	NEL-BH093_5.05-5.17m,								
NEL-BH092_9.85-10.0m,	NEL-BH089_8.70-8.90m,								
NEL-BH089_15.0-15.7m,	NEL-BH087_5.60-5.79m,								
NEL-BH087_14.90-15.10m,	NEL-BH100_5.10-5.30m,								
NEL-BH100_17.34-17.44m,	NEL-BH031_10.04-10.11m,								
NEL-BH031_20.03-20.13m,	NEL-BH083_14.84-15.0m,								
NEL-BH083_25.0-25.22m,	NEL-BH084_20.0-20.08m,								
NEL-BH084_29.63-29.79m,	NEL-BH084_37.95-38.05m,								
NEL-BH076_19.88-20.03m,	NEL-BH074_30.0m,	NEL-BH076_30.0-30.13m,							
NEL-BH076_39.79-40.02m,	NEL-BH074_20.0-20.14m,								
NEL-BH074_41.89-42.0m,									
NEL-BH073_24.90-25.06m,	NEL-BH059_5.5m,								
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,								
NEL-BH037_5m,	NEL-BH037_14.98-15.10m,								
NEL-BH037_25.0-25.08m,	NEL-BH124_25.0-25.12m,								
NEL-BH124_35.03-35.12m,	NEL-BH124_45.0-45.1m,								
NEL-BH067_12.06-12.21m,	NEL-BH067_25.0-25.13m,								
NEL-BH068_8.20-8.30m,	NEL-BH068_14.96-15.06m								
Snap Lock Bag - frozen (ED040S)									
NEL-BH068_19.97-20.05m,	NEL-BH039_5.9m,		**06-Apr-2018**	**23-Apr-2018**	04-May-2018	✓	**23-Apr-2018**	21-May-2018	✓
NEL-BH039_9.80m,	NEL-BH004_9.05m,								
NEL-BH070_5.0m,	NEL-BH085_5.0-5.12m,								
NEL-BH085_15.0-15.1m,	NEL-BH042_14.97-15.08m,								
NEL-BH042_25.15-25.25m									

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
ED042T: Total Sulfur by LECO								
80* dried soil (ED042T)								
NEL-BH137_14.87-15.0m		**06-Apr-2018**	**19-Apr-2018**	04-May-2018	✓	**19-Apr-2018**	04-May-2018	✓
Snap Lock Bag - frozen (ED042T)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**19-Apr-2018**	13-Apr-2018	×	**19-Apr-2018**	16-Oct-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH095_5.45-5.55m,	NEL-BH095_9.97-10.11m,							
NEL-BH122_4.56-4.64m,	NEL-BH093_5.05-5.17m,							
NEL-BH108_5.7-5.79m,	NEL-BH092_5.0-5.10m,							
NEL-BH092_9.85-10.0m,	NEL-BH089_8.70-8.90m,							
NEL-BH089_15.0-15.7m,	NEL-BH087_5.60-5.79m,							
NEL-BH087_14.90-15.10m,	NEL-BH100_5.10-5.30m,							
NEL-BH100_17.34-17.44m,	NEL-BH031_10.04-10.11m,							
NEL-BH031_20.03-20.13m,	NEL-BH083_14.84-15.0m,							
NEL-BH083_25.0-25.22m,	NEL-BH084_15.3-15.40m,							
NEL-BH084_29.63-29.79m,	NEL-BH084_37.95-38.05m,							
NEL-BH076_30.0-30.13m,	NEL-BH074_20.0-20.14m,							
NEL-BH074_30.0m,	NEL-BH074_41.89-42.0m,							
NEL-BH073_24.90-25.06m,	NEL-BH059_10.04-10.18m,							
NEL-BH059_20.0-20.21m,	NEL-BH037_14.98-15.10m,							
NEL-BH037_25.0-25.08m,	NEL-BH124_25.0-25.12m,							
NEL-BH124_35.03-35.12m,	NEL-BH124_45.0-45.1m,							
NEL-BH067_12.06-12.21m,	NEL-BH067_25.0-25.13m,							
NEL-BH068_8.20-8.30m,	NEL-BH042_14.97-15.08m							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser							
Snap Lock Bag - frozen (ED045G) NEL-BH114_5.22-5.30m, NEL-BH008_10.0-10.1m, NEL-BH099_10.0-10.10m, NEL-BH099_20.04-20.18m, NEL-BH095_5.45-5.55m, NEL-BH093_5.05-5.17m, NEL-BH092_9.85-10.0m, NEL-BH089_8.70-8.90m, NEL-BH089_15.0-15.7m, NEL-BH087_5.60-5.79m, NEL-BH087_14.90-15.10m, NEL-BH100_5.10-5.30m, NEL-BH100_17.34-17.44m, NEL-BH031_10.04-10.11m, NEL-BH031_20.03-20.13m, NEL-BH083_14.84-15.0m, NEL-BH083_25.0-25.22m, NEL-BH084_20.0-20.08m, NEL-BH084_29.63-29.79m, NEL-BH084_37.95-38.05m, NEL-BH076_19.88-20.03m, NEL-BH074_30.0m, NEL-BH076_30.0-30.13m, NEL-BH076_39.79-40.02m, NEL-BH074_20.0-20.14m, NEL-BH074_41.89-42.0m, NEL-BH073_24.90-25.06m, NEL-BH059_5.5m, NEL-BH059_10.04-10.18m, NEL-BH059_20.0-20.21m, NEL-BH037_5m, NEL-BH037_14.98-15.10m, NEL-BH037_25.0-25.08m, NEL-BH124_25.0-25.12m, NEL-BH124_35.03-35.12m, NEL-BH124_45.0-45.1m, NEL-BH067_12.06-12.21m, NEL-BH067_25.0-25.13m, NEL-BH068_8.20-8.30m, NEL-BH068_14.96-15.06m	**06-Apr-2018**	**19-Apr-2018**	04-May-2018	✓	**20-Apr-2018**	17-May-2018	✓
Snap Lock Bag - frozen (ED045G) NEL-BH068_19.97-20.05m, NEL-BH039_5.9m, NEL-BH039_9.80m, NEL-BH004_9.05m, NEL-BH070_5.0m, NEL-BH085_5.0-5.12m, NEL-BH085_15.0-15.1m, NEL-BH042_14.97-15.08m, NEL-BH042_25.15-25.25m	**06-Apr-2018**	**23-Apr-2018**	04-May-2018	✓	**23-Apr-2018**	21-May-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED093S: Soluble Major Cations								
Snap Lock Bag - frozen (ED093S)								
NEL-BH114_5.22-5.30m,	NEL-BH008_10.0-10.1m,	**06-Apr-2018**	**19-Apr-2018**	03-Oct-2018	✓	**20-Apr-2018**	03-Oct-2018	✓
NEL-BH099_10.0-10.10m,	NEL-BH099_20.04-20.18m,							
NEL-BH095_5.45-5.55m,	NEL-BH093_5.05-5.17m,							
NEL-BH092_9.85-10.0m,	NEL-BH089_8.70-8.90m,							
NEL-BH089_15.0-15.7m,	NEL-BH087_5.60-5.79m,							
NEL-BH087_14.90-15.10m,	NEL-BH100_5.10-5.30m,							
NEL-BH100_17.34-17.44m,	NEL-BH031_10.04-10.11m,							
NEL-BH031_20.03-20.13m,	NEL-BH083_14.84-15.0m,							
NEL-BH083_25.0-25.22m,	NEL-BH084_20.0-20.08m,							
NEL-BH084_29.63-29.79m,	NEL-BH084_37.95-38.05m,							
NEL-BH076_19.88-20.03m,	NEL-BH074_30.0m, NEL-BH076_30.0-30.13m,							
NEL-BH076_39.79-40.02m,	NEL-BH074_20.0-20.14m,							
NEL-BH074_41.89-42.0m,								
NEL-BH073_24.90-25.06m,	NEL-BH059_5.5m,							
NEL-BH059_10.04-10.18m,	NEL-BH059_20.0-20.21m,							
NEL-BH037_5m,	NEL-BH037_14.98-15.10m,							
NEL-BH037_25.0-25.08m,	NEL-BH124_25.0-25.12m,							
NEL-BH124_35.03-35.12m,	NEL-BH124_45.0-45.1m,							
NEL-BH067_12.06-12.21m,	NEL-BH067_25.0-25.13m,							
NEL-BH068_8.20-8.30m,	NEL-BH068_14.96-15.06m							
Snap Lock Bag - frozen (ED093S)								
NEL-BH068_19.97-20.05m,	NEL-BH039_5.9m,	**06-Apr-2018**	**23-Apr-2018**	03-Oct-2018	✓	**23-Apr-2018**	03-Oct-2018	✓
NEL-BH039_9.80m,	NEL-BH004_9.05m,							
NEL-BH070_5.0m,	NEL-BH085_5.0-5.12m,							
NEL-BH085_15.0-15.1m,	NEL-BH042_14.97-15.08m,							
NEL-BH042_25.15-25.25m								
EP004: Organic Matter								
Snap Lock Bag - frozen (EP004)								
NEL-BH068_8.20-8.30m,	NEL-BH039_5.9m,	**06-Apr-2018**	**19-Apr-2018**	03-Oct-2018	✓	**19-Apr-2018**	03-Oct-2018	✓
NEL-BH004_9.05m								

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acid Neutralising Capacity (ANC)	EA013	5	41	**12.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	5	49	**10.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	5	49	**10.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	5	46	**10.87**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	5	49	**10.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	5	43	**11.63**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	5	41	**12.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (Saturated Paste)	EA031	5	49	**10.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	5	41	**12.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Neutralising Capacity (ANC)	EA013	3	41	**7.32**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	3	49	**6.12**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	6	49	**12.24**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	3	46	**6.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	3	49	**6.12**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	3	41	**7.32**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (Saturated Paste)	EA031	6	49	**12.24**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	3	41	**7.32**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	14	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Cations - soluble by ICP-AES	ED093S	3	49	**6.12**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	3	49	**6.12**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	3	46	**6.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	3	49	**6.12**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	3	41	**7.32**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	14	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Organic Matter	EP004	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Net Acid Production Potential	EA009	SOIL	In house: Referenced to Coastech Research (Canada)(Mod.). NAPP = Acid Production Potential (APP or MAP-Maximum Acid Potential) minus Neutralising Capacity (ANC). NAPP may be +ve, zero or -ve.
Net Acid Generation	EA011	SOIL	In house: Referenced to Miller (1998) Titremetric procedure determines net acidity in a soil following peroxide oxidation. Titrations to both pH 4.5 and pH 7 are reported.
Acid Neutralising Capacity (ANC)	EA013	SOIL	In house: Referenced to USEPA 600/2-78-054, I. Miller (2000). A fizz test is done to semiquanititatively estimate the likely reactivity. The soil is then reacted with an known excess quanitity of an appropriate acid. Titration determines the acid remaining, and the ANC can be calculated from comparison with a blank titration.
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
pH (Saturated Paste)	* EA031	SOIL	In house: Referenced to USEPA 600/2 - 78 - 054 - pH determined on a saturated paste by ISE.
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Resistivity (Saturated Paste)	EA084	SOIL	In house: Calculated from Saturated Paste Electrical Conductivity
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Sulfur - Total as S (LECO)	ED042T	SOIL	In house: Dried and pulverised sample is combusted in a high temperature furnace in the presence of strong oxidants / catalysts. The evolved S (as SO2) is measured by infra-red detector
Chloride Soluble By Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate.
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).
Sulphate Reducing Bacteria BART	MM820	SOIL	Microbiological analysis subcontracted to ALS Scoresby. NATA accreditation does not cover performance of this service.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)
Dry and Pulverise (up to 100g)	GEO30	SOIL	#

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1813212**	Page	: 1 of 9
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350061101	Date Samples Received	: 17-Aug-2018 16:45
Order number	:	Date Analysis Commenced	: 21-Aug-2018
C-O-C number	: ----	Issue Date	: 27-Aug-2018 09:14
Sampler	: SCOTT HILLIARD		
Site	: Melbourne		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 14		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA031 (Saturated Paste pH): NATA accreditation does not cover the performance of this service.
- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.
- ALS is not NATA accredited for the calculation of saturated resistivity in a soil.

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	NEL-EF-BH017_10m	NEL-EF-BH017_20m	NEL-EF-BH018_20m	NEL-EF-BH019_10m	NEL-EF-BH019_20m
			Client sampling date / time	14-Aug-2018 00:00	14-Aug-2018 00:00	17-Jul-2018 00:00	13-Jul-2018 00:00	13-Jul-2018 00:00
Compound	CAS Number	LOR	Unit	EM1813212-004	EM1813212-005	EM1813212-008	EM1813212-010	EM1813212-011
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-0.1**	**-3.1**	**-3.6**	**-8.4**	**-6.4**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**3.5**	**4.0**	**4.0**	**7.3**	**6.9**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	**2.1**	**0.6**	**0.6**	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**4.8**	**2.6**	**2.9**	<0.1	**0.2**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**9.0**	**8.9**	**10.0**	**9.0**	**7.0**
ANC as CaCO3	----	0.1	% CaCO3	**0.9**	**0.9**	**1.0**	**0.9**	**0.7**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**1**	**1**	**0**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.9**	**7.0**	**6.8**	**6.4**	**6.6**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.211**	**0.164**	**0.179**	<0.005	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**132**	**102**	**112**	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**0.42**	**0.65**	**0.37**	----	**0.31**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**84**	**130**	**75**	----	**62**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.13**	**0.21**	**0.12**	----	**0.10**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	**0.12**	**0.02**	**0.10**	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	**76**	**16**	**62**	<10	<10
Liming Rate	----	1	kg CaCO3/t	**6**	**1**	**5**	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.21**	**0.16**	**0.18**	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**132**	**102**	**112**	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	**10**	**8**	**8**	<1	<1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.29**	**0.19**	**0.21**	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH009_2.9m	NEL-EF-BH015_6.5m	NEL-EF-BH017_2m	NEL-EF-BH018_1.90m	NEL-EF-BH018_10m
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	15-Jun-2018 00:00	25-Jun-2018 00:00	17-Jul-2018 00:00
Compound	CAS Number	LOR	Unit	EM1813212-001	EM1813212-002	EM1813212-003	EM1813212-006	EM1813212-007
				Result	Result	Result	Result	Result
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	----	----	----	----	**-7.7**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	----	----	----	**7.1**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	----	----	----	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	----	----	----	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	----	----	----	**8.6**
ANC as CaCO3	----	0.1	% CaCO3	----	----	----	----	**0.9**
Fizz Rating	----	0	Fizz Unit	----	----	----	----	**0**
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	**5.9**	**6.7**	----
pH OX (23B)	----	0.1	pH Unit	----	----	**6.3**	**7.7**	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	**2**	<2	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	**7**	<2	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	**4**	<2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	<0.020	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	<10	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	**0.037**	<0.020	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	**0.039**	**0.021**	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	<0.020	**0.021**	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	<10	**11**	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH009_2.9m	NEL-EF-BH015_6.5m	NEL-EF-BH017_2m	NEL-EF-BH018_1.90m	NEL-EF-BH018_10m
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	15-Jun-2018 00:00	25-Jun-2018 00:00	17-Jul-2018 00:00
Compound	CAS Number	LOR	Unit	EM1813212-001	EM1813212-002	EM1813212-003	EM1813212-006	EM1813212-007
				Result	Result	Result	Result	Result
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	**0.128**	**0.055**	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	**0.132**	**0.072**	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	<10	**14**	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	<0.020	**0.023**	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	----	----	**0.145**	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	----	**29**	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	----	----	**0.046**	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	**1.5**	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	<10	<10	----
Liming Rate	----	1	kg CaCO3/t	----	----	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	<0.02	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	<10	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	<1	<1	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	**8.0**	**7.1**	**6.9**	**7.3**	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**7.5**	**6.4**	----	**6.7**	**6.4**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	----	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	----	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	----	<0.005	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	----	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**2.00**	----	----	**0.36**	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**399**	----	----	**72**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH009_2.9m	NEL-EF-BH015_6.5m	NEL-EF-BH017_2m	NEL-EF-BH018_1.90m	NEL-EF-BH018_10m
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	15-Jun-2018 00:00	25-Jun-2018 00:00	17-Jul-2018 00:00
Compound	CAS Number	LOR	Unit	EM1813212-001	EM1813212-002	EM1813212-003	EM1813212-006	EM1813212-007
				Result	Result	Result	Result	Result
EA033-C: Acid Neutralising Capacity - Continued								
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**0.64**	----	----	**0.11**	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	----	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	----	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	----	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	----	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	----	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	----	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	----	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**9.0**	**16.5**	**16.5**	**8.7**	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	**950**	**790**	**1490**	**800**	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**130**	**60**	**20**	**20**	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	----	----	----	**0.03**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**80**	**410**	**40**	**490**	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	----
Sodium	7440-23-5	10	mg/kg	**190**	**350**	**110**	**130**	----
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	NEL-EF-BH019_5m	NEL-BH101_1.90m	NEL-BH101_7.50m	NEL-EF-BH014_1.5m	----
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	29-Jun-2018 00:00	[29-Jun-2018]	----
Compound	CAS Number	LOR	Unit	EM1813212-009	EM1813212-012	EM1813212-013	EM1813212-014	--------
				Result	Result	Result	Result	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	----	**-7.5**	**-5.8**	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	**7.4**	**7.2**	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	<0.1	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	<0.1	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	**8.1**	**6.4**	----	----
ANC as CaCO3	----	0.1	% CaCO3	----	**0.8**	**0.6**	----	----
Fizz Rating	----	0	Fizz Unit	----	**0**	**0**	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	**6.7**	**5.8**	----
pH OX (23B)	----	0.1	pH Unit	----	----	**7.2**	**6.4**	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	<2	**2**	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	<2	**4**	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	<2	**2**	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	<0.020	<0.020	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	<0.020	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	<10	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	**0.020**	<0.020	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	**0.025**	<0.020	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	<0.020	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	<10	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-E: Magnesium Values								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH019_5m	NEL-BH101_1.90m	NEL-BH101_7.50m	NEL-EF-BH014_1.5m	----
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	29-Jun-2018 00:00	[29-Jun-2018]	----
Compound	CAS Number	LOR	Unit	EM1813212-009	EM1813212-012	EM1813212-013	EM1813212-014	--------
				Result	Result	Result	Result	----
EA029-E: Magnesium Values - Continued								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	**0.067**	**0.045**	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	**0.081**	**0.051**	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	**11**	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	----	**0.096**	----	----
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	----	**19**	----	----
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	----	**0.031**	----	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	**1.5**	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	<10	<10	----
Liming Rate	----	1	kg CaCO3/t	----	----	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	<0.02	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	<10	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	<1	<1	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	**7.3**	**7.4**	**6.8**	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.4**	**6.6**	**6.7**	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	**0.40**	**0.30**	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	**79**	**59**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	NEL-EF-BH019_5m	NEL-BH101_1.90m	NEL-BH101_7.50m	NEL-EF-BH014_1.5m	----
			Client sampling date / time	04-Jul-2018 00:00	29-Jun-2018 00:00	29-Jun-2018 00:00	[29-Jun-2018]	----
Compound	CAS Number	LOR	Unit	EM1813212-009	EM1813212-012	EM1813212-013	EM1813212-014	--------
				Result	Result	Result	Result	----
EA033-C: Acid Neutralising Capacity - Continued								
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	**0.13**	**0.09**	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	**18.2**	**19.2**	**5.3**	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	----	**520**	**730**	**1160**	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	**190**	**160**	**40**	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	**0.02**	**0.02**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	**730**	**720**	**170**	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	----	<10	<10	<10	----
Sodium	7440-23-5	10	mg/kg	----	**600**	**600**	**170**	----
Potassium	7440-09-7	10	mg/kg	----	<10	**10**	<10	----

AECOM

ANZ

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: GHD Pty Ltd	ADDRESS / OFFICE:	SAMPLER: GHD	**Destination Laboratory**
PROJECT MANAGER (PM): David Quinn	SITE: Melbourne	MOBILE: S.Hilliard 0430 344 657 PHONE:	ALS Springvale
PROJECT NUMBER & TASK COI 31350061101	P.O. NO.:	EMAIL REPORT TO: kory.auch@ghd.com marcin.wieloch@ghd.com	ATT: Shirley LeCornu
RESULTS REQUIRED (Date): Regular TAT	QUOTE NO.:	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:
- Note: Please send to GHD Lab Reports

Extra volume for QC or trace LORs etc.
NEL-Suite 1 inc. testing of concentration of: Ca2+, Na+, Mg2+, K+, SO42-, Cl-.
NEL-Suite 2 inc. testing of soil resistivity (to AS 1289.4.4.1) and pH (to AS 1289.4.3.1).
NEL-Suite 3 inc. acid sulphate soil testing to include pHKCl, TAA and pHOx as per AS 4969.12 and net acidity as per AS 4969.14. Where sample at designated depth is rock not soil, undertake NAG and NAP testing instead.
NEL-Suite 4 inc. NAPP (ASS-1) and NAG (EA011) testing.
NEL-Suite 5 inc. testing of total organic carbon (TOC) content and sulphate reducing bacteria (SRB). TOC testing to be carried out to (AS 1289.4.1.1).

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total Bags	NAPP (ASS-1)	NAG (EA011)	Chromium Suite (EA033)	SPOCAS Suite (EA029)	NEL-Suite 1	NEL-Suite 2	NEL-Suite 3	NEL-Suite 4	NEL-Suite 5	
1	NEL-EF-BH009_2.9m	S	4/7/18		ASS	1			1		1	1				
2	NEL-EF-BH015_6.5m	S	29/6/18		ASS	1			1		1	1				
3	NEL-EF-BH017_2m	S	15/6/18		ASS	1				1	1	1				
4	NEL-EF-BH017_10m	S	14/8/18		ASS	1	1	1	1							
5	NEL-EF-BH017_20m	S	14/8/18		ASS	1	1	1	1							
6	NEL-EF-BH018_1.90m	S	25/6/18		ASS	1			1		1	1	1			
7	NEL-EF-BH018_10m	S	17/7/18		ASS	1	1	1	1							
8	NEL-EF-BH018_20m	S	17/7/18		ASS	1	1	1	1							
9	NEL-EF-BH019_5m	S	4/7/18		ASS	1			1							
10	NEL-EF-BH019_10m	S	13/7/18		ASS	1	1	1	1							
11	NEL-EF-BH019_20m	S	13/7/18		ASS	1	1	1	1							
12	NEL-BH101_1.90m	S	29/6/18		ASS	1	1	1	1		1	1				
13	NEL-BH101_7.50m	S	29/6/18		ASS	1	1	1	1		1	1	1			
14	NEL-EF-BH014_1.5m	S	- ?		ASS	1				1	1	1				Not frozen at time of sampling
			dates as per bags													
			NP (ALS) 20/8.													

Environmental Division
Melbourne
Work Order Reference
EM1813212

Telephone : + 61-3-8549 9600

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name:	Date:	Name:	Date:	Name: [illegible]	Date: 17/8	Con' Note No:
Of:	Time:	Of:	Time:	Of: [illegible]	Time: 16:40	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

COC Page of

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1813212**	Page	: 1 of 7
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9630
Project	: 31350061101	Date Samples Received	: 17-Aug-2018
Order number	:	Date Analysis Commenced	: 21-Aug-2018
C-O-C number	: ----	Issue Date	: 27-Aug-2018
Sampler	: SCOTT HILLIARD		
Site	: Melbourne		
Quote number	: ME/124/18 - North East Link		
No. of samples received	: 14		
No. of samples analysed	: 14		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA011: Net Acid Generation (QC Lot: 1889883)									
EM1813212-004	NEL-EF-BH017_10m	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	2.1	2.2	0.00	0% - 20%
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	4.8	4.9	3.28	0% - 20%
		EA011: pH (OX)	----	0.1	pH Unit	3.5	3.4	2.90	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 1889881)									
EB1820255-002	Anonymous	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	4.6	3.8	17.2	No Limit
EA029-A: pH Measurements (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: pH KCl (23A)	----	0.1	pH Unit	6.6	6.2	6.25	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	7.2	7.1	1.40	0% - 20%
EA029-B: Acidity Trail (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.00	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.00	No Limit
EA029-C: Sulfur Trail (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA029-D: Calcium Values (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.115	0.114	0.00	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.138	0.137	0.00	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	0.022	0.023	0.00	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	11	11	0.00	No Limit
EA029-E: Magnesium Values (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.099	0.101	1.60	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.109	0.105	3.55	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.00	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	<0.020	0.00	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA029-F: Excess Acid Neutralising Capacity (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	0.102	0.110	6.76	No Limit
		EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	0.033	0.035	6.76	No Limit
		EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	20	22	6.76	No Limit
EA029-H: Acid Base Accounting (QC Lot: 1889882)									
EB1820258-001	Anonymous	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.00	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.00	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.00	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.00	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.00	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.00	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA031: pH (saturated paste) (QC Lot: 1887525)									
EM1813212-014	NEL-EF-BH014_1.5m	EA031: pH (Saturated Paste)	----	0.1	pH Unit	6.8	6.8	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 1889880)									
EB1819629-055	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	9.7	9.7	0.00	0% - 20%
EB1820175-010	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.07	0.08	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	46	47	2.29	0% - 20%
		EA033: pH KCl (23A)	----	0.1	pH Unit	4.3	4.3	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 1889884)									
EM1813212-005	NEL-EF-BH017_20m	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA033-A: Actual Acidity (QC Lot: 1889884) - continued									
EM1813212-005	NEL-EF-BH017_20m	EA033: pH KCl (23A)	----	0.1	pH Unit	7.0	7.3	4.20	0% - 20%
EA033-B: Potential Acidity (QC Lot: 1889880)									
EB1819629-055	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.131	0.126	4.08	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	82	79	4.08	No Limit
EB1820175-010	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-B: Potential Acidity (QC Lot: 1889884)									
EM1813212-005	NEL-EF-BH017_20m	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.164	0.158	3.51	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	102	99	3.51	0% - 50%
EA033-C: Acid Neutralising Capacity (QC Lot: 1889880)									
EB1819629-055	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	5.33	5.41	1.55	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	1.71	1.73	1.55	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	1060	1080	1.55	0% - 20%
EA033-C: Acid Neutralising Capacity (QC Lot: 1889884)									
EM1813212-005	NEL-EF-BH017_20m	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.65	0.75	14.8	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.21	0.24	14.8	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	130	151	14.8	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1887111)									
EM1813212-003	NEL-EF-BH017_2m	EA055: Moisture Content	----	0.1	%	16.5	16.5	0.00	0% - 50%
ED040S: Soluble Major Anions (QC Lot: 1887106)									
EM1813212-001	NEL-EF-BH009_2.9m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	160	20.4	0% - 50%
ED042T: Total Sulfur by LECO (QC Lot: 1889917)									
EM1813212-004	NEL-EF-BH017_10m	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.29	0.28	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 1887107)									
EM1813212-001	NEL-EF-BH009_2.9m	ED045G: Chloride	16887-00-6	10	mg/kg	80	90	16.9	No Limit
ED093S: Soluble Major Cations (QC Lot: 1887108)									
EM1813212-001	NEL-EF-BH009_2.9m	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	<10	<10	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	190	210	13.5	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA011: Net Acid Generation (QCLot: 1889883)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.5 kg H2SO4/t	98.8	70	130
EA013: Acid Neutralising Capacity (QCLot: 1889881)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	9.9 kg H2SO4 equiv./t	97.5	82	120
EA029-A: pH Measurements (QCLot: 1889882)								
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.6 pH Unit	106	70	130
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.3 pH Unit	109	70	130
EA029-B: Acidity Trail (QCLot: 1889882)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	83.6	70	130
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	35.2 mole H+ / t	85.4	70	130
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 1889882)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.052 % S	89.6	70	130
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.158 % S	87.9	70	130
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-D: Calcium Values (QCLot: 1889882)								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.097 % Ca	114	70	130
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.22 % Ca	100	70	130
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----
EA029-E: Magnesium Values (QCLot: 1889882)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.25 % Mg	78.0	70	130
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.234 % Mg	82.1	70	130
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----
EA029-F: Excess Acid Neutralising Capacity (QCLot: 1889882)								
EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	<0.020	----	----	----	----
EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	<10	----	----	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EA029-F: Excess Acid Neutralising Capacity (QCLot: 1889882) - continued								
EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	<0.020	----	----	----	----
EA029-H: Acid Base Accounting (QCLot: 1889882)								
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----
EA031: pH (saturated paste) (QCLot: 1887525)								
EA031: pH (Saturated Paste)	----	----	pH Unit	----	4 pH Unit	100	99	101
				----	7 pH Unit	100	99	101
EA033-A: Actual Acidity (QCLot: 1889880)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.6 pH Unit	104	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	81.7	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 1889884)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.6 pH Unit	104	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	17.7 mole H+ / t	85.1	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1889880)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	95.9	70	130
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1889884)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	93.7	70	130
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1889880)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	106	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1889884)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	106	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
ED040S: Soluble Major Anions (QCLot: 1887106)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	500 mg/kg	101	90	114

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED042T: Total Sulfur by LECO (QCLot: 1889917)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.16 %	107	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 1887107)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	91.7	83	119
				<10	5000 mg/kg	98.6	83	119
ED093S: Soluble Major Cations (QCLot: 1887108)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	500 mg/kg	99.1	80	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	500 mg/kg	102	80	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	500 mg/kg	99.5	80	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	500 mg/kg	99.7	80	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1813212**	Page	: 1 of 11
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Telephone	: +61-3-8549 9630
Project	: 31350061101	Date Samples Received	: 17-Aug-2018
Site	: Melbourne	Issue Date	: 27-Aug-2018
Sampler	: SCOTT HILLIARD	No. of samples received	: 14
Order number	:	No. of samples analysed	: 14

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method Container / Client Sample ID(s)		Extraction / Preparation Date extracted	Due for extraction	Days overdue	Analysis Date analysed	Due for analysis	Days overdue
EA055: Moisture Content (Dried @ 105-110°C)							
Snap Lock Bag - frozen NEL-EF-BH009_2.9m		----	----	----	21-Aug-2018	18-Jul-2018	**34**
Snap Lock Bag - frozen NEL-EF-BH017_2m		----	----	----	21-Aug-2018	29-Jun-2018	**53**
Snap Lock Bag - frozen NEL-EF-BH018_1.90m		----	----	----	21-Aug-2018	09-Jul-2018	**43**
Snap Lock Bag - frozen NEL-EF-BH015_6.5m, NEL-BH101_7.50m,	NEL-BH101_1.90m, NEL-EF-BH014_1.5m	----	----	----	21-Aug-2018	13-Jul-2018	**39**
ED040S : Soluble Sulfate by ICPAES							
Snap Lock Bag - frozen NEL-EF-BH009_2.9m		22-Aug-2018	01-Aug-2018	**21**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH017_2m		22-Aug-2018	13-Jul-2018	**40**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH018_1.90m		22-Aug-2018	23-Jul-2018	**30**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH015_6.5m, NEL-BH101_7.50m,	NEL-BH101_1.90m, NEL-EF-BH014_1.5m	22-Aug-2018	27-Jul-2018	**26**	----	----	----
ED042T: Total Sulfur by LECO							
Pulp Bag NEL-EF-BH019_10m,	NEL-EF-BH019_20m	22-Aug-2018	10-Aug-2018	**12**	22-Aug-2018	10-Aug-2018	**12**
Pulp Bag NEL-EF-BH018_10m,	NEL-EF-BH018_20m	22-Aug-2018	14-Aug-2018	**8**	22-Aug-2018	14-Aug-2018	**8**
Pulp Bag NEL-BH101_1.90m,	NEL-BH101_7.50m	22-Aug-2018	27-Jul-2018	**26**	22-Aug-2018	27-Jul-2018	**26**
ED045G: Chloride by Discrete Analyser							
Snap Lock Bag - frozen NEL-EF-BH009_2.9m		22-Aug-2018	01-Aug-2018	**21**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH017_2m		22-Aug-2018	13-Jul-2018	**40**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH018_1.90m		22-Aug-2018	23-Jul-2018	**30**	----	----	----
Snap Lock Bag - frozen NEL-EF-BH015_6.5m, NEL-BH101_7.50m,	NEL-BH101_1.90m, NEL-EF-BH014_1.5m	22-Aug-2018	27-Jul-2018	**26**	----	----	----

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA011: Net Acid Generation								
Snap Lock Bag - frozen (EA011) NEL-EF-BH019_10m,	NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA011) NEL-EF-BH017_10m,	NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA011) NEL-EF-BH018_10m,	NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA011) NEL-BH101_1.90m,	NEL-BH101_7.50m	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
EA013: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA013) NEL-EF-BH019_10m,	NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA013) NEL-EF-BH017_10m,	NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA013) NEL-EF-BH018_10m,	NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
Snap Lock Bag - frozen (EA013) NEL-BH101_1.90m,	NEL-BH101_7.50m	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	19-Feb-2019	✓
EA029-A: pH Measurements								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-B: Acidity Trail								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA029-C: Sulfur Trail								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-D: Calcium Values								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-E: Magnesium Values								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-F: Excess Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-G: Retained Acidity								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
EA029-H: Acid Base Accounting								
Snap Lock Bag - frozen (EA029) NEL-EF-BH017_2m		**15-Jun-2018**	**23-Aug-2018**	10-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	20-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA029) NEL-BH101_7.50m,	NEL-EF-BH014_1.5m	**29-Jun-2018**	**23-Aug-2018**	24-Mar-2021	✓	**23-Aug-2018**	21-Nov-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA031: pH (saturated paste)							
Snap Lock Bag - frozen (EA031) NEL-EF-BH009_2.9m	**04-Jul-2018**	**----**	----	----	**21-Aug-2018**	31-Dec-2018	✓
Snap Lock Bag - frozen (EA031) NEL-EF-BH017_2m	**15-Jun-2018**	**----**	----	----	**21-Aug-2018**	12-Dec-2018	✓
Snap Lock Bag - frozen (EA031) NEL-EF-BH018_1.90m	**25-Jun-2018**	**----**	----	----	**21-Aug-2018**	22-Dec-2018	✓
Snap Lock Bag - frozen (EA031) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m, NEL-EF-BH014_1.5m	**29-Jun-2018**	**----**	----	----	**21-Aug-2018**	26-Dec-2018	✓
EA033-A: Actual Acidity							
Snap Lock Bag - frozen (EA033) NEL-EF-BH009_2.9m, NEL-EF-BH019_5m	**04-Jul-2018**	**23-Aug-2018**	04-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH019_10m, NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH017_10m, NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_10m, NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_1.90m	**25-Jun-2018**	**23-Aug-2018**	25-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
EA033-B: Potential Acidity							
Snap Lock Bag - frozen (EA033) NEL-EF-BH009_2.9m, NEL-EF-BH019_5m	**04-Jul-2018**	**23-Aug-2018**	04-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH019_10m, NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH017_10m, NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_10m, NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_1.90m	**25-Jun-2018**	**23-Aug-2018**	25-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓

Matrix: **SOIL** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation Date extracted	Due for extraction	Evaluation	Analysis Date analysed	Due for analysis	Evaluation
EA033-C: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA033) NEL-EF-BH009_2.9m,	NEL-EF-BH019_5m	**04-Jul-2018**	**23-Aug-2018**	04-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH019_10m,	NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH017_10m,	NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_10m,	NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	25-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH015_6.5m, NEL-BH101_7.50m	NEL-BH101_1.90m,	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
EA033-D: Retained Acidity								
Snap Lock Bag - frozen (EA033) NEL-EF-BH009_2.9m,	NEL-EF-BH019_5m	**04-Jul-2018**	**23-Aug-2018**	04-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH019_10m,	NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH017_10m,	NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_10m,	NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	25-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH015_6.5m, NEL-BH101_7.50m	NEL-BH101_1.90m,	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033) NEL-EF-BH009_2.9m,	NEL-EF-BH019_5m	**04-Jul-2018**	**23-Aug-2018**	04-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH019_10m,	NEL-EF-BH019_20m	**13-Jul-2018**	**23-Aug-2018**	13-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH017_10m,	NEL-EF-BH017_20m	**14-Aug-2018**	**23-Aug-2018**	14-Aug-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_10m,	NEL-EF-BH018_20m	**17-Jul-2018**	**23-Aug-2018**	17-Jul-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH018_1.90m		**25-Jun-2018**	**23-Aug-2018**	25-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓
Snap Lock Bag - frozen (EA033) NEL-EF-BH015_6.5m, NEL-BH101_7.50m	NEL-BH101_1.90m,	**29-Jun-2018**	**23-Aug-2018**	29-Jun-2019	✓	**23-Aug-2018**	21-Nov-2018	✓

Matrix: **SOIL**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Snap Lock Bag - frozen (EA055) NEL-EF-BH009_2.9m	**04-Jul-2018**	**----**	----	----	**21-Aug-2018**	18-Jul-2018	✘
Snap Lock Bag - frozen (EA055) NEL-EF-BH017_2m	**15-Jun-2018**	**----**	----	----	**21-Aug-2018**	29-Jun-2018	✘
Snap Lock Bag - frozen (EA055) NEL-EF-BH018_1.90m	**25-Jun-2018**	**----**	----	----	**21-Aug-2018**	09-Jul-2018	✘
Snap Lock Bag - frozen (EA055) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m, NEL-EF-BH014_1.5m	**29-Jun-2018**	**----**	----	----	**21-Aug-2018**	13-Jul-2018	✘
ED040S : Soluble Sulfate by ICPAES							
Snap Lock Bag - frozen (ED040S) NEL-EF-BH009_2.9m	**04-Jul-2018**	**22-Aug-2018**	01-Aug-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED040S) NEL-EF-BH017_2m	**15-Jun-2018**	**22-Aug-2018**	13-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED040S) NEL-EF-BH018_1.90m	**25-Jun-2018**	**22-Aug-2018**	23-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED040S) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m, NEL-EF-BH014_1.5m	**29-Jun-2018**	**22-Aug-2018**	27-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
ED042T: Total Sulfur by LECO							
Pulp Bag (ED042T) NEL-EF-BH019_10m, NEL-EF-BH019_20m	**13-Jul-2018**	**22-Aug-2018**	10-Aug-2018	✘	**22-Aug-2018**	10-Aug-2018	✘
Pulp Bag (ED042T) NEL-EF-BH017_10m, NEL-EF-BH017_20m	**14-Aug-2018**	**22-Aug-2018**	11-Sep-2018	✓	**22-Aug-2018**	11-Sep-2018	✓
Pulp Bag (ED042T) NEL-EF-BH018_10m, NEL-EF-BH018_20m	**17-Jul-2018**	**22-Aug-2018**	14-Aug-2018	✘	**22-Aug-2018**	14-Aug-2018	✘
Pulp Bag (ED042T) NEL-BH101_1.90m, NEL-BH101_7.50m	**29-Jun-2018**	**22-Aug-2018**	27-Jul-2018	✘	**22-Aug-2018**	27-Jul-2018	✘
ED045G: Chloride by Discrete Analyser							
Snap Lock Bag - frozen (ED045G) NEL-EF-BH009_2.9m	**04-Jul-2018**	**22-Aug-2018**	01-Aug-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED045G) NEL-EF-BH017_2m	**15-Jun-2018**	**22-Aug-2018**	13-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED045G) NEL-EF-BH018_1.90m	**25-Jun-2018**	**22-Aug-2018**	23-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓
Snap Lock Bag - frozen (ED045G) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m, NEL-EF-BH014_1.5m	**29-Jun-2018**	**22-Aug-2018**	27-Jul-2018	✘	**22-Aug-2018**	19-Sep-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED093S: Soluble Major Cations							
Snap Lock Bag - frozen (ED093S) NEL-EF-BH009_2.9m	**04-Jul-2018**	**22-Aug-2018**	31-Dec-2018	✓	**22-Aug-2018**	31-Dec-2018	✓
Snap Lock Bag - frozen (ED093S) NEL-EF-BH017_2m	**15-Jun-2018**	**22-Aug-2018**	12-Dec-2018	✓	**22-Aug-2018**	12-Dec-2018	✓
Snap Lock Bag - frozen (ED093S) NEL-EF-BH018_1.90m	**25-Jun-2018**	**22-Aug-2018**	22-Dec-2018	✓	**22-Aug-2018**	22-Dec-2018	✓
Snap Lock Bag - frozen (ED093S) NEL-EF-BH015_6.5m, NEL-BH101_1.90m, NEL-BH101_7.50m, NEL-EF-BH014_1.5m	**29-Jun-2018**	**22-Aug-2018**	26-Dec-2018	✓	**22-Aug-2018**	26-Dec-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acid Neutralising Capacity (ANC)	EA013	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (Saturated Paste)	EA031	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Neutralising Capacity (ANC)	EA013	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (Saturated Paste)	EA031	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Net Acid Production Potential	EA009	SOIL	In house: Referenced to Coastech Research (Canada)(Mod.). NAPP = Acid Production Potential (APP or MAP-Maximum Acid Potential) minus Neutralising Capacity (ANC). NAPP may be +ve, zero or -ve.
Net Acid Generation	EA011	SOIL	In house: Referenced to Miller (1998) Titremetric procedure determines net acidity in a soil following peroxide oxidation. Titrations to both pH 4.5 and pH 7 are reported.
Acid Neutralising Capacity (ANC)	EA013	SOIL	In house: Referenced to USEPA 600/2-78-054, I. Miller (2000). A fizz test is done to semiquanititatively estimate the likely reactivity. The soil is then reacted with an known excess quanitity of an appropriate acid. Titration determines the acid remaining, and the ANC can be calculated from comparison with a blank titration.
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
pH (Saturated Paste)	* EA031	SOIL	In house: Referenced to USEPA 600/2 - 78 - 054 - pH determined on a saturated paste by ISE.
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Resistivity (Saturated Paste)	EA084	SOIL	In house: Calculated from Saturated Paste Electrical Conductivity
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Sulfur - Total as S (LECO)	ED042T	SOIL	In house: Dried and pulverised sample is combusted in a high temperature furnace in the presence of strong oxidants / catalysts. The evolved S (as SO2) is measured by infra-red detector
Chloride Soluble By Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate.
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Dry and Pulverise (up to 100g)	GEO30	SOIL	#

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EM1813212**		
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR DAVID QUINN	Contact	: Shirley LeCornu
Address	: LEVEL 8, 180 LONSDALE ST MELBOURNE VIC, AUSTRALIA 3001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: david.quinn@ghd.com	E-mail	: shirley.lecornu@Alsglobal.com
Telephone	: ----	Telephone	: +61-3-8549 9630
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: 31350061101	Page	: 1 of 4
Order number	:	Quote number	: EM2018GHDSER0003 (ME/124/18 - North East Link)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Melbourne		
Sampler	: SCOTT HILLIARD		

Dates

Date Samples Received	: 17-Aug-2018 16:45	Issue Date	: 20-Aug-2018
Client Requested Due Date	: 27-Aug-2018	Scheduled Reporting Date	: **27-Aug-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 4.5°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 14 / 14

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Brisbane.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method Client sample ID	Sample Container Received	Preferred Sample Container for Analysis
pH (Saturated Paste) : EA031		
NEL-EF-BH009_2.9m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-EF-BH015_6.5m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-EF-BH017_2m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-EF-BH018_1.90m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH101_1.90m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-BH101_7.50m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved
NEL-EF-BH014_1.5m	- Snap Lock Bag - frozen	- Soil Glass Jar - Unpreserved

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA029 SPOCAS	SOIL - EA031 pH (Saturated Paste)	SOIL - EA033 Chromium Suite for Acid Sulphate Soils	SOIL - EA055-103 Moisture Content	SOIL - EA084 Saturated Resistivity	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S Major Anions (Cl, SO4)
EM1813212-001	04-Jul-2018 00:00	NEL-EF-BH009_2.9m		✓	✓	✓	✓	✓	✓
EM1813212-002	29-Jun-2018 00:00	NEL-EF-BH015_6.5m		✓	✓	✓	✓	✓	✓
EM1813212-003	15-Jun-2018 00:00	NEL-EF-BH017_2m	✓	✓		✓	✓	✓	✓
EM1813212-004	14-Aug-2018 00:00	NEL-EF-BH017_10m			✓				
EM1813212-005	14-Aug-2018 00:00	NEL-EF-BH017_20m			✓				
EM1813212-006	25-Jun-2018 00:00	NEL-EF-BH018_1.90m	✓	✓	✓	✓	✓	✓	✓
EM1813212-007	17-Jul-2018 00:00	NEL-EF-BH018_10m			✓				
EM1813212-008	17-Jul-2018 00:00	NEL-EF-BH018_20m			✓				
EM1813212-009	04-Jul-2018 00:00	NEL-EF-BH019_5m			✓				
EM1813212-010	13-Jul-2018 00:00	NEL-EF-BH019_10m			✓				
EM1813212-011	13-Jul-2018 00:00	NEL-EF-BH019_20m			✓				
EM1813212-012	29-Jun-2018 00:00	NEL-BH101_1.90m		✓	✓	✓	✓	✓	✓
EM1813212-013	29-Jun-2018 00:00	NEL-BH101_7.50m	✓	✓	✓	✓	✓	✓	✓
EM1813212-014	[29-Jun-2018]	NEL-EF-BH014_1.5m	✓	✓		✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - ASS1 NAPP	SOIL - EA011 Net Acid Generation (NAG)
EM1813212-004	14-Aug-2018 00:00	NEL-EF-BH017_10m	✓	✓
EM1813212-005	14-Aug-2018 00:00	NEL-EF-BH017_20m	✓	✓
EM1813212-007	17-Jul-2018 00:00	NEL-EF-BH018_10m	✓	✓
EM1813212-008	17-Jul-2018 00:00	NEL-EF-BH018_20m	✓	✓
EM1813212-010	13-Jul-2018 00:00	NEL-EF-BH019_10m	✓	✓
EM1813212-011	13-Jul-2018 00:00	NEL-EF-BH019_20m	✓	✓
EM1813212-012	29-Jun-2018 00:00	NEL-BH101_1.90m	✓	✓
EM1813212-013	29-Jun-2018 00:00	NEL-BH101_7.50m	✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **SOIL**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA055: Moisture Content							
NEL-BH101_1.90m	Snap Lock Bag - frozen	----	13-Jul-2018	17-Aug-2018	✘	----	----
NEL-BH101_7.50m	Snap Lock Bag - frozen	----	13-Jul-2018	17-Aug-2018	✘	----	----
NEL-EF-BH009_2.9m	Snap Lock Bag - frozen	----	18-Jul-2018	17-Aug-2018	✘	----	----
NEL-EF-BH014_1.5m	Snap Lock Bag - frozen	----	13-Jul-2018	17-Aug-2018	✘	----	----
NEL-EF-BH015_6.5m	Snap Lock Bag - frozen	----	13-Jul-2018	17-Aug-2018	✘	----	----
NEL-EF-BH017_2m	Snap Lock Bag - frozen	----	29-Jun-2018	17-Aug-2018	✘	----	----
NEL-EF-BH018_1.90	Snap Lock Bag - frozen	----	09-Jul-2018	17-Aug-2018	✘	----	----
ED040S: Major Anions - Soluble							
NEL-BH101_1.90m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-BH101_7.50m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH009_2.9m	Snap Lock Bag - frozen	01-Aug-2018	29-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH014_1.5m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH015_6.5m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH017_2m	Snap Lock Bag - frozen	13-Jul-2018	10-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH018_1.90	Snap Lock Bag - frozen	23-Jul-2018	20-Aug-2018	17-Aug-2018	✘	----	----
ED042T: Sulfur - Total as S (LECO)							
NEL-BH101_1.90m	Pulp Bag	27-Jul-2018	27-Jul-2018	17-Aug-2018	✘	----	----
NEL-BH101_7.50m	Pulp Bag	27-Jul-2018	27-Jul-2018	17-Aug-2018	✘	----	----
NEL-EF-BH018_10m	Pulp Bag	14-Aug-2018	14-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH018_20m	Pulp Bag	14-Aug-2018	14-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH019_10m	Pulp Bag	10-Aug-2018	10-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH019_20m	Pulp Bag	10-Aug-2018	10-Aug-2018	17-Aug-2018	✘	----	----
ED045G: Chloride Soluble By Discrete Analyser							
NEL-BH101_1.90m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-BH101_7.50m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH009_2.9m	Snap Lock Bag - frozen	01-Aug-2018	29-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH014_1.5m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH015_6.5m	Snap Lock Bag - frozen	27-Jul-2018	24-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH017_2m	Snap Lock Bag - frozen	13-Jul-2018	10-Aug-2018	17-Aug-2018	✘	----	----
NEL-EF-BH018_1.90	Snap Lock Bag - frozen	23-Jul-2018	20-Aug-2018	17-Aug-2018	✘	----	----

Requested Deliverables

ALL ACCOUNTS		
- A4 - AU Tax Invoice (INV)	Email	ap-fss@ghd.com
DAVID QUINN		
- *AU Certificate of Analysis - NATA (COA)	Email	david.quinn@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	david.quinn@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	david.quinn@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	david.quinn@ghd.com
- A4 - AU Tax Invoice (INV)	Email	david.quinn@ghd.com
- Chain of Custody (CoC) (COC)	Email	david.quinn@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	david.quinn@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	david.quinn@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	david.quinn@ghd.com
GHD LAB REPORTS		
- *AU Certificate of Analysis - NATA (COA)	Email	GHDLabreports@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	GHDLabreports@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	GHDLabreports@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	GHDLabreports@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	GHDLabreports@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	GHDLabreports@ghd.com
KORY AUCH		
- *AU Certificate of Analysis - NATA (COA)	Email	kory.auch@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	kory.auch@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	kory.auch@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	kory.auch@ghd.com
- Chain of Custody (CoC) (COC)	Email	kory.auch@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	kory.auch@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	kory.auch@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	kory.auch@ghd.com
MARCIN WIELOCH		
- *AU Certificate of Analysis - NATA (COA)	Email	marcin.wieloch@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	marcin.wieloch@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	marcin.wieloch@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	marcin.wieloch@ghd.com
- Chain of Custody (CoC) (COC)	Email	marcin.wieloch@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	marcin.wieloch@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	marcin.wieloch@ghd.com
- Electronic SRN for ESdat (ESRN_ESDAT)	Email	marcin.wieloch@ghd.com

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GHD Melbourne
Level 8, 180 Lonsdale St
Melbourne
VIC 3000

Attention: **Matthew Moore**

Report **607533-W**
Project name BULLEEN VIC 3105
Project ID 31/35006/0813
Received Date Jul 13, 2018

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			Water	Water	Water	Water
Eurofins | mgt Sample No.			M18-Jl15454	M18-Jl15455	M18-Jl15456	M18-Jl15457
Date Sampled			Jul 06, 2018	Jul 12, 2018	Jul 12, 2018	Jul 12, 2018
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	-	0.19	< 0.02	< 0.02
TRH C10-C14	0.05	mg/L	-	< 0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
TRH C10-36 (Total)	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	-	0.053	< 0.001	< 0.001
Toluene	0.001	mg/L	-	0.003	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	-	0.019	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	-	0.024	< 0.002	< 0.002
o-Xylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	-	0.024	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	-	120	127	127
Volatile Organics						
1.1-Dichloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.1-Dichloroethene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.1.1-Trichloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.1.1.2-Tetrachloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.1.2-Trichloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.1.2.2-Tetrachloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2-Dibromoethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2-Dichlorobenzene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2-Dichloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2-Dichloropropane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2.3-Trichloropropane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.2.4-Trimethylbenzene	0.001	mg/L	-	0.025	< 0.001	< 0.001
1.3-Dichlorobenzene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.3-Dichloropropane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
1.3.5-Trimethylbenzene	0.001	mg/L	-	0.004	< 0.001	< 0.001
1.4-Dichlorobenzene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
2-Butanone (MEK)	0.001	mg/L	-	0.002	< 0.001	< 0.001
2-Propanone (Acetone)	0.001	mg/L	-	0.041	< 0.005	< 0.001
4-Chlorotoluene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
4-Methyl-2-pentanone (MIBK)	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Allyl chloride	0.001	mg/L	-	< 0.001	< 0.001	< 0.001

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			Water	Water	Water	Water
Eurofins | mgt Sample No.			M18-Jl15454	M18-Jl15455	M18-Jl15456	M18-Jl15457
Date Sampled			Jul 06, 2018	Jul 12, 2018	Jul 12, 2018	Jul 12, 2018
Test/Reference	LOR	Unit				
Volatile Organics						
Benzene	0.001	mg/L	-	0.053	< 0.001	< 0.001
Bromobenzene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Bromochloromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Bromodichloromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Bromoform	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Bromomethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Carbon disulfide	0.001	mg/L	-	0.001	< 0.001	< 0.001
Carbon Tetrachloride	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Chlorobenzene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Chloroethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Chloroform	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Chloromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
cis-1.2-Dichloroethene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
cis-1.3-Dichloropropene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibromochloromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibromomethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dichlorodifluoromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	-	0.019	< 0.001	< 0.001
Iodomethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Isopropyl benzene (Cumene)	0.001	mg/L	-	0.002	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	-	0.024	< 0.002	< 0.002
Methylene Chloride	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
o-Xylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Styrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Tetrachloroethene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	-	0.003	< 0.001	< 0.001
trans-1.2-Dichloroethene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
trans-1.3-Dichloropropene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Trichloroethene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Trichlorofluoromethane	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Vinyl chloride	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	-	0.024	< 0.003	< 0.003
Total MAH*	0.003	mg/L	-	0.101	< 0.003	< 0.003
Vic EPA IWRG 621 CHC (Total)*	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Vic EPA IWRG 621 Other CHC (Total)*	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4-Bromofluorobenzene (surr.)	1	%	-	120	127	127
Toluene-d8 (surr.)	1	%	-	111	106	104
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	-	0.23	< 0.02	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	-	0.13	< 0.02	< 0.02
TRH >C10-C16	0.05	mg/L	-	< 0.05	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	-	< 0.05	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	-	< 0.1	< 0.1	< 0.1

eurofins | mgt

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	-	0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	-	0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	-	98	102	103
p-Terphenyl-d14 (surr.)	1	%	-	84	83	90
Organochlorine Pesticides						
Chlordanes - Total	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
4.4'-DDD	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
4.4'-DDE	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
4.4'-DDT	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
a-BHC	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Aldrin	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
b-BHC	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
d-BHC	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Dieldrin	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endosulfan I	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endosulfan II	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endosulfan sulphate	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endrin	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endrin aldehyde	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Endrin ketone	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
g-BHC (Lindane)	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Heptachlor	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Heptachlor epoxide	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Hexachlorobenzene	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Methoxychlor	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Toxaphene	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
Aldrin and Dieldrin (Total)*	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
DDT + DDE + DDD (Total)*	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Vic EPA IWRG 621 OCP (Total)*	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Vic EPA IWRG 621 Other OCP (Total)*	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibutylchlorendate (surr.)	1	%	-	88	77	115
Tetrachloro-m-xylene (surr.)	1	%	-	114	115	124

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Organophosphorus Pesticides						
Azinphos-methyl	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Bolstar	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Chlorfenvinphos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Chlorpyrifos	0.02	mg/L	-	< 0.02	< 0.02	< 0.02
Chlorpyrifos-methyl	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Coumaphos	0.02	mg/L	-	< 0.02	< 0.02	< 0.02
Demeton-S	0.02	mg/L	-	< 0.02	< 0.02	< 0.02
Demeton-O	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Diazinon	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Dichlorvos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Dimethoate	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Disulfoton	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
EPN	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Ethion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Ethoprop	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Ethyl parathion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Fenitrothion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Fensulfothion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Fenthion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Malathion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Merphos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Methyl parathion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Mevinphos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Monocrotophos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Naled	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Omethoate	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Phorate	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Pirimiphos-methyl	0.02	mg/L	-	< 0.02	< 0.02	< 0.02
Pyrazophos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Ronnel	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Terbufos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Tetrachlorvinphos	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Tokuthion	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Trichloronate	0.002	mg/L	-	< 0.002	< 0.002	< 0.002
Triphenylphosphate (surr.)	1	%	-	108	104	110
Polychlorinated Biphenyls						
Aroclor-1016	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1221	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1232	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1242	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1248	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1254	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Aroclor-1260	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Total PCB*	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibutylchlorendate (surr.)	1	%	-	88	77	115
Tetrachloro-m-xylene (surr.)	1	%	-	114	115	124

eurofins | mgt

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Phenols (Halogenated)						
2-Chlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.4-Dichlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.4.5-Trichlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2.4.6-Trichlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2.6-Dichlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
4-Chloro-3-methylphenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
Pentachlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
Tetrachlorophenols - Total	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
Total Halogenated Phenol*	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
Phenols (non-Halogenated)						
2-Cyclohexyl-4.6-dinitrophenol	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
2-Methyl-4.6-dinitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
2-Methylphenol (o-Cresol)	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2-Nitrophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2.4-Dimethylphenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.4-Dinitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
3&4-Methylphenol (m&p-Cresol)	0.006	mg/L	-	< 0.006	< 0.006	< 0.006
4-Nitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
Dinoseb	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
Phenol	0.003	mg/L	-	0.007	< 0.003	< 0.003
Total Non-Halogenated Phenol*	0.1	mg/L	-	< 0.1	< 0.1	< 0.1
Phenol-d6 (surr.)	1	%	-	88	89	69
Semivolatile Organics						
2-Methyl-4.6-dinitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
1-Chloronaphthalene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1-Naphthylamine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2-Dichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2.3-Trichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2.3.4-Tetrachlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2.3.5-Tetrachlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2.4-Trichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.2.4.5-Tetrachlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.3-Dichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.3.5-Trichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
1.4-Dichlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2-Chloronaphthalene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2-Chlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2-Methylnaphthalene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2-Methylphenol (o-Cresol)	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2-Naphthylamine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2-Nitroaniline	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2-Nitrophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2-Picoline	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2.3.4.6-Tetrachlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2.4-Dichlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.4-Dimethylphenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.4-Dinitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
2.4-Dinitrotoluene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
2.4.5-Trichlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Semivolatile Organics						
2.4.6-Trichlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
2.6-Dichlorophenol	0.003	mg/L	-	< 0.003	< 0.003	< 0.003
2.6-Dinitrotoluene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
3&4-Methylphenol (m&p-Cresol)	0.006	mg/L	-	< 0.006	< 0.006	< 0.006
3-Methylcholanthrene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
3.3'-Dichlorobenzidine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4-Aminobiphenyl	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4-Bromophenyl phenyl ether	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4-Chloro-3-methylphenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
4-Chlorophenyl phenyl ether	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4-Nitrophenol	0.03	mg/L	-	< 0.03	< 0.03	< 0.03
4.4'-DDD	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4.4'-DDE	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
4.4'-DDT	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
7.12-Dimethylbenz(a)anthracene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
a-BHC	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Acenaphthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Acetophenone	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Aldrin	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Aniline	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
b-BHC	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Benz(a)anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Benzyl chloride	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Bis(2-chloroethoxy)methane	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Bis(2-chloroisopropyl)ether	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Bis(2-ethylhexyl)phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Butyl benzyl phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Chrysene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
d-BHC	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Di-n-butyl phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Di-n-octyl phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Dibenz(a.h)anthracene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Dibenz(a.j)acridine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Dibenzofuran	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Dieldrin	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Diethyl phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Dimethyl phthalate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Dimethylaminoazobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Diphenylamine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Endosulfan I	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Endosulfan II	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Endosulfan sulphate	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Endrin	0.005	mg/L	-	< 0.005	< 0.005	< 0.005

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Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Semivolatile Organics						
Endrin aldehyde	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Endrin ketone	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Fluoranthene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
g-BHC (Lindane)	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Heptachlor	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Heptachlor epoxide	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Hexachlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Hexachlorobutadiene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Hexachlorocyclopentadiene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Hexachloroethane	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Indeno(1.2.3-cd)pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Methoxychlor	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
N-Nitrosodibutylamine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
N-Nitrosodipropylamine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
N-Nitrosopiperidine	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Naphthalene	0.001	mg/L	-	0.001	< 0.001	< 0.001
Nitrobenzene	0.05	mg/L	-	< 0.05	< 0.05	< 0.05
Pentachlorobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Pentachloronitrobenzene	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Pentachlorophenol	0.01	mg/L	-	< 0.01	< 0.01	< 0.01
Phenanthrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Phenol	0.003	mg/L	-	0.007	< 0.003	< 0.003
Pronamide	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Pyrene	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Trifluralin	0.005	mg/L	-	< 0.005	< 0.005	< 0.005
Phenol-d6 (surr.)	1	%	-	88	89	69
Nitrobenzene-d5 (surr.)	1	%	-	80	58	61
2-Fluorobiphenyl (surr.)	1	%	-	98	102	103
2.4.6-Tribromophenol (surr.)	1	%	-	51	42	25
Perfluoroalkyl carboxylic acids (PFCAs)						
Perfluorobutanoic acid (PFBA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
Perfluoropentanoic acid (PFPeA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorohexanoic acid (PFHxA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluoroheptanoic acid (PFHpA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorooctanoic acid (PFOA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorononanoic acid (PFNA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorodecanoic acid (PFDA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluoroundecanoic acid (PFUnDA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorododecanoic acid (PFDoDA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorotridecanoic acid (PFTrDA)[N15]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorotetradecanoic acid (PFTeDA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
13C4-PFBA (surr.)	1	%	-	82	101	109
13C5-PFPeA (surr.)	1	%	-	99	118	129
13C5-PFHxA (surr.)	1	%	-	98	106	109
13C4-PFHpA (surr.)	1	%	-	100	104	107
13C8-PFOA (surr.)	1	%	-	92	97	95
13C5-PFNA (surr.)	1	%	-	98	110	100
13C6-PFDA (surr.)	1	%	-	76	81	77

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Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			Water	Water	Water	Water
Eurofins | mgt Sample No.			M18-Jl15454	M18-Jl15455	M18-Jl15456	M18-Jl15457
Date Sampled			Jul 06, 2018	Jul 12, 2018	Jul 12, 2018	Jul 12, 2018
Test/Reference	LOR	Unit				
Perfluoroalkyl carboxylic acids (PFCAs)						
13C2-PFUnDA (surr.)	1	%	-	65	73	71
13C2-PFDoDA (surr.)	1	%	-	68	81	76
13C2-PFTeDA (surr.)	1	%	-	63	77	72
Perfluoroalkyl sulfonamido substances						
Perfluorooctane sulfonamide (FOSA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
13C8-FOSA (surr.)	1	%	-	72	83	75
D3-N-MeFOSA (surr.)	1	%	-	61	84	61
D5-N-EtFOSA (surr.)	1	%	-	80	115	82
D7-N-MeFOSE (surr.)	1	%	-	45	54	49
D9-N-EtFOSE (surr.)	1	%	-	47	51	49
D5-N-EtFOSAA (surr.)	1	%	-	53	64	57
D3-N-MeFOSAA (surr.)	1	%	-	51	60	54
Perfluoroalkyl sulfonic acids (PFSAs)						
Perfluorobutanesulfonic acid (PFBS)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluoropentanesulfonic acid (PFPeS)[N15]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorohexanesulfonic acid (PFHxS)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluoroheptanesulfonic acid (PFHpS)[N15]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorooctanesulfonic acid (PFOS)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Perfluorodecanesulfonic acid (PFDS)[N15]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
13C3-PFBS (surr.)	1	%	-	113	115	118
18O2-PFHxS (surr.)	1	%	-	128	131	137
13C8-PFOS (surr.)	1	%	-	105	108	106
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)						
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)[N11]	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)[N11]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)[N15]	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
13C2-4:2 FTSA (surr.)	1	%	-	77	92	80
13C2-6:2 FTSA (surr.)	1	%	-	61	64	51
13C2-8:2 FTSA (surr.)	1	%	-	41	46	39
PFASs Summations						
Sum (PFHxS + PFOS)*	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Sum of US EPA PFAS (PFOS + PFOA)*	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	0.01	ug/L	-	< 0.01	< 0.01	< 0.01
Sum of WA DER PFAS (n=10)*	0.05	ug/L	-	< 0.05	< 0.05	< 0.05
Sum of PFASs (n=28)*	0.1	ug/L	-	< 0.1	< 0.1	< 0.1

eurofins | mgt

Client Sample ID			NEL-PB01A	NEL-BH089 / 120718	NEL-BH088 / 120718	NEL-BH087 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15454**	**M18-Jl15455**	**M18-Jl15456**	**M18-Jl15457**
Date Sampled			**Jul 06, 2018**	**Jul 12, 2018**	**Jul 12, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Ammonia (as N)	0.01	mg/L	2.7	< 0.01	< 0.01	< 0.01
Carbon Dioxide (free)	5	mg/L	-	41	41	25
Chloride	1	mg/L	100	2500	2300	2600
Conductivity (at 25°C)	1	uS/cm	1200	10000	10000	11000
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	0.18	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02	< 0.02	0.13	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	0.05	< 0.02
pH (at 25°C)	0.1	pH Units	7.1	7.4	7.7	7.8
Phosphate total (as P)	0.05	mg/L	0.12	0.16	0.07	0.09
Phosphorus reactive (as P)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Sulphate (as SO4)	5	mg/L	< 5	250	120	320
Total Dissolved Solids	10	mg/L	790	6800	6100	6300
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	4.7	0.4	< 0.2	< 0.2
Total Nitrogen (as N)	0.2	mg/L	4.7	0.4	< 0.2	< 0.2
Total Organic Carbon	5	mg/L	21	27	< 5	13
Alkalinity (speciated)						
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	550	820	1100	790
Carbonate Alkalinity (as CaCO3)	10	mg/L	< 10	< 10	< 10	< 10
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20	< 20	< 20	< 20
Total Alkalinity (as CaCO3)	20	mg/L	550	820	1100	790
Heavy Metals						
Arsenic (filtered)	0.001	mg/L	-	0.003	< 0.001	< 0.001
Beryllium (filtered)	0.001	mg/L	-	< 0.001	< 0.001	< 0.001
Boron (filtered)	0.05	mg/L	-	0.07	0.20	0.17
Cadmium (filtered)	0.0002	mg/L	-	< 0.0002	< 0.0002	< 0.0002
Chromium (filtered)	0.001	mg/L	-	< 0.001	0.001	< 0.001
Cobalt (filtered)	0.001	mg/L	-	0.003	0.003	0.003
Copper (filtered)	0.001	mg/L	-	0.013	0.022	0.012
Iron (filtered)	0.05	mg/L	-	1.4	0.05	0.07
Lead (filtered)	0.001	mg/L	-	0.001	0.002	< 0.001
Manganese (filtered)	0.005	mg/L	-	0.77	0.051	0.17
Mercury (filtered)	0.0001	mg/L	-	< 0.0001	< 0.0001	< 0.0001
Nickel (filtered)	0.001	mg/L	-	0.11	0.053	0.036
Selenium (filtered)	0.001	mg/L	-	< 0.001	0.012	< 0.001
Zinc (filtered)	0.005	mg/L	-	0.041	0.063	0.032
Alkali Metals						
Calcium	0.5	mg/L	41	34	59	65
Magnesium	0.5	mg/L	61	190	190	230
Potassium	0.5	mg/L	2.6	51	43	43
Sodium	0.5	mg/L	120	1900	1900	2000

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			Water	Water	Water	Water
Eurofins | mgt Sample No.			M18-Jl15458	M18-Jl15459	M18-Jl15460	M18-Jl15461
Date Sampled			Jul 12, 2018	Jul 12, 2018	Jul 13, 2018	Jul 12, 2018
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C10-36 (Total)	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	126	123	127	131
Volatile Organics						
1.1-Dichloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.1-Dichloroethene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.1.1-Trichloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.1.1.2-Tetrachloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.1.2-Trichloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.1.2.2-Tetrachloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2-Dibromoethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2-Dichlorobenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2-Dichloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2-Dichloropropane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2.3-Trichloropropane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.2.4-Trimethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.3-Dichlorobenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.3-Dichloropropane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.3.5-Trimethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
1.4-Dichlorobenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Butanone (MEK)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Propanone (Acetone)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
4-Chlorotoluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
4-Methyl-2-pentanone (MIBK)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Allyl chloride	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Bromobenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Bromochloromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Bromodichloromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Bromoform	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Bromomethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Carbon disulfide	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Carbon Tetrachloride	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chlorobenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chloroethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chloroform	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Chloromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
cis-1.2-Dichloroethene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
cis-1.3-Dichloropropene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Volatile Organics						
Dibromochloromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibromomethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dichlorodifluoromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Iodomethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Isopropyl benzene (Cumene)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Methylene Chloride	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Styrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Tetrachloroethene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
trans-1.2-Dichloroethene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
trans-1.3-Dichloropropene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Trichloroethene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Trichlorofluoromethane	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Vinyl chloride	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
Total MAH*	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
Vic EPA IWRG 621 CHC (Total)*	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Vic EPA IWRG 621 Other CHC (Total)*	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4-Bromofluorobenzene (surr.)	1	%	126	123	127	131
Toluene-d8 (surr.)	1	%	107	105	108	108
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001

eurofins | mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
2-Fluorobiphenyl (surr.)	1	%	107	84	86	97
p-Terphenyl-d14 (surr.)	1	%	92	107	95	79
Organochlorine Pesticides						
Chlordanes - Total	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
4.4'-DDD	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
4.4'-DDE	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
4.4'-DDT	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
a-BHC	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aldrin	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
b-BHC	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
d-BHC	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Dieldrin	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endosulfan I	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endosulfan II	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endosulfan sulphate	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endrin	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endrin aldehyde	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Endrin ketone	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
g-BHC (Lindane)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Heptachlor	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Heptachlor epoxide	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Hexachlorobenzene	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Methoxychlor	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Toxaphene	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin and Dieldrin (Total)*	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
DDT + DDE + DDD (Total)*	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Vic EPA IWRG 621 OCP (Total)*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Vic EPA IWRG 621 Other OCP (Total)*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibutylchlorendate (surr.)	1	%	87	71	62	75
Tetrachloro-m-xylene (surr.)	1	%	119	100	112	106
Organophosphorus Pesticides						
Azinphos-methyl	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Bolstar	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Chlorfenvinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Chlorpyrifos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Chlorpyrifos-methyl	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Coumaphos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Demeton-S	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Demeton-O	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Diazinon	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dichlorvos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dimethoate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Disulfoton	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
EPN	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethoprop	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethyl parathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Fenitrothion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Fensulfothion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002

eurofins | mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Organophosphorus Pesticides						
Fenthion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Malathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Merphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Methyl parathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Mevinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Monocrotophos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Naled	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Omethoate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Phorate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Pirimiphos-methyl	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Pyrazophos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ronnel	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Terbufos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Tetrachlorvinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Tokuthion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Trichloronate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Triphenylphosphate (surr.)	1	%	113	148	128	105
Polychlorinated Biphenyls						
Aroclor-1016	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1221	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1232	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1242	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1248	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1254	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Aroclor-1260	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PCB*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibutylchlorendate (surr.)	1	%	87	71	62	75
Tetrachloro-m-xylene (surr.)	1	%	119	100	112	106
Phenols (Halogenated)						
2-Chlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.4-Dichlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.4.5-Trichlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.4.6-Trichlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.6-Dichlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Chloro-3-methylphenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Pentachlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Tetrachlorophenols - Total	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
Total Halogenated Phenol*	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Phenols (non-Halogenated)						
2-Cyclohexyl-4.6-dinitrophenol	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
2-Methyl-4.6-dinitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
2-Methylphenol (o-Cresol)	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2-Nitrophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.4-Dimethylphenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.4-Dinitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
3&4-Methylphenol (m&p-Cresol)	0.006	mg/L	< 0.006	< 0.006	< 0.006	< 0.006
4-Nitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
Dinoseb	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Phenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003

eurofins | mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Phenols (non-Halogenated)						
Total Non-Halogenated Phenol*	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Phenol-d6 (surr.)	1	%	Q09int	Q09int	Q09int	89
Semivolatile Organics						
2-Methyl-4.6-dinitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
1-Chloronaphthalene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1-Naphthylamine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2-Dichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2.3-Trichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2.3.4-Tetrachlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2.3.5-Tetrachlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2.4-Trichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.2.4.5-Tetrachlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.3-Dichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.3.5-Trichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
1.4-Dichlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2-Chloronaphthalene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2-Chlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2-Methylnaphthalene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2-Methylphenol (o-Cresol)	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2-Naphthylamine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2-Nitroaniline	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2-Nitrophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2-Picoline	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2.3.4.6-Tetrachlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.4-Dichlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.4-Dimethylphenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.4-Dinitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
2.4-Dinitrotoluene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
2.4.5-Trichlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.4.6-Trichlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
2.6-Dichlorophenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
2.6-Dinitrotoluene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
3&4-Methylphenol (m&p-Cresol)	0.006	mg/L	< 0.006	< 0.006	< 0.006	< 0.006
3-Methylcholanthrene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
3.3'-Dichlorobenzidine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4-Aminobiphenyl	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4-Bromophenyl phenyl ether	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4-Chloro-3-methylphenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
4-Chlorophenyl phenyl ether	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4-Nitrophenol	0.03	mg/L	< 0.03	< 0.03	< 0.03	< 0.03
4.4'-DDD	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4.4'-DDE	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
4.4'-DDT	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
7.12-Dimethylbenz(a)anthracene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
a-BHC	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acetophenone	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Aldrin	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005

eurofins | mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			Water	Water	Water	Water
Eurofins | mgt Sample No.			M18-Jl15458	M18-Jl15459	M18-Jl15460	M18-Jl15461
Date Sampled			Jul 12, 2018	Jul 12, 2018	Jul 13, 2018	Jul 12, 2018
Test/Reference	LOR	Unit				
Semivolatile Organics						
Aniline	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
b-BHC	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzyl chloride	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Bis(2-chloroethoxy)methane	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Bis(2-chloroisopropyl)ether	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Bis(2-ethylhexyl)phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Butyl benzyl phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
d-BHC	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Di-n-butyl phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Di-n-octyl phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.j)acridine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dibenzofuran	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dieldrin	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Diethyl phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dimethyl phthalate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dimethylaminoazobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Diphenylamine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endosulfan I	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endosulfan II	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endosulfan sulphate	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endrin	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endrin aldehyde	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Endrin ketone	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
g-BHC (Lindane)	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Heptachlor	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Heptachlor epoxide	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Hexachlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Hexachlorobutadiene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Hexachlorocyclopentadiene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Hexachloroethane	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Methoxychlor	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
N-Nitrosodibutylamine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
N-Nitrosodipropylamine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
N-Nitrosopiperidine	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Nitrobenzene	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Pentachlorobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Pentachloronitrobenzene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005

eurofins | mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Semivolatile Organics						
Pentachlorophenol	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenol	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
Pronamide	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Trifluralin	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Phenol-d6 (surr.)	1	%	[Q09]int	[Q09]int	[Q09]int	89
Nitrobenzene-d5 (surr.)	1	%	92	61	75	51
2-Fluorobiphenyl (surr.)	1	%	107	84	86	97
2.4.6-Tribromophenol (surr.)	1	%	[Q09]int	[Q09]int	[Q09]int	41
Perfluoroalkyl carboxylic acids (PFCAs)						
Perfluorobutanoic acid (PFBA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
Perfluoropentanoic acid (PFPeA)[N11]	0.01	ug/L	< 0.01	< 0.01	0.02	< 0.01
Perfluorohexanoic acid (PFHxA)[N11]	0.01	ug/L	< 0.01	< 0.01	0.01	< 0.01
Perfluoroheptanoic acid (PFHpA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorooctanoic acid (PFOA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorononanoic acid (PFNA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorodecanoic acid (PFDA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluoroundecanoic acid (PFUnDA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorododecanoic acid (PFDoDA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorotridecanoic acid (PFTrDA)[N15]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorotetradecanoic acid (PFTeDA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
13C4-PFBA (surr.)	1	%	102	101	109	123
13C5-PFPeA (surr.)	1	%	124	119	119	134
13C5-PFHxA (surr.)	1	%	105	102	106	112
13C4-PFHpA (surr.)	1	%	102	100	108	109
13C8-PFOA (surr.)	1	%	91	92	103	103
13C5-PFNA (surr.)	1	%	103	97	120	127
13C6-PFDA (surr.)	1	%	79	71	92	105
13C2-PFUnDA (surr.)	1	%	72	64	79	90
13C2-PFDoDA (surr.)	1	%	76	70	87	98
13C2-PFTeDA (surr.)	1	%	76	71	81	92
Perfluoroalkyl sulfonamido substances						
Perfluorooctane sulfonamide (FOSA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
13C8-FOSA (surr.)	1	%	77	75	88	89
D3-N-MeFOSA (surr.)	1	%	65	87	86	77
D5-N-EtFOSA (surr.)	1	%	91	120	117	101
D7-N-MeFOSE (surr.)	1	%	51	51	60	65
D9-N-EtFOSE (surr.)	1	%	53	50	58	62

eurofins mgt

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-JI15458**	**M18-JI15459**	**M18-JI15460**	**M18-JI15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Perfluoroalkyl sulfonamido substances						
D5-N-EtFOSAA (surr.)	1	%	61	54	62	89
D3-N-MeFOSAA (surr.)	1	%	56	51	60	78
Perfluoroalkyl sulfonic acids (PFSAs)						
Perfluorobutanesulfonic acid (PFBS)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluoropentanesulfonic acid (PFPeS)[N15]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorohexanesulfonic acid (PFHxS)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluoroheptanesulfonic acid (PFHpS)[N15]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
Perfluorooctanesulfonic acid (PFOS)[N11]	0.01	ug/L	< 0.01	< 0.01	[N09]0.02	< 0.01
Perfluorodecanesulfonic acid (PFDS)[N15]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
13C3-PFBS (surr.)	1	%	115	112	114	118
18O2-PFHxS (surr.)	1	%	131	131	137	138
13C8-PFOS (surr.)	1	%	109	98	118	126
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)						
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)[N11]	0.05	ug/L	< 0.05	< 0.05	< 0.05	< 0.05
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)[N11]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)[N15]	0.01	ug/L	< 0.01	< 0.01	< 0.01	< 0.01
13C2-4:2 FTSA (surr.)	1	%	78	90	93	116
13C2-6:2 FTSA (surr.)	1	%	54	60	69	75
13C2-8:2 FTSA (surr.)	1	%	41	42	54	80
PFASs Summations						
Sum (PFHxS + PFOS)*	0.01	ug/L	< 0.01	< 0.01	0.02	< 0.01
Sum of US EPA PFAS (PFOS + PFOA)*	0.01	ug/L	< 0.01	< 0.01	0.02	< 0.01
Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	0.01	ug/L	< 0.01	< 0.01	0.02	< 0.01
Sum of WA DER PFAS (n=10)*	0.05	ug/L	< 0.05	< 0.05	0.05	< 0.05
Sum of PFASs (n=28)*	0.1	ug/L	< 0.1	< 0.1	< 0.1	< 0.1
Ammonia (as N)	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Carbon Dioxide (free)	5	mg/L	26	40	8.3	49
Chloride	1	mg/L	3700	3600	260	< 1
Conductivity (at 25°C)	1	uS/cm	15000	15000	2400	8.5
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	4.2	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02	< 0.02	4.2	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
pH (at 25°C)	0.1	pH Units	7.7	7.5	8.1	5.4
Phosphate total (as P)	0.05	mg/L	0.10	0.10	< 0.05	< 0.05
Phosphorus reactive (as P)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Sulphate (as SO4)	5	mg/L	610	600	68	< 5
Total Dissolved Solids	10	mg/L	10000	10000	1300	< 10
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	0.5	< 0.2
Total Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	4.7	< 0.2
Total Organic Carbon	5	mg/L	5.1	< 5	9.4	< 5
Alkalinity (speciated)						
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	660	680	590	< 20
Carbonate Alkalinity (as CaCO3)	10	mg/L	< 10	< 10	< 10	< 10
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20	< 20	< 20	< 20
Total Alkalinity (as CaCO3)	20	mg/L	660	680	590	< 20

Client Sample ID			NEL-BH086 / 120718	QC1 / 120718	ENC-BH014 / 130718	RB01 / 120718
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins | mgt Sample No.			**M18-Jl15458**	**M18-Jl15459**	**M18-Jl15460**	**M18-Jl15461**
Date Sampled			**Jul 12, 2018**	**Jul 12, 2018**	**Jul 13, 2018**	**Jul 12, 2018**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	0.001	mg/L	-	-	-	< 0.001
Arsenic (filtered)	0.001	mg/L	< 0.001	< 0.001	0.002	-
Beryllium	0.001	mg/L	-	-	-	< 0.001
Beryllium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	-
Boron	0.05	mg/L	-	-	-	< 0.05
Boron (filtered)	0.05	mg/L	0.17	0.20	0.53	-
Cadmium	0.0002	mg/L	-	-	-	< 0.0002
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	-
Chromium	0.001	mg/L	-	-	-	< 0.001
Chromium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	-
Cobalt	0.001	mg/L	-	-	-	< 0.001
Cobalt (filtered)	0.001	mg/L	0.001	0.002	< 0.001	-
Copper	0.001	mg/L	-	-	-	< 0.001
Copper (filtered)	0.001	mg/L	0.006	0.086	0.021	-
Iron	0.05	mg/L	-	-	-	< 0.05
Iron (filtered)	0.05	mg/L	< 0.05	< 0.05	< 0.05	-
Lead	0.001	mg/L	-	-	-	< 0.001
Lead (filtered)	0.001	mg/L	< 0.001	0.003	0.002	-
Manganese	0.005	mg/L	-	-	-	< 0.005
Manganese (filtered)	0.005	mg/L	0.074	0.081	0.013	-
Mercury	0.0001	mg/L	-	-	-	< 0.0001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	-
Nickel	0.001	mg/L	-	-	-	< 0.001
Nickel (filtered)	0.001	mg/L	0.070	0.085	0.062	-
Selenium	0.001	mg/L	-	-	-	< 0.001
Selenium (filtered)	0.001	mg/L	< 0.001	< 0.001	0.002	-
Zinc	0.005	mg/L	-	-	-	< 0.005
Zinc (filtered)	0.005	mg/L	0.007	0.14	0.041	-
Alkali Metals						
Calcium	0.5	mg/L	70	70	14	< 0.5
Magnesium	0.5	mg/L	400	400	26	< 0.5
Potassium	0.5	mg/L	48	50	6.4	< 0.5
Sodium	0.5	mg/L	2600	2600	420	< 0.5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2010 TRH C6-C36			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Jul 13, 2018	7 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Jul 17, 2018	7 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
BTEX and Naphthalene			
BTEX	Melbourne	Jul 13, 2018	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Volatile Organics	Melbourne	Jul 13, 2018	7 Days
- Method: LTM-ORG-2150 VOCs in Soils Liquid and other Aqueous Matrices			
Semivolatile Organics	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2190 SVOC in Water & Soil by GC-MS			
Polycyclic Aromatic Hydrocarbons	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Organochlorine Pesticides	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Organophosphorus Pesticides	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2200 Organophosphorus Pesticides by GC-MS			
Polychlorinated Biphenyls	Melbourne	Jul 17, 2018	7 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Carbon Dioxide (free)	Melbourne	Jul 13, 2018	24 Hours
- Method: APHA 4500-CO2 C. Free Carbon Dioxide by Titration			
Conductivity (at 25°C)	Melbourne	Jul 13, 2018	28 Day
- Method: LTM-INO-4030 Conductivity			
pH (at 25°C)	Melbourne	Jul 13, 2018	0 Hours
- Method: LTM-GEN-7090 pH in water by ISE			
Total Dissolved Solids	Melbourne	Jul 13, 2018	7 Day
- Method: LTM-INO-4170 Total Dissolved Solids in Water			
Total Organic Carbon	Melbourne	Jul 16, 2018	28 Day
- Method: APHA 5310B Total Organic Carbon			
NEPM 2013 Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn, Se, Zn)	Melbourne	Jul 13, 2018	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
NEPM 2013 Filtered Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn, Se, Zn)	Melbourne	Jul 13, 2018	28 Day
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals	Melbourne	Jul 17, 2018	180 Day
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals (filtered)	Melbourne	Jul 17, 2018	180 Day
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Eurofins | mgt Suite B11C: Na/K/Ca/Mg	Melbourne	Jul 13, 2018	180 Day
- Method: LTM-MET-3010 Alkali Metals by ICP-AES			
Phenols (IWRG 621)			
Phenols (Halogenated)	Melbourne	Jul 17, 2018	7 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Phenols (non-Halogenated)	Melbourne	Jul 17, 2018	7 Day
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Per- and Polyfluoroalkyl Substances (PFASs)			
Perfluoroalkyl carboxylic acids (PFCAs)	Brisbane	Jul 16, 2018	14 Day
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			

Description	Testing Site	Extracted	Holding Time
Perfluoroalkyl sulfonamido substances	Brisbane	Jul 16, 2018	14 Day
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			
Perfluoroalkyl sulfonic acids (PFSAs)	Brisbane	Jul 16, 2018	14 Day
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)	Brisbane	Jul 16, 2018	14 Day
- Method: LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS)			
Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P			
Ammonia (as N)	Melbourne	Jul 13, 2018	28 Day
- Method: APHA 4500-NH3 Ammonia Nitrogen by FIA			
Nitrate & Nitrite (as N)	Melbourne	Jul 13, 2018	28 Day
- Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA			
Nitrate (as N)	Melbourne	Jul 13, 2018	28 Day
- Method: APHA 4500-NO3 Nitrate Nitrogen by FIA			
Nitrite (as N)	Melbourne	Jul 13, 2018	2 Day
- Method: APHA 4500-NO2 Nitrite Nitrogen by FIA			
Phosphate total (as P)	Melbourne	Jul 13, 2018	28 Day
- Method: APHA 4500-P E. Phosphorous			
Phosphorus reactive (as P)	Melbourne	Jul 13, 2018	2 Day
- Method: APHA4500-PO4			
Total Kjeldahl Nitrogen (as N)	Melbourne	Jul 13, 2018	7 Day
- Method: LTM-INO-4310 TKN in Waters & Soils by FIA			
Eurofins | mgt Suite B11E: Cl/SO4/Alkalinity			
Chloride	Melbourne	Jul 13, 2018	28 Day
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Sulphate (as SO4)	Melbourne	Jul 13, 2018	28 Day
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Alkalinity (speciated)	Melbourne	Jul 13, 2018	14 Day
- Method: APHA 2320 Alkalinity by Titration			

GHD
180 Latrobe Street, Melbourne VIC 3000 Tel: (03) 8687 8000

CHAIN OF CUSTODY

Golder Job Number 31/35006/0813
Job Location: Bulleen, VIC 3105
Laboratory Issued To: Eurofins MGT
Order No.:
Sampled By: M.Moore and C.Millis
Job Contact: Matthew Moore (0490 784 218), Tim Anderson (03 8687 8208)
Contact Email: matthew.moore5@ghd.com timothy.anderson@ghd.com

# OBSERV - ATIONS	SAMPLE DATE	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DEPTH (m)	No. OF CONTAINERS	Major Anions	Major Cations	Nutrient Screen	Physio-Chemical Parameters (pH, EC, TDS, TOC)		NEPM Metals Suite	TRH C6 - C40	BTEXN	PAH	Phenols	OC / OP / PCB	VOCs / SVOCs	PFAS suite		SRB	Free CO2	Alkalinity (hydroxide as CaCO3, total as CaCO3, bicarbonate alkalinity as						HOLD
	06.07.2018	NEL-PB01A	WATER	-	1	X	X	X	X																			
	12.07.2018	NEL-BH089 / 120718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	12.07.2018	NEL-BH088 / 120718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	12.07.2018	NEL-BH087 / 120718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	12.07.2018	NEL-BH086 / 120718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	12.07.2018	QC1 / 120718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	13.07.2018	ENV-BH014 / 130718	WATER	-	9 ~~10~~	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	12.07.2018	RB1 / 120718	RB	-	9 10	X	X	X	X		X	X	X	X	X	X	X	X			X	X						
	~~13.07.2018~~	~~RB2 / 130718~~	~~RB~~		~~10~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~						

Special Instructions:
As per quote **#180206GHDV**, dated 6 February 2018

TURN AROUND TIME REQUIRED

☐ 1 Working Day ☐ 2 Working Days ☐ 3 Working Days ☐ 4 Working Days [X] 5 Working Days (standard) Other ________

SAMPLE RECEIPT

Relinquished by: Matthew Moore **Date:** 13.07.2018 **Recieved by:** Jalpa Patel **Date:** 13/7/18
Organisation: GHD **Time:** 11:00 **Organisation:** MGT **Time:** 12:46PM

DELIVERED BY: COURIER/LAB [X] GHD ☐
SAMPLE STATUS: [X] Security Sealed

ANALYTICAL SCHEDULE

Relinquished by: Matthew Moore **Date:** 13.07.2018 **Received by:** **Date:**
Organisation: GHD **Time:** 11:00 **Organisation:** **Time:**

RECEIVED BY: FAX ☐ HAND [X]
[X] Chilled ☐ Frozen ☐ Ambient

RECEIVING LABORATORY TO CONFIRM RECEIPT OF ANALYTICAL SCHEDULE BY EMAIL TO: matthew.moore5@ghd.com

Checked By: ________ Date: ________

607533

Sample Receipt Advice

Company name:	**GHD Pty Ltd VIC**
Contact name:	Matthew Moore
Project name:	BULLEEN VIC 3105
Project ID:	31/35006/0813
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Jul 13, 2018 12:46 PM
Eurofins | mgt reference:	**607533**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☒ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☒ Appropriate sample containers have been used.

☑ Sample containers for volatile analysis received with zero headspace.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Natalie Krasselt on Phone : +61 3 8564 5000 or by e.mail: NatalieKrasselt@eurofins.com

Results will be delivered electronically via e.mail to Matthew Moore - matthew.moore5@ghd.com.

Company Name:	GHD Pty Ltd VIC	**Order No.:**		**Received:**	Jul 13, 2018 12:46 PM
Address:	Level 8, 180 Lonsdale St Melbourne VIC 3000	**Report #:**	607533	**Due:**	Jul 20, 2018
		Phone:	8687 8000	**Priority:**	5 Day
		Fax:	8687 8111	**Contact Name:**	Matthew Moore
Project Name:	BULLEEN VIC 3105				
Project ID:	31/35006/0813				

Eurofins | mgt Analytical Services Manager : Natalie Krasselt

Sample Detail						Carbon Dioxide (free)	Conductivity (at 25°C)	pH (at 25°C)	Total Dissolved Solids	Total Organic Carbon	Polycyclic Aromatic Hydrocarbons	Organochlorine Pesticides	Organophosphorus Pesticides	Polychlorinated Biphenyls	Phenols (IWRG 621)	BTEX and Naphthalene	Total Recoverable Hydrocarbons	Eurofins | mgt Suite SVV: SVOC/VOC	NEPM 2013 Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn, Se, Zn)	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P	Eurofins | mgt Suite B11E: Cl/SO4/Alkalinity	Per- and Polyfluoroalkyl Substances (PFASs)	NEPM 2013 Filtered Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn,	Eurofins | mgt Suite B11C: Na/K/Ca/Mg
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Sydney Laboratory - NATA Site # 18217																								
Brisbane Laboratory - NATA Site # 20794																						X		
Perth Laboratory - NATA Site # 23736																								
External Laboratory																								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																			
1	NEL-PB01A	Jul 06, 2018		Water	M18-Jl15454		X	X	X	X										X	X			X
2	NEL-BH089 / 120718	Jul 12, 2018		Water	M18-Jl15455	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
3	NEL-BH088 / 120718	Jul 12, 2018		Water	M18-Jl15456	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
4	NEL-BH087 / 120718	Jul 12, 2018		Water	M18-Jl15457	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
5	NEL-BH086 / 120718	Jul 12, 2018		Water	M18-Jl15458	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
6	QC1 / 120718	Jul 12, 2018		Water	M18-Jl15459	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
7	ENC-BH014 /	Jul 13, 2018		Water	M18-Jl15460	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X

Company Name: GHD Pty Ltd VIC
Address: Level 8, 180 Lonsdale St
Melbourne
VIC 3000

Project Name: BULLEEN VIC 3105
Project ID: 31/35006/0813

Order No.:
Report #: 607533
Phone: 8687 8000
Fax: 8687 8111

Received: Jul 13, 2018 12:46 PM
Due: Jul 20, 2018
Priority: 5 Day
Contact Name: Matthew Moore

Eurofins | mgt Analytical Services Manager : Natalie Krasselt

Sample Detail						Carbon Dioxide (free)	Conductivity (at 25°C)	pH (at 25°C)	Total Dissolved Solids	Total Organic Carbon	Polycyclic Aromatic Hydrocarbons	Organochlorine Pesticides	Organophosphorus Pesticides	Polychlorinated Biphenyls	Phenols (IWRG 621)	BTEX and Naphthalene	Total Recoverable Hydrocarbons	Eurofins | mgt Suite SVV: SVOC/VOC	NEPM 2013 Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn, Se, Zn)	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P	Eurofins | mgt Suite B11E: Cl/SO4/Alkalinity	Per- and Polyfluoroalkyl Substances (PFASs)	NEPM 2013 Filtered Metals without Cr6+ (As, Be, B, Cd, Co, Cr, Cu, Hg, Pb, Ni, Mn,	Eurofins | mgt Suite B11C: Na/K/Ca/Mg
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Sydney Laboratory - NATA Site # 18217																								
Brisbane Laboratory - NATA Site # 20794																						X		
Perth Laboratory - NATA Site # 23736																								
	130718																							
8	RB01 / 120718	Jul 12, 2018		Water	M18-Jl15461	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Test Counts						7	8	8	8	8	7	7	7	7	7	7	7	7	1	8	8	7	6	8

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

eurofins | mgt

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Volatile Organics							
1.1-Dichloroethane	mg/L	< 0.001			0.001	Pass	
1.1-Dichloroethene	mg/L	< 0.001			0.001	Pass	
1.1.1-Trichloroethane	mg/L	< 0.001			0.001	Pass	
1.1.1.2-Tetrachloroethane	mg/L	< 0.001			0.001	Pass	
1.1.2-Trichloroethane	mg/L	< 0.001			0.001	Pass	
1.1.2.2-Tetrachloroethane	mg/L	< 0.001			0.001	Pass	
1.2-Dibromoethane	mg/L	< 0.001			0.001	Pass	
1.2-Dichlorobenzene	mg/L	< 0.001			0.001	Pass	
1.2-Dichloroethane	mg/L	< 0.001			0.001	Pass	
1.2-Dichloropropane	mg/L	< 0.001			0.001	Pass	
1.2.3-Trichloropropane	mg/L	< 0.001			0.001	Pass	
1.2.4-Trimethylbenzene	mg/L	< 0.001			0.001	Pass	
1.3-Dichlorobenzene	mg/L	< 0.001			0.001	Pass	
1.3-Dichloropropane	mg/L	< 0.001			0.001	Pass	
1.3.5-Trimethylbenzene	mg/L	< 0.001			0.001	Pass	
1.4-Dichlorobenzene	mg/L	< 0.001			0.001	Pass	
2-Butanone (MEK)	mg/L	< 0.001			0.001	Pass	
2-Propanone (Acetone)	mg/L	< 0.001			0.001	Pass	
4-Chlorotoluene	mg/L	< 0.001			0.001	Pass	
4-Methyl-2-pentanone (MIBK)	mg/L	< 0.001			0.001	Pass	
Allyl chloride	mg/L	< 0.001			0.001	Pass	
Bromobenzene	mg/L	< 0.001			0.001	Pass	
Bromochloromethane	mg/L	< 0.001			0.001	Pass	
Bromodichloromethane	mg/L	< 0.001			0.001	Pass	
Bromoform	mg/L	< 0.001			0.001	Pass	
Bromomethane	mg/L	< 0.001			0.001	Pass	
Carbon disulfide	mg/L	< 0.001			0.001	Pass	
Carbon Tetrachloride	mg/L	< 0.001			0.001	Pass	
Chlorobenzene	mg/L	< 0.001			0.001	Pass	
Chloroethane	mg/L	< 0.001			0.001	Pass	
Chloroform	mg/L	< 0.005			0.005	Pass	
Chloromethane	mg/L	< 0.001			0.001	Pass	
cis-1.2-Dichloroethene	mg/L	< 0.001			0.001	Pass	
cis-1.3-Dichloropropene	mg/L	< 0.001			0.001	Pass	
Dibromochloromethane	mg/L	< 0.001			0.001	Pass	
Dibromomethane	mg/L	< 0.001			0.001	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Dichlorodifluoromethane	mg/L	< 0.001			0.001	Pass	
Iodomethane	mg/L	< 0.001			0.001	Pass	
Isopropyl benzene (Cumene)	mg/L	< 0.001			0.001	Pass	
Methylene Chloride	mg/L	< 0.001			0.001	Pass	
Styrene	mg/L	< 0.001			0.001	Pass	
Tetrachloroethene	mg/L	< 0.001			0.001	Pass	
trans-1.2-Dichloroethene	mg/L	< 0.001			0.001	Pass	
trans-1.3-Dichloropropene	mg/L	< 0.001			0.001	Pass	
Trichloroethene	mg/L	< 0.001			0.001	Pass	
Trichlorofluoromethane	mg/L	< 0.001			0.001	Pass	
Vinyl chloride	mg/L	< 0.001			0.001	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g.h.i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a.h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1.2.3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/L	< 0.001			0.001	Pass	
4.4'-DDD	mg/L	< 0.0001			0.0001	Pass	
4.4'-DDE	mg/L	< 0.0001			0.0001	Pass	
4.4'-DDT	mg/L	< 0.0001			0.0001	Pass	
a-BHC	mg/L	< 0.0001			0.0001	Pass	
Aldrin	mg/L	< 0.0001			0.0001	Pass	
b-BHC	mg/L	< 0.0001			0.0001	Pass	
d-BHC	mg/L	< 0.0001			0.0001	Pass	
Dieldrin	mg/L	< 0.0001			0.0001	Pass	
Endosulfan I	mg/L	< 0.0001			0.0001	Pass	
Endosulfan II	mg/L	< 0.0001			0.0001	Pass	
Endosulfan sulphate	mg/L	< 0.0001			0.0001	Pass	
Endrin	mg/L	< 0.0001			0.0001	Pass	
Endrin aldehyde	mg/L	< 0.0001			0.0001	Pass	
Endrin ketone	mg/L	< 0.0001			0.0001	Pass	
g-BHC (Lindane)	mg/L	< 0.0001			0.0001	Pass	

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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Heptachlor	mg/L	< 0.0001			0.0001	Pass	
Heptachlor epoxide	mg/L	< 0.0001			0.0001	Pass	
Hexachlorobenzene	mg/L	< 0.0001			0.0001	Pass	
Methoxychlor	mg/L	< 0.0001			0.0001	Pass	
Toxaphene	mg/L	< 0.01			0.01	Pass	
Method Blank							
Organophosphorus Pesticides							
Azinphos-methyl	mg/L	< 0.002			0.002	Pass	
Bolstar	mg/L	< 0.002			0.002	Pass	
Chlorfenvinphos	mg/L	< 0.002			0.002	Pass	
Chlorpyrifos	mg/L	< 0.02			0.02	Pass	
Chlorpyrifos-methyl	mg/L	< 0.002			0.002	Pass	
Coumaphos	mg/L	< 0.02			0.02	Pass	
Demeton-S	mg/L	< 0.02			0.02	Pass	
Demeton-O	mg/L	< 0.002			0.002	Pass	
Diazinon	mg/L	< 0.002			0.002	Pass	
Dichlorvos	mg/L	< 0.002			0.002	Pass	
Dimethoate	mg/L	< 0.002			0.002	Pass	
Disulfoton	mg/L	< 0.002			0.002	Pass	
EPN	mg/L	< 0.002			0.002	Pass	
Ethion	mg/L	< 0.002			0.002	Pass	
Ethoprop	mg/L	< 0.002			0.002	Pass	
Ethyl parathion	mg/L	< 0.002			0.002	Pass	
Fenitrothion	mg/L	< 0.002			0.002	Pass	
Fensulfothion	mg/L	< 0.002			0.002	Pass	
Fenthion	mg/L	< 0.002			0.002	Pass	
Malathion	mg/L	< 0.002			0.002	Pass	
Merphos	mg/L	< 0.002			0.002	Pass	
Methyl parathion	mg/L	< 0.002			0.002	Pass	
Mevinphos	mg/L	< 0.002			0.002	Pass	
Monocrotophos	mg/L	< 0.002			0.002	Pass	
Naled	mg/L	< 0.002			0.002	Pass	
Omethoate	mg/L	< 0.002			0.002	Pass	
Phorate	mg/L	< 0.002			0.002	Pass	
Pirimiphos-methyl	mg/L	< 0.02			0.02	Pass	
Pyrazophos	mg/L	< 0.002			0.002	Pass	
Ronnel	mg/L	< 0.002			0.002	Pass	
Terbufos	mg/L	< 0.002			0.002	Pass	
Tetrachlorvinphos	mg/L	< 0.002			0.002	Pass	
Tokuthion	mg/L	< 0.002			0.002	Pass	
Trichloronate	mg/L	< 0.002			0.002	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/L	< 0.001			0.001	Pass	
Aroclor-1221	mg/L	< 0.001			0.001	Pass	
Aroclor-1232	mg/L	< 0.001			0.001	Pass	
Aroclor-1242	mg/L	< 0.001			0.001	Pass	
Aroclor-1248	mg/L	< 0.001			0.001	Pass	
Aroclor-1254	mg/L	< 0.001			0.001	Pass	
Aroclor-1260	mg/L	< 0.001			0.001	Pass	
Total PCB*	mg/L	< 0.001			0.001	Pass	
Method Blank							
Phenols (Halogenated)							
2-Chlorophenol	mg/L	< 0.003			0.003	Pass	

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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
2.4-Dichlorophenol	mg/L	< 0.003			0.003	Pass	
2.4.5-Trichlorophenol	mg/L	< 0.01			0.01	Pass	
2.4.6-Trichlorophenol	mg/L	< 0.01			0.01	Pass	
2.6-Dichlorophenol	mg/L	< 0.003			0.003	Pass	
4-Chloro-3-methylphenol	mg/L	< 0.01			0.01	Pass	
Pentachlorophenol	mg/L	< 0.01			0.01	Pass	
Tetrachlorophenols - Total	mg/L	< 0.03			0.03	Pass	
Method Blank							
Phenols (non-Halogenated)							
2-Cyclohexyl-4.6-dinitrophenol	mg/L	< 0.1			0.1	Pass	
2-Methyl-4.6-dinitrophenol	mg/L	< 0.03			0.03	Pass	
2-Methylphenol (o-Cresol)	mg/L	< 0.003			0.003	Pass	
2-Nitrophenol	mg/L	< 0.01			0.01	Pass	
2.4-Dimethylphenol	mg/L	< 0.003			0.003	Pass	
2.4-Dinitrophenol	mg/L	< 0.03			0.03	Pass	
3&4-Methylphenol (m&p-Cresol)	mg/L	< 0.006			0.006	Pass	
4-Nitrophenol	mg/L	< 0.03			0.03	Pass	
Dinoseb	mg/L	< 0.1			0.1	Pass	
Phenol	mg/L	< 0.003			0.003	Pass	
Method Blank							
Semivolatile Organics							
1-Chloronaphthalene	mg/L	< 0.005			0.005	Pass	
1-Naphthylamine	mg/L	< 0.005			0.005	Pass	
1.2-Dichlorobenzene	mg/L	< 0.005			0.005	Pass	
1.2.3-Trichlorobenzene	mg/L	< 0.005			0.005	Pass	
1.2.3.4-Tetrachlorobenzene	mg/L	< 0.005			0.005	Pass	
1.2.3.5-Tetrachlorobenzene	mg/L	< 0.005			0.005	Pass	
1.2.4-Trichlorobenzene	mg/L	< 0.005			0.005	Pass	
1.2.4.5-Tetrachlorobenzene	mg/L	< 0.005			0.005	Pass	
1.3-Dichlorobenzene	mg/L	< 0.005			0.005	Pass	
1.3.5-Trichlorobenzene	mg/L	< 0.005			0.005	Pass	
1.4-Dichlorobenzene	mg/L	< 0.005			0.005	Pass	
2-Chloronaphthalene	mg/L	< 0.005			0.005	Pass	
2-Methylnaphthalene	mg/L	< 0.005			0.005	Pass	
2-Naphthylamine	mg/L	< 0.005			0.005	Pass	
2-Nitroaniline	mg/L	< 0.005			0.005	Pass	
2-Picoline	mg/L	< 0.005			0.005	Pass	
2.3.4.6-Tetrachlorophenol	mg/L	< 0.01			0.01	Pass	
2.4-Dinitrotoluene	mg/L	< 0.005			0.005	Pass	
2.6-Dinitrotoluene	mg/L	< 0.005			0.005	Pass	
3-Methylcholanthrene	mg/L	< 0.005			0.005	Pass	
3.3'-Dichlorobenzidine	mg/L	< 0.005			0.005	Pass	
4-Aminobiphenyl	mg/L	< 0.005			0.005	Pass	
4-Bromophenyl phenyl ether	mg/L	< 0.005			0.005	Pass	
4-Chlorophenyl phenyl ether	mg/L	< 0.005			0.005	Pass	
4.4'-DDD	mg/L	< 0.005			0.005	Pass	
4.4'-DDE	mg/L	< 0.005			0.005	Pass	
4.4'-DDT	mg/L	< 0.005			0.005	Pass	
7.12-Dimethylbenz(a)anthracene	mg/L	< 0.005			0.005	Pass	
a-BHC	mg/L	< 0.005			0.005	Pass	
Acetophenone	mg/L	< 0.005			0.005	Pass	
Aldrin	mg/L	< 0.005			0.005	Pass	
Aniline	mg/L	< 0.005			0.005	Pass	
b-BHC	mg/L	< 0.005			0.005	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzyl chloride	mg/L	< 0.005			0.005	Pass	
Bis(2-chloroethoxy)methane	mg/L	< 0.005			0.005	Pass	
Bis(2-chloroisopropyl)ether	mg/L	< 0.005			0.005	Pass	
Bis(2-ethylhexyl)phthalate	mg/L	< 0.005			0.005	Pass	
Butyl benzyl phthalate	mg/L	< 0.005			0.005	Pass	
d-BHC	mg/L	< 0.005			0.005	Pass	
Di-n-butyl phthalate	mg/L	< 0.005			0.005	Pass	
Di-n-octyl phthalate	mg/L	< 0.005			0.005	Pass	
Dibenz(a.j)acridine	mg/L	< 0.005			0.005	Pass	
Dibenzofuran	mg/L	< 0.005			0.005	Pass	
Dieldrin	mg/L	< 0.005			0.005	Pass	
Diethyl phthalate	mg/L	< 0.005			0.005	Pass	
Dimethyl phthalate	mg/L	< 0.005			0.005	Pass	
Dimethylaminoazobenzene	mg/L	< 0.005			0.005	Pass	
Diphenylamine	mg/L	< 0.005			0.005	Pass	
Endosulfan I	mg/L	< 0.005			0.005	Pass	
Endosulfan II	mg/L	< 0.005			0.005	Pass	
Endosulfan sulphate	mg/L	< 0.005			0.005	Pass	
Endrin	mg/L	< 0.005			0.005	Pass	
Endrin aldehyde	mg/L	< 0.005			0.005	Pass	
Endrin ketone	mg/L	< 0.005			0.005	Pass	
g-BHC (Lindane)	mg/L	< 0.005			0.005	Pass	
Heptachlor	mg/L	< 0.005			0.005	Pass	
Heptachlor epoxide	mg/L	< 0.005			0.005	Pass	
Hexachlorobenzene	mg/L	< 0.005			0.005	Pass	
Hexachlorobutadiene	mg/L	< 0.005			0.005	Pass	
Hexachlorocyclopentadiene	mg/L	< 0.005			0.005	Pass	
Hexachloroethane	mg/L	< 0.005			0.005	Pass	
Methoxychlor	mg/L	< 0.005			0.005	Pass	
N-Nitrosodibutylamine	mg/L	< 0.005			0.005	Pass	
N-Nitrosodipropylamine	mg/L	< 0.005			0.005	Pass	
N-Nitrosopiperidine	mg/L	< 0.005			0.005	Pass	
Nitrobenzene	mg/L	< 0.05			0.05	Pass	
Pentachlorobenzene	mg/L	< 0.005			0.005	Pass	
Pentachloronitrobenzene	mg/L	< 0.005			0.005	Pass	
Pronamide	mg/L	< 0.005			0.005	Pass	
Trifluralin	mg/L	< 0.005			0.005	Pass	
Method Blank							
Perfluoroalkyl carboxylic acids (PFCAs)							
Perfluorobutanoic acid (PFBA)	ug/L	< 0.05			0.05	Pass	
Perfluoropentanoic acid (PFPeA)	ug/L	< 0.01			0.01	Pass	
Perfluorohexanoic acid (PFHxA)	ug/L	< 0.01			0.01	Pass	
Perfluoroheptanoic acid (PFHpA)	ug/L	< 0.01			0.01	Pass	
Perfluorooctanoic acid (PFOA)	ug/L	< 0.01			0.01	Pass	
Perfluorononanoic acid (PFNA)	ug/L	< 0.01			0.01	Pass	
Perfluorodecanoic acid (PFDA)	ug/L	< 0.01			0.01	Pass	
Perfluoroundecanoic acid (PFUnDA)	ug/L	< 0.01			0.01	Pass	
Perfluorododecanoic acid (PFDoDA)	ug/L	< 0.01			0.01	Pass	
Perfluorotridecanoic acid (PFTrDA)	ug/L	< 0.01			0.01	Pass	
Perfluorotetradecanoic acid (PFTeDA)	ug/L	< 0.01			0.01	Pass	
Method Blank							
Perfluoroalkyl sulfonamido substances							
Perfluorooctane sulfonamide (FOSA)	ug/L	< 0.05			0.05	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	ug/L	< 0.05			0.05	Pass	

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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	ug/L	< 0.05			0.05	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)	ug/L	< 0.05			0.05	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)	ug/L	< 0.05			0.05	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	ug/L	< 0.05			0.05	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	ug/L	< 0.05			0.05	Pass	
Method Blank							
Perfluoroalkyl sulfonic acids (PFSAs)							
Perfluorobutanesulfonic acid (PFBS)	ug/L	< 0.01			0.01	Pass	
Perfluoropentanesulfonic acid (PFPeS)	ug/L	< 0.01			0.01	Pass	
Perfluorohexanesulfonic acid (PFHxS)	ug/L	< 0.01			0.01	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	ug/L	< 0.01			0.01	Pass	
Perfluorooctanesulfonic acid (PFOS)	ug/L	< 0.01			0.01	Pass	
Perfluorodecanesulfonic acid (PFDS)	ug/L	< 0.01			0.01	Pass	
Method Blank							
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)							
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	ug/L	< 0.01			0.01	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)	ug/L	< 0.05			0.05	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	ug/L	< 0.01			0.01	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	ug/L	< 0.01			0.01	Pass	
Method Blank							
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Chloride	mg/L	< 1			1	Pass	
Nitrate & Nitrite (as N)	mg/L	< 0.05			0.05	Pass	
Nitrate (as N)	mg/L	< 0.02			0.02	Pass	
Nitrite (as N)	mg/L	< 0.02			0.02	Pass	
Phosphate total (as P)	mg/L	< 0.05			0.05	Pass	
Phosphorus reactive (as P)	mg/L	< 0.05			0.05	Pass	
Sulphate (as SO4)	mg/L	< 5			5	Pass	
Total Dissolved Solids	mg/L	< 10			10	Pass	
Total Kjeldahl Nitrogen (as N)	mg/L	< 0.2			0.2	Pass	
Total Organic Carbon	mg/L	< 5			5	Pass	
Method Blank							
Alkalinity (speciated)							
Bicarbonate Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Carbonate Alkalinity (as CaCO3)	mg/L	< 10			10	Pass	
Hydroxide Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Total Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/L	< 0.001			0.001	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Beryllium	mg/L	< 0.001			0.001	Pass	
Beryllium (filtered)	mg/L	< 0.001			0.001	Pass	
Boron	mg/L	< 0.05			0.05	Pass	
Boron (filtered)	mg/L	< 0.05			0.05	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium	mg/L	< 0.001			0.001	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Cobalt	mg/L	< 0.001			0.001	Pass	
Cobalt (filtered)	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Iron	mg/L	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Manganese	mg/L	< 0.005			0.005	Pass	
Manganese (filtered)	mg/L	< 0.005			0.005	Pass	
Mercury	mg/L	< 0.0001			0.0001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Selenium	mg/L	< 0.001			0.001	Pass	
Selenium (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc	mg/L	< 0.005			0.005	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
Method Blank							
Alkali Metals							
Calcium	mg/L	< 0.5			0.5	Pass	
Magnesium	mg/L	< 0.5			0.5	Pass	
Potassium	mg/L	< 0.5			0.5	Pass	
Sodium	mg/L	< 0.5			0.5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	126			70-130	Pass	
TRH C10-C14	%	80			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	108			70-130	Pass	
Toluene	%	112			70-130	Pass	
Ethylbenzene	%	119			70-130	Pass	
m&p-Xylenes	%	116			70-130	Pass	
Xylenes - Total	%	116			70-130	Pass	
LCS - % Recovery							
Volatile Organics							
1.1-Dichloroethene	%	100			70-130	Pass	
1.1.1-Trichloroethane	%	120			70-130	Pass	
1.2-Dichlorobenzene	%	100			70-130	Pass	
1.2-Dichloroethane	%	116			70-130	Pass	
Trichloroethene	%	115			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	92			70-130	Pass	
TRH C6-C10	%	129			70-130	Pass	
TRH >C10-C16	%	91			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	99			70-130	Pass	
Acenaphthylene	%	77			70-130	Pass	
Anthracene	%	105			70-130	Pass	
Benz(a)anthracene	%	122			70-130	Pass	
Benzo(a)pyrene	%	120			70-130	Pass	
Benzo(b&j)fluoranthene	%	125			70-130	Pass	
Benzo(g.h.i)perylene	%	106			70-130	Pass	
Benzo(k)fluoranthene	%	121			70-130	Pass	
Chrysene	%	125			70-130	Pass	
Dibenz(a.h)anthracene	%	103			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Fluoranthene	%	92			70-130	Pass	
Fluorene	%	100			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	106			70-130	Pass	
Naphthalene	%	85			70-130	Pass	
Phenanthrene	%	99			70-130	Pass	
Pyrene	%	94			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
Chlordanes - Total	%	91			70-130	Pass	
4.4'-DDD	%	99			70-130	Pass	
4.4'-DDE	%	107			70-130	Pass	
4.4'-DDT	%	112			70-130	Pass	
a-BHC	%	92			70-130	Pass	
Aldrin	%	94			70-130	Pass	
b-BHC	%	110			70-130	Pass	
d-BHC	%	112			70-130	Pass	
Dieldrin	%	114			70-130	Pass	
Endosulfan I	%	107			70-130	Pass	
Endosulfan II	%	122			70-130	Pass	
Endosulfan sulphate	%	121			70-130	Pass	
Endrin	%	122			70-130	Pass	
Endrin aldehyde	%	114			70-130	Pass	
Endrin ketone	%	120			70-130	Pass	
g-BHC (Lindane)	%	119			70-130	Pass	
Heptachlor	%	74			70-130	Pass	
Heptachlor epoxide	%	87			70-130	Pass	
Hexachlorobenzene	%	82			70-130	Pass	
Methoxychlor	%	85			70-130	Pass	
LCS - % Recovery							
Organophosphorus Pesticides							
Diazinon	%	104			70-130	Pass	
Dimethoate	%	94			70-130	Pass	
Ethion	%	107			70-130	Pass	
Fenitrothion	%	129			70-130	Pass	
Methyl parathion	%	97			70-130	Pass	
Mevinphos	%	89			70-130	Pass	
LCS - % Recovery							
Phenols (Halogenated)							
2-Chlorophenol	%	62			30-130	Pass	
2.4-Dichlorophenol	%	38			30-130	Pass	
2.4.5-Trichlorophenol	%	39			30-130	Pass	
2.4.6-Trichlorophenol	%	42			30-130	Pass	
2.6-Dichlorophenol	%	37			30-130	Pass	
4-Chloro-3-methylphenol	%	53			30-130	Pass	
Pentachlorophenol	%	36			30-130	Pass	
Tetrachlorophenols - Total	%	36			30-130	Pass	
LCS - % Recovery							
Phenols (non-Halogenated)							
2-Cyclohexyl-4.6-dinitrophenol	%	41			30-130	Pass	
2-Methyl-4.6-dinitrophenol	%	43			30-130	Pass	
2-Methylphenol (o-Cresol)	%	58			30-130	Pass	
2-Nitrophenol	%	45			30-130	Pass	
2.4-Dimethylphenol	%	56			30-130	Pass	
3&4-Methylphenol (m&p-Cresol)	%	110			30-130	Pass	

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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
4-Nitrophenol	%	38			30-130	Pass	
Dinoseb	%	43			30-130	Pass	
Phenol	%	76			30-130	Pass	
LCS - % Recovery							
Semivolatile Organics							
1.2.4-Trichlorobenzene	%	104			70-130	Pass	
1.4-Dichlorobenzene	%	90			70-130	Pass	
2.4-Dinitrotoluene	%	128			70-130	Pass	
N-Nitrosodipropylamine	%	108			70-130	Pass	
LCS - % Recovery							
Perfluoroalkyl carboxylic acids (PFCAs)							
Perfluorobutanoic acid (PFBA)	%	90			50-150	Pass	
Perfluoropentanoic acid (PFPeA)	%	71			50-150	Pass	
Perfluorohexanoic acid (PFHxA)	%	88			50-150	Pass	
Perfluoroheptanoic acid (PFHpA)	%	88			50-150	Pass	
Perfluorooctanoic acid (PFOA)	%	89			50-150	Pass	
Perfluorononanoic acid (PFNA)	%	85			50-150	Pass	
Perfluorodecanoic acid (PFDA)	%	88			50-150	Pass	
Perfluoroundecanoic acid (PFUnDA)	%	89			50-150	Pass	
Perfluorododecanoic acid (PFDoDA)	%	85			50-150	Pass	
Perfluorotridecanoic acid (PFTrDA)	%	131			50-150	Pass	
Perfluorotetradecanoic acid (PFTeDA)	%	83			50-150	Pass	
LCS - % Recovery							
Perfluoroalkyl sulfonamido substances							
Perfluorooctane sulfonamide (FOSA)	%	85			50-150	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	%	85			50-150	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	%	81			50-150	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)	%	84			50-150	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)	%	84			50-150	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	%	84			50-150	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	%	75			50-150	Pass	
LCS - % Recovery							
Perfluoroalkyl sulfonic acids (PFSAs)							
Perfluorobutanesulfonic acid (PFBS)	%	123			50-150	Pass	
Perfluoropentanesulfonic acid (PFPeS)	%	78			50-150	Pass	
Perfluorohexanesulfonic acid (PFHxS)	%	80			50-150	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	%	84			50-150	Pass	
Perfluorooctanesulfonic acid (PFOS)	%	81			50-150	Pass	
Perfluorodecanesulfonic acid (PFDS)	%	117			50-150	Pass	
LCS - % Recovery							
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)							
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	%	86			50-150	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)	%	80			50-150	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	%	82			50-150	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	%	75			50-150	Pass	
LCS - % Recovery							
Ammonia (as N)	%	98			70-130	Pass	
Chloride	%	102			70-130	Pass	
Nitrate & Nitrite (as N)	%	100			70-130	Pass	
Nitrate (as N)	%	100			70-130	Pass	
Nitrite (as N)	%	106			70-130	Pass	
Phosphate total (as P)	%	88			70-130	Pass	
Phosphorus reactive (as P)	%	110			70-130	Pass	
Sulphate (as SO4)	%	107			70-130	Pass	

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Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Total Dissolved Solids			%	88			70-130	Pass	
Total Kjeldahl Nitrogen (as N)			%	104			70-130	Pass	
Total Organic Carbon			%	95			70-130	Pass	
LCS - % Recovery									
Alkalinity (speciated)									
Carbonate Alkalinity (as CaCO3)			%	104			70-130	Pass	
Total Alkalinity (as CaCO3)			%	104			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Arsenic			%	99			80-120	Pass	
Arsenic (filtered)			%	95			80-120	Pass	
Beryllium			%	92			80-120	Pass	
Boron			%	98			80-120	Pass	
Boron (filtered)			%	109			80-120	Pass	
Cadmium			%	86			80-120	Pass	
Cadmium (filtered)			%	84			80-120	Pass	
Chromium			%	102			80-120	Pass	
Chromium (filtered)			%	97			80-120	Pass	
Cobalt			%	99			80-120	Pass	
Cobalt (filtered)			%	95			80-120	Pass	
Copper			%	83			80-120	Pass	
Copper (filtered)			%	86			80-120	Pass	
Iron			%	97			80-120	Pass	
Iron (filtered)			%	108			80-120	Pass	
Lead			%	92			80-120	Pass	
Lead (filtered)			%	95			80-120	Pass	
Manganese			%	104			80-120	Pass	
Manganese (filtered)			%	98			80-120	Pass	
Mercury			%	86			75-125	Pass	
Mercury (filtered)			%	85			70-130	Pass	
Nickel			%	97			80-120	Pass	
Nickel (filtered)			%	93			80-120	Pass	
Selenium			%	98			80-120	Pass	
Selenium (filtered)			%	95			80-120	Pass	
Zinc			%	100			80-120	Pass	
Zinc (filtered)			%	96			80-120	Pass	
LCS - % Recovery									
Alkali Metals									
Calcium			%	93			70-130	Pass	
Magnesium			%	97			70-130	Pass	
Potassium			%	84			70-130	Pass	
Sodium			%	111			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M18-Jl15751	NCP	%	93			70-130	Pass	
Nitrate & Nitrite (as N)	M18-Jl15751	NCP	%	99			70-130	Pass	
Nitrate (as N)	M18-Jl15751	NCP	%	98			70-130	Pass	
Nitrite (as N)	M18-Jl15751	NCP	%	102			70-130	Pass	
Phosphate total (as P)	M18-Jl16246	NCP	%	90			70-130	Pass	
Phosphorus reactive (as P)	M18-Jl13259	NCP	%	78			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	M18-Jl16246	NCP	%	88			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
TRH C10-C14	M18-Jl16662	NCP	%	90			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	M18-Jl16662	NCP	%	97			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	M18-Jl19520	NCP	%	92			70-130	Pass	
Acenaphthylene	M18-Jl19520	NCP	%	76			70-130	Pass	
Anthracene	M18-Jl19520	NCP	%	77			70-130	Pass	
Benz(a)anthracene	M18-Jl19520	NCP	%	119			70-130	Pass	
Benzo(a)pyrene	M18-Jl19520	NCP	%	94			70-130	Pass	
Benzo(b&j)fluoranthene	M18-Jl19520	NCP	%	118			70-130	Pass	
Benzo(g.h.i)perylene	M18-Jl19520	NCP	%	79			70-130	Pass	
Benzo(k)fluoranthene	M18-Jl19520	NCP	%	120			70-130	Pass	
Chrysene	M18-Jl19520	NCP	%	118			70-130	Pass	
Dibenz(a.h)anthracene	M18-Jl19520	NCP	%	99			70-130	Pass	
Fluoranthene	M18-Jl19520	NCP	%	78			70-130	Pass	
Fluorene	M18-Jl19520	NCP	%	71			70-130	Pass	
Indeno(1.2.3-cd)pyrene	M18-Jl19520	NCP	%	84			70-130	Pass	
Naphthalene	M18-Jl19520	NCP	%	76			70-130	Pass	
Phenanthrene	M18-Jl19520	NCP	%	71			70-130	Pass	
Pyrene	M18-Jl19520	NCP	%	82			70-130	Pass	
Spike - % Recovery									
Phenols (Halogenated)				Result 1					
2-Chlorophenol	M18-Jl19520	NCP	%	94			30-130	Pass	
2.4-Dichlorophenol	M18-Jl19520	NCP	%	69			30-130	Pass	
2.4.5-Trichlorophenol	M18-Jl19520	NCP	%	67			30-130	Pass	
2.4.6-Trichlorophenol	M18-Jl19520	NCP	%	79			30-130	Pass	
2.6-Dichlorophenol	M18-Jl19520	NCP	%	61			30-130	Pass	
4-Chloro-3-methylphenol	M18-Jl19520	NCP	%	108			30-130	Pass	
Pentachlorophenol	M18-Jl19520	NCP	%	49			30-130	Pass	
Tetrachlorophenols - Total	M18-Jl19520	NCP	%	35			30-130	Pass	
Spike - % Recovery									
Phenols (non-Halogenated)				Result 1					
2-Cyclohexyl-4.6-dinitrophenol	M18-Jl19520	NCP	%	86			30-130	Pass	
2-Methyl-4.6-dinitrophenol	M18-Jl19520	NCP	%	38			30-130	Pass	
2-Methylphenol (o-Cresol)	M18-Jl19520	NCP	%	92			30-130	Pass	
2-Nitrophenol	M18-Jl19520	NCP	%	80			30-130	Pass	
2.4-Dimethylphenol	M18-Jl19520	NCP	%	108			30-130	Pass	
3&4-Methylphenol (m&p-Cresol)	M18-Jl19520	NCP	%	80			30-130	Pass	
4-Nitrophenol	M18-Jl19520	NCP	%	35			30-130	Pass	
Dinoseb	M18-Jl19520	NCP	%	74			30-130	Pass	
Phenol	M18-Jl19520	NCP	%	114			30-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	M18-Jl15455	CP	%	115			70-130	Pass	
Beryllium (filtered)	M18-Jl15455	CP	%	102			75-125	Pass	
Boron (filtered)	M18-Jl15455	CP	%	127			75-125	Fail	Q08
Cadmium (filtered)	M18-Jl15455	CP	%	91			70-130	Pass	
Chromium (filtered)	M18-Jl15455	CP	%	115			70-130	Pass	
Cobalt (filtered)	M18-Jl15455	CP	%	108			75-125	Pass	
Copper (filtered)	M18-Jl15455	CP	%	86			70-130	Pass	
Iron (filtered)	M18-Jl17132	NCP	%	90			70-130	Pass	
Lead (filtered)	M18-Jl15455	CP	%	98			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Manganese (filtered)	M18-Jl15745	NCP	%	110			70-130	Pass	
Mercury (filtered)	M18-Jl15745	NCP	%	81			70-130	Pass	
Nickel (filtered)	M18-Jl15455	CP	%	107			70-130	Pass	
Selenium (filtered)	M18-Jl15455	CP	%	117			70-130	Pass	
Zinc (filtered)	M18-Jl15455	CP	%	106			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	M18-Jl15457	CP	%	80			70-130	Pass	
4.4'-DDE	M18-Jl15457	CP	%	95			70-130	Pass	
4.4'-DDT	M18-Jl15457	CP	%	83			70-130	Pass	
a-BHC	M18-Jl15457	CP	%	114			70-130	Pass	
Aldrin	M18-Jl15457	CP	%	87			70-130	Pass	
b-BHC	M18-Jl15457	CP	%	121			70-130	Pass	
d-BHC	M18-Jl15457	CP	%	114			70-130	Pass	
Dieldrin	M18-Jl15457	CP	%	105			70-130	Pass	
Endosulfan I	M18-Jl15457	CP	%	94			70-130	Pass	
Endosulfan II	M18-Jl15457	CP	%	120			70-130	Pass	
Endosulfan sulphate	M18-Jl15457	CP	%	100			70-130	Pass	
Endrin	M18-Jl15457	CP	%	113			70-130	Pass	
Endrin aldehyde	M18-Jl15457	CP	%	82			70-130	Pass	
Endrin ketone	M18-Jl15457	CP	%	89			70-130	Pass	
g-BHC (Lindane)	M18-Jl15457	CP	%	114			70-130	Pass	
Heptachlor	M18-Jl15457	CP	%	71			70-130	Pass	
Heptachlor epoxide	M18-Jl15457	CP	%	71			70-130	Pass	
Hexachlorobenzene	M18-Jl15457	CP	%	118			70-130	Pass	
Methoxychlor	M18-Jl15457	CP	%	84			70-130	Pass	
Spike - % Recovery									
				Result 1					
Sulphate (as SO4)	M18-Jl15457	CP	%	71			70-130	Pass	
Spike - % Recovery									
Alkali Metals				Result 1					
Calcium	M18-Jl15457	CP	%	99			70-130	Pass	
Magnesium	M18-Jl15457	CP	%	105			70-130	Pass	
Potassium	M18-Jl15457	CP	%	89			70-130	Pass	
Sodium	M18-Jl15457	CP	%	114			70-130	Pass	
Spike - % Recovery									
Perfluoroalkyl carboxylic acids (PFCAs)				Result 1					
Perfluorobutanoic acid (PFBA)	M18-Jl15461	CP	%	91			50-150	Pass	
Perfluoropentanoic acid (PFPeA)	M18-Jl15461	CP	%	77			50-150	Pass	
Perfluorohexanoic acid (PFHxA)	M18-Jl15461	CP	%	89			50-150	Pass	
Perfluoroheptanoic acid (PFHpA)	M18-Jl15461	CP	%	88			50-150	Pass	
Perfluorooctanoic acid (PFOA)	M18-Jl15461	CP	%	89			50-150	Pass	
Perfluorononanoic acid (PFNA)	M18-Jl15461	CP	%	89			50-150	Pass	
Perfluorodecanoic acid (PFDA)	M18-Jl15461	CP	%	92			50-150	Pass	
Perfluoroundecanoic acid (PFUnDA)	M18-Jl15461	CP	%	89			50-150	Pass	
Perfluorododecanoic acid (PFDoDA)	M18-Jl15461	CP	%	92			50-150	Pass	
Perfluorotridecanoic acid (PFTrDA)	M18-Jl15461	CP	%	118			50-150	Pass	
Perfluorotetradecanoic acid (PFTeDA)	M18-Jl15461	CP	%	94			50-150	Pass	
Spike - % Recovery									
Perfluoroalkyl sulfonamido substances				Result 1					
Perfluorooctane sulfonamide (FOSA)	M18-Jl15461	CP	%	88			50-150	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	M18-Jl15461	CP	%	90			50-150	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	M18-Jl15461	CP	%	90			50-150	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)	M18-Jl15461	CP	%	90			50-150	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)	M18-Jl15461	CP	%	90			50-150	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	M18-Jl15461	CP	%	87			50-150	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	M18-Jl15461	CP	%	78			50-150	Pass	
Spike - % Recovery									
Perfluoroalkyl sulfonic acids (PFSAs)				Result 1					
Perfluorobutanesulfonic acid (PFBS)	M18-Jl15461	CP	%	109			50-150	Pass	
Perfluoropentanesulfonic acid (PFPeS)	M18-Jl15461	CP	%	85			50-150	Pass	
Perfluorohexanesulfonic acid (PFHxS)	M18-Jl15461	CP	%	84			50-150	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	M18-Jl15461	CP	%	87			50-150	Pass	
Perfluorooctanesulfonic acid (PFOS)	M18-Jl15461	CP	%	85			50-150	Pass	
Perfluorodecanesulfonic acid (PFDS)	M18-Jl15461	CP	%	115			50-150	Pass	
Spike - % Recovery									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)				Result 1					
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	M18-Jl15461	CP	%	93			50-150	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)	M18-Jl15461	CP	%	91			50-150	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	M18-Jl15461	CP	%	86			50-150	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	M18-Jl15461	CP	%	80			50-150	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S18-Jl14677	NCP	%	98			75-125	Pass	
Beryllium	S18-Jl14677	NCP	%	98			75-125	Pass	
Boron	S18-Jl14677	NCP	%	107			75-125	Pass	
Cadmium	S18-Jl14677	NCP	%	99			75-125	Pass	
Chromium	S18-Jl14677	NCP	%	101			75-125	Pass	
Cobalt	S18-Jl14677	NCP	%	100			75-125	Pass	
Copper	S18-Jl14677	NCP	%	101			75-125	Pass	
Iron	S18-Jl14677	NCP	%	109			75-125	Pass	
Lead	S18-Jl14677	NCP	%	104			75-125	Pass	
Manganese	S18-Jl14677	NCP	%	102			75-125	Pass	
Mercury	S18-Jl14677	NCP	%	93			70-130	Pass	
Nickel	S18-Jl14677	NCP	%	100			75-125	Pass	
Selenium	S18-Jl14677	NCP	%	96			75-125	Pass	
Zinc	S18-Jl14677	NCP	%	101			75-125	Pass	

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Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	M18-Jl15751	NCP	mg/L	0.06	0.06	1.0	30%	Pass	
Nitrate & Nitrite (as N)	M18-Jl15751	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Nitrate (as N)	M18-Jl15751	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Nitrite (as N)	M18-Jl15751	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
pH (at 25°C)	M18-Jl16215	NCP	pH Units	8.6	8.5	pass	30%	Pass	
Phosphate total (as P)	M18-Jl15464	NCP	mg/L	0.39	0.35	12	30%	Pass	
Total Kjeldahl Nitrogen (as N)	M18-Jl15464	NCP	mg/L	0.4	0.4	5.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (at 25°C)	M18-Jl15455	CP	uS/cm	10000	13000	1.0	30%	Pass	
Phosphorus reactive (as P)	M18-Jl15455	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Duplicate									
Alkalinity (speciated)				Result 1	Result 2	RPD			
Bicarbonate Alkalinity (as CaCO3)	M18-Jl15455	CP	mg/L	820	820	1.0	30%	Pass	
Carbonate Alkalinity (as CaCO3)	M18-Jl15455	CP	mg/L	< 10	< 10	<1	30%	Pass	
Hydroxide Alkalinity (as CaCO3)	M18-Jl15455	CP	mg/L	< 20	< 20	<1	30%	Pass	
Total Alkalinity (as CaCO3)	M18-Jl15455	CP	mg/L	820	820	1.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	M18-Jl15455	CP	mg/L	0.003	0.003	4.0	30%	Pass	
Beryllium (filtered)	M18-Jl15455	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Boron (filtered)	M18-Jl15455	CP	mg/L	0.07	0.08	9.0	30%	Pass	
Cadmium (filtered)	M18-Jl15455	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	M18-Jl15455	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt (filtered)	M18-Jl15455	CP	mg/L	0.003	0.003	1.0	30%	Pass	
Copper (filtered)	M18-Jl15455	CP	mg/L	0.013	0.012	8.0	30%	Pass	
Iron (filtered)	M18-Jl15455	CP	mg/L	1.4	1.4	1.0	30%	Pass	
Lead (filtered)	M18-Jl15455	CP	mg/L	0.001	0.001	7.0	30%	Pass	
Manganese (filtered)	M18-Jl15455	CP	mg/L	0.77	0.78	1.0	30%	Pass	
Mercury (filtered)	M18-Jl15455	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	M18-Jl15455	CP	mg/L	0.11	0.11	1.0	30%	Pass	
Selenium (filtered)	M18-Jl15455	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	M18-Jl15455	CP	mg/L	0.041	0.040	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	M18-Jl15456	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	M18-Jl15456	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C34-C40	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Acenaphthylene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Anthracene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benz(a)anthracene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(a)pyrene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(b&j)fluoranthene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(g.h.i)perylene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Benzo(k)fluoranthene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chrysene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Dibenz(a.h)anthracene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluoranthene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluorene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Naphthalene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Phenanthrene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Pyrene	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	M18-Jl15456	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
4.4'-DDD	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
4.4'-DDE	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
4.4'-DDT	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
a-BHC	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Aldrin	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
b-BHC	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
d-BHC	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Dieldrin	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endosulfan I	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endosulfan II	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endosulfan sulphate	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endrin	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endrin aldehyde	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Endrin ketone	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
g-BHC (Lindane)	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Heptachlor	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Heptachlor epoxide	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Hexachlorobenzene	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Methoxychlor	M18-Jl15456	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Duplicate									
Organophosphorus Pesticides				Result 1	Result 2	RPD			
Azinphos-methyl	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Bolstar	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Chlorfenvinphos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Chlorpyrifos	M18-Jl15456	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Chlorpyrifos-methyl	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Coumaphos	M18-Jl15456	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Demeton-S	M18-Jl15456	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Demeton-O	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Diazinon	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Dichlorvos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Dimethoate	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Disulfoton	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
EPN	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethoprop	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethyl parathion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fenitrothion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fensulfothion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fenthion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Malathion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Merphos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	

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Duplicate									
Organophosphorus Pesticides				Result 1	Result 2	RPD			
Methyl parathion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Mevinphos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Monocrotophos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Naled	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Omethoate	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Phorate	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Pirimiphos-methyl	M18-Jl15456	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Pyrazophos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ronnel	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Terbufos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Tetrachlorvinphos	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Tokuthion	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Trichloronate	M18-Jl15456	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Duplicate									
Phenols (Halogenated)				Result 1	Result 2	RPD			
2-Chlorophenol	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
2.4-Dichlorophenol	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
2.4.5-Trichlorophenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
2.4.6-Trichlorophenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
2.6-Dichlorophenol	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
4-Chloro-3-methylphenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Pentachlorophenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Tetrachlorophenols - Total	M18-Jl15456	CP	mg/L	< 0.03	< 0.03	<1	30%	Pass	
Duplicate									
Phenols (non-Halogenated)				Result 1	Result 2	RPD			
2-Cyclohexyl-4.6-dinitrophenol	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
2-Methyl-4.6-dinitrophenol	M18-Jl15456	CP	mg/L	< 0.03	< 0.03	<1	30%	Pass	
2-Methylphenol (o-Cresol)	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
2-Nitrophenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
2.4-Dimethylphenol	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
2.4-Dinitrophenol	M18-Jl15456	CP	mg/L	< 0.03	< 0.03	<1	30%	Pass	
3&4-Methylphenol (m&p-Cresol)	M18-Jl15456	CP	mg/L	< 0.006	< 0.006	<1	30%	Pass	
4-Nitrophenol	M18-Jl15456	CP	mg/L	< 0.03	< 0.03	<1	30%	Pass	
Dinoseb	M18-Jl15456	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Phenol	M18-Jl15456	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Semivolatile Organics				Result 1	Result 2	RPD			
1-Chloronaphthalene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1-Naphthylamine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2-Dichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2.3-Trichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2.3.4-Tetrachlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2.3.5-Tetrachlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2.4-Trichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.2.4.5-Tetrachlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.3-Dichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.3.5-Trichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
1.4-Dichlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2-Chloronaphthalene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2-Methylnaphthalene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2-Naphthylamine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2-Nitroaniline	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2-Picoline	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2.3.4.6-Tetrachlorophenol	M18-Jl15456	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	

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Duplicate									
Semivolatile Organics				Result 1	Result 2	RPD			
2.4-Dinitrotoluene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
2.6-Dinitrotoluene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
3-Methylcholanthrene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
3.3'-Dichlorobenzidine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4-Aminobiphenyl	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4-Bromophenyl phenyl ether	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4-Chlorophenyl phenyl ether	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4.4'-DDD	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4.4'-DDE	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
4.4'-DDT	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
7.12-Dimethylbenz(a)anthracene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
a-BHC	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Acetophenone	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Aldrin	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Aniline	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
b-BHC	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Benzyl chloride	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Bis(2-chloroethoxy)methane	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Bis(2-chloroisopropyl)ether	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Bis(2-ethylhexyl)phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Butyl benzyl phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
d-BHC	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Di-n-butyl phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Di-n-octyl phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Dibenz(a.j)acridine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Dibenzofuran	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Dieldrin	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Diethyl phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Dimethyl phthalate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Dimethylaminoazobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Diphenylamine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endosulfan I	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endosulfan II	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endosulfan sulphate	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endrin	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endrin aldehyde	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Endrin ketone	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
g-BHC (Lindane)	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Heptachlor	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Heptachlor epoxide	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Hexachlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Hexachlorobutadiene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Hexachlorocyclopentadiene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Hexachloroethane	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Methoxychlor	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
N-Nitrosodibutylamine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
N-Nitrosodipropylamine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
N-Nitrosopiperidine	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Nitrobenzene	M18-Jl15456	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Pentachlorobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Pentachloronitrobenzene	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Pronamide	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Trifluralin	M18-Jl15456	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

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Duplicate									
				Result 1	Result 2	RPD			
Chloride	M18-Jl15457	CP	mg/L	2600	2400	4.0	30%	Pass	
Sulphate (as SO4)	M18-Jl15457	CP	mg/L	320	330	2.0	30%	Pass	
Duplicate									
Alkali Metals				Result 1	Result 2	RPD			
Calcium	M18-Jl15457	CP	mg/L	65	60	9.0	30%	Pass	
Magnesium	M18-Jl15457	CP	mg/L	230	210	8.0	30%	Pass	
Potassium	M18-Jl15457	CP	mg/L	43	38	11	30%	Pass	
Sodium	M18-Jl15457	CP	mg/L	2000	1900	7.0	30%	Pass	
Duplicate									
Perfluoroalkyl carboxylic acids (PFCAs)				Result 1	Result 2	RPD			
Perfluorobutanoic acid (PFBA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
Perfluoropentanoic acid (PFPeA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorohexanoic acid (PFHxA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoroheptanoic acid (PFHpA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorooctanoic acid (PFOA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorononanoic acid (PFNA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorodecanoic acid (PFDA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoroundecanoic acid (PFUnDA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorododecanoic acid (PFDoDA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorotridecanoic acid (PFTrDA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorotetradecanoic acid (PFTeDA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
Perfluoroalkyl sulfonamido substances				Result 1	Result 2	RPD			
Perfluorooctane sulfonamide (FOSA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
Duplicate									
Perfluoroalkyl sulfonic acids (PFSAs)				Result 1	Result 2	RPD			
Perfluorobutanesulfonic acid (PFBS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoropentanesulfonic acid (PFPeS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorohexanesulfonic acid (PFHxS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorooctanesulfonic acid (PFOS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorodecanesulfonic acid (PFDS)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	

Duplicate									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)				Result 1	Result 2	RPD			
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)	M18-Jl15459	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	M18-Jl15459	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Total Dissolved Solids	M18-Jl15459	CP	mg/L	10000	10000	6.0	30%	Pass	
Duplicate									
Perfluoroalkyl carboxylic acids (PFCAs)				Result 1	Result 2	RPD			
Perfluorobutanoic acid (PFBA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
Perfluoropentanoic acid (PFPeA)	M18-Jl15460	CP	ug/L	0.02	0.02	6.0	30%	Pass	
Perfluorohexanoic acid (PFHxA)	M18-Jl15460	CP	ug/L	0.01	0.01	1.0	30%	Pass	
Perfluoroheptanoic acid (PFHpA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorooctanoic acid (PFOA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorononanoic acid (PFNA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorodecanoic acid (PFDA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoroundecanoic acid (PFUnDA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorododecanoic acid (PFDoDA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorotridecanoic acid (PFTrDA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorotetradecanoic acid (PFTeDA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
Perfluoroalkyl sulfonamido substances				Result 1	Result 2	RPD			
Perfluorooctane sulfonamide (FOSA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-methylperfluoro-1-octane sulfonamide (N-MeFOSA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
2-(N-methylperfluoro-1-octane sulfonamido)-ethanol (N-MeFOSE)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol (N-EtFOSE)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
Duplicate									
Perfluoroalkyl sulfonic acids (PFSAs)				Result 1	Result 2	RPD			
Perfluorobutanesulfonic acid (PFBS)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoropentanesulfonic acid (PFPeS)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorohexanesulfonic acid (PFHxS)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluoroheptanesulfonic acid (PFHpS)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Perfluorooctanesulfonic acid (PFOS)	M18-Jl15460	CP	ug/L	0.02	0.02	3.0	30%	Pass	
Perfluorodecanesulfonic acid (PFDS)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	

Duplicate									
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs)				Result 1	Result 2	RPD			
1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
1H.1H.2H.2H-perfluorooctanesulfonic acid (6:2 FTSA)	M18-Jl15460	CP	ug/L	< 0.05	< 0.05	<1	30%	Pass	
1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)	M18-Jl15460	CP	ug/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Total Organic Carbon	M18-Jl15461	CP	mg/L	< 5	< 5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Beryllium	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Boron	S18-Jl14677	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Cadmium	S18-Jl14677	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Iron	S18-Jl14677	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Lead	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Manganese	S18-Jl14677	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Mercury	S18-Jl14677	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Selenium	S18-Jl14677	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc	S18-Jl14677	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	No
Appropriate sample containers have been used	No
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
N09	Quantification of linear and branched isomers has been conducted as a single total response using the relative response factor for the corresponding linear/branched standard.
N11	Isotope dilution is used for calibration of each native compound for which an exact labelled analogue is available (Isotope Dilution Quantitation). The isotopically labelled analogues allow identification and recovery correction of the concentration of the associated native PFAS compounds.
N15	Where the native PFAS compound does not have labelled analogue then the quantification is made using the Extracted Internal Standard Analyte with the closest retention time to the analyte and no recovery correction has been made (Internal Standard Quantitation).
Q08	The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference
Q09	The Surrogate recovery is outside of the recommended acceptance criteria due to matrix interference. Acceptance criteria were met for all other QC
Q15	The RPD reported passes Eurofins | mgt's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Natalie Krasselt	Analytical Services Manager
Alex Petridis	Senior Analyst-Metal (VIC)
Harry Bacalis	Senior Analyst-Volatile (VIC)
Jonathon Angell	Senior Analyst-Organic (QLD)
Joseph Edouard	Senior Analyst-Organic (VIC)
Michael Brancati	Senior Analyst-Inorganic (VIC)

Glenn Jackson

National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Appendix D – Greenhouse gas assessment

GHG 1 Carbon Gauge inputs and assumptions

Carbon Gauge category		Carbon Gauge input	Data provided and GHD assumption/s for project design
Fuel type			
Construction activity	Site offices	Diesel	Assumption made of 100% diesel vehicles on-site.
	Construction	Diesel	
	Demolition and earthworks	Diesel	
	Vegetation removal	Diesel	
	Percentage of site vehicles using petrol	0%	
Pavements			
Pavement types	Pavement 2	• 1,485,931 m^2	Assume pavement type is 'deep strength' in Carbon Gauge as per recommendations from the reference project engineering team.
	Pavement 5	• 350,202 m^2	Assume pavement type is 'reinforced concrete' in Carbon Gauge as per recommendations from the reference project engineering team.
	Pavement 2	• 134,202 m^2	Assume pavement type is 'deep strength' in Carbon Gauge as per recommendations from the reference project engineering team.
Structures			
Structures type	Bridges (including interchanges and overpasses)	Concrete: • Length = 6.534 km • Width = 16.00 m Steel: • Length = 9.932 km • Width = 10.39 m	Calculations from reference project engineering team. Assumed all bridges to be concrete based unless specified to be steel or truss. Average width were calculated from total lengths and areas.
	Reinforced soil walls	• 8,330 m in length • 8 m in height	Calculations from reference project engineering team. Advised heights may vary up to 8 m, a conservative value of 8 metre was used for calculations.
	Retaining walls	• 3,960 m in length • 8 m in height	

Carbon Gauge category		Carbon Gauge input	Data provided and GHD assumption/s for project design
Drainage			
Drainage type	Kerbing	• 50,744 m upright kerb and gutter (channel)	Advice from reference project engineering team.
	Culverts – pipes or box culverts for water drainage	• 124,968 m Medium (450-750 RCP) Culverts	No advice provided – assumption of medium drainage type on either side of the road for a length of 62,484 m
Road furniture			
Road furniture type	Road safety barriers	• 5 km Wire Rope Barrier • 320.403 km F-type barrier	Advice from reference project engineering team. Assumption made for wire rope barrier in absence of detailed design.
	Noise walls	42,096 m	Advice from reference project engineering team.
Earthworks			
Earthwork type	Strip and respread topsoil	0	No information provided, assume zero.
	Cut to spoil	4,157,400 m^3	Advice from reference project engineering team.
	Cut to fill	999,400	Advice from reference project engineering team.
	Import and place filling	250,000 m^3	Advice from reference project engineering team.
Vegetation removal			
Vegetation removal type	Biotype class Vegetation removed	• 26 ha Class C Open Forest • 26 ha Class D Open Woodland	Advice from reference project engineering team. Estimated total loss of 52 ha loss. Assumption of a 50-50 evenly split between Class C and D vegetation types.
Street lighting			
Street lighting type	Freeway through carriageways	• 54,870 m	Advice from reference project engineering team of 62,484 m, with 35,049 m of this on carriageway on Eastern Freeway which may be retained. Assumed lighting on both sides of the road.
	Freeway lamps and arterial roads	• 20,000 m	Advice from reference project engineering team. Assumed lighting on both sides of the road.
	Underpasses	• 4,838 m	Advice from reference project engineering team Assumed lighting on both sides of the road. Tunnel lighting included separately in tunnel calculations

Carbon Gauge category		Carbon Gauge input	Data provided and GHD assumption/s for project design
Traffic Signals			
Traffic signal type	LED traffic signals	• 5 Freeway with divided road (full diamond interchange)	Assumption based on advice from reference project engineering team: 5 new or significantly changed intersections + 27 ramp meters. Assumption made that ramp meters would be negligible in comparison to large intersections.
Maintenance activities			
Maintenance activities type	Pavements – flexible and rigid	Automatically calculated by Carbon Gauge based on pavement inputs.	

GHG 2 Carbon Gauge inputs and outputs

Carbon Gauge

Materiality Checklist

Activity/Emission Source	Tick if included	Emission source to be included in GHG Assessment
Construction		
Will a diesel generator be used to provide power to the project site office for more than 12 months?	☑ YES	If yes, fuel combusted in powering site offices will be included.
Will more than 120 buildings be required to be demolished per 1km of road?	☐ YES	If yes, fuel combusted in demolishing buildings will be included.
Will more than 0.5 ha (5,000m^2) of vegetation be removed?	☑ YES	If yes, vegetation removal and/or revegetation will be included.
Will the project involve tunnelling?	☐ YES	If yes, electricity consumption and explosives used will be included. **Tunnelling is not yet included.**
Is the project located more than 50 km from the nearest material suppliers/quarry/city?	☐ YES	If yes, the emissions associated with the transport of materials to site will be included.
Will the project utilise on-site batching plants or other continuously operating stationary plant and equipment for more than 6 months?	☐ YES	If yes, fuel combusted in stationary engines will be included. **Batching plants are not yet included.**
Will the project include road safety barriers along more than 50% of the road length if barriers are used on both sides of a dual carriageway (i.e. 4 sets) or 100% of the road length if used on both side of a single carriageway (i.e. two sets)?	☑ YES	If yes, the emissions from the construction and installation of road safety barriers will be included.
Will the project include noise walls along more than 50% of the road length on both sides or 100% of the road length on one side?	☑ YES	If yes, the emissions from the construction and installation of noise walls will be included.
Operation		
Will the project include street lighting continuously along more than: 15% of the road length (VIC) 20% of the road length (ACT, NSW, QLD) 25% of the road length (SA, WA, NT) 70% of the road length (TAS)? 100% of the road length (NZ)?	☑ YES	If yes, the emissions from the operation of street lighting will be included.
Will the project include traffic signals and/or interchanges using incandescent lights that are less than: 14.9 km apart (VIC) 11.5 km apart (ACT, NSW, QLD, NT) 8.0 km apart (SA, WA) 3.1 km apart (TAS)? 1.7 km apart (NZ)?	☑ YES	If yes, the emissions from the operation of traffic signals using incandescent lights wil be included.
Will the project include traffic signals and/or interchanges using quartz halogen lights that are less than: 5.6 km apart (VIC) 4.5 km apart (ACT, NSW, QLD, NT) 3.5 km apart (SA, WA) 1.3 km apart (TAS)? 0.6 km apart (NZ)?	☐ YES	If yes, the emissions from the operation of traffic signals using quartz halogen lights wil be included.
Will the project include traffic signals and/or interchanges using LED lights that are less than: 2.7 km apart (VIC) 2.0 km apart (ACT, NSW, QLD) 1.8 km apart (SA, WA, NT) 0.6 km apart (TAS)? 0.3 km apart (NZ)?	☑ YES	If yes, the emissions from the operation of traffic signals using LED lights wil be included.
Will the project include emissions from vehicles using the road during its 50 year life?	☐ YES	If yes, enter the emissions from vehicles using the road over the 50 year life of the road project. Note that these emissions must be calculated separately and then entered into the calculator.

Carbon Gauge

Inputs

Key: 50 User Input | 0 Calculated Cell | Cell not available for input

Project Details

Project title	North East Link	
Project location	Western Ring Road (M80) to the Eastern Freeway	Country: (•) Australia ( ) NZ — Region: ( ) Rural (•) Urban
State	VIC	
Brief description of the works e.g. (eg. new road, road duplication, road upgrade, intersection upgrade, etc)	New Freeway Standard road connection	

Construction

Estimated Value ($m)	15000	Large Project
Project Duration (Months)	84	

Fuel Type

	Construction Activity	Fuel Type	Percentage of site vehicles using Petrol
Plant Equipment Fuel	Site Offices	Diesel	0%
	Construction	Diesel	
	Demolition and Earthworks	Diesel	
	Vegetation Removal	Diesel	

Pavements

Pavement Options are only available for road pavement types 1 to 5

	Pavement types	Pavement area (m^2)	Use Pavement Option	Press Button to configure
Pavement 1	02. Deep Strength Asphalt	1,550,000	☐ YES	
Pavement 2	05. Reinforced Concrete (RC)	380,000	☐ YES	
Pavement 3	02. Deep Strength Asphalt	150,000	☐ YES	
Pavement 4	01. Full Depth Asphalt	0	☐ YES	
Pavement 5	01. Full Depth Asphalt	0	☐ YES	
Pavement 6	01. Full Depth Asphalt	0	☐ YES	

Structures

	Type	Total Length (km)	Width (m)	Height (m)
Bridges (including interchanges and overpasses)	Bridge constructed using precast reinforced concrete beams	6.534	16	
	Bridge constructed using steel beams	9.932	10.39	
Reinforced Soil Walls	Reinforced Soil Walls	8.33		8
Retaining Walls	Concrete retaining walls	3		8
	Timber retaining walls	0		0
	Rock retaining walls	0		0

Drainage

		Total Length (km)
Kerbing	Mountable Kerb	0
	Semi-mountable Kerb	0
	Upright kerb and Gutter (Channel)	50.744
	Invert drain	0
Culverts – pipes or box culverts for water drainage	Small <450 RCP	0
	Medium 450 – 750 RCP	124.968
	Large 750 – 1200 RCP	0
	375x 600 RCBC	0
	600 x 1200 RCBC	0
Open, Unlined Drains	Form open, unlined drains	0

Road Furniture

		Total Length (km)
Road Safety Barriers	Wire rope barrier	0
	W-beam barrier	0
	F-type (New Jersey) barrier	320.403
Noise Walls	Reinforced concrete wall	43.5
	Hebel noise wall	0
	Timber wall	0
	Steel plate wall	0

Material Transport

	Pavements	Structures	Drainage	Road Furniture	Truck Size per Load of Material (GVM)	Distance from source to site (km)
Aggregate						

Only include materials being transported more than 50km							
	Asphalt & Bitumen						
	Cement and Concrete						
	Steel						
	Timber						

Earthworks

		Total Volume (m^3)
Earthwork Types	Strip and respread topsoil	0
	Cut to spoil	4,917,806
	Cut to fill	1,182,194
	Import and place filling	650,000

Demolition

		Quantity demolished (Number of buildings)
Buildings	Houses	
	Small commercial	
	Medium commercial	
	Large commercial	

Vegetation Removal

		Select biomass class
Biomass Class	Potential maximum biomass class	Class 1: 0 - 50 (t dry matter/ha)

		Area cleared (ha)
Vegetation Removed	Class A (Rainforest and vine thicket)	Not Possible
	Class B (Eucalypt tall open forest)	Not Possible
	Class C (Open forest)	21
	Class D (Open woodlands)	6
	Class E (Callitris forest & woodland)	0
	Class F (Mallee & Acacia woodland)	0
	Class G (Open shrubland)	25
	Class H (Heathlands)	0
	Class I (Grasslands)	0

Operations

Street Lighting

		Street Length (m)
Lighting Street lighting is only for one side of the road, if lighting is on both sides double the length entered	Freeway through carriageways	54,870
	Freeway ramps and arterial roads	20,000
	Underpasses	7,200

Traffic Signals

		Number of Intersections
Incadescent Traffic Signals	Major urban intersection - Divided Road	0
	Major intersection - Undivided Road	0
	Freeway with divided road (full diamond interchange)	0
Quartz Halogen Traffic Signals	Major urban intersection - Divided Road	
	Major intersection - Undivided Road	
	Freeway with divided road (full diamond interchange)	
LED Traffic Signals	Major urban intersection - Divided Road	0
	Major intersection - Undivided Road	0
	Freeway with divided road (full diamond interchange)	5

Vehicle Use

		Emissions GHGe (t CO2-e)
Vehicles	Emissions from vehicles using road	

Maintenance

Maintenance Activities

		Pavement area (m^2)	Construction area (m^2)
Pavements - Flexible	01. Full Depth Asphalt	0	0
	02. Deep Strength Asphalt	1,620,133	1,700,000
	03. Granular with Spray Seal	0	0
Pavements - Rigid	04. Plain Concrete (PC)	0	0
	05. Reinforced Concrete (RC)	350,202	380,000

Carbon Gauge

Summary Report

Note: This Workbook is designed to enable a consistent methodology for the assessment of significant emission sources and estimation of greenhouse gas emissions. As such it deliberately does not cover activities and emission sources assessed as insignificant, and it is not designed for compliance reporting.

Project Description

Project title	North East Link
Project location	Western Ring Road (M80) to theEastern Freev
State	VIC
Description	New Freeway Standard road connection

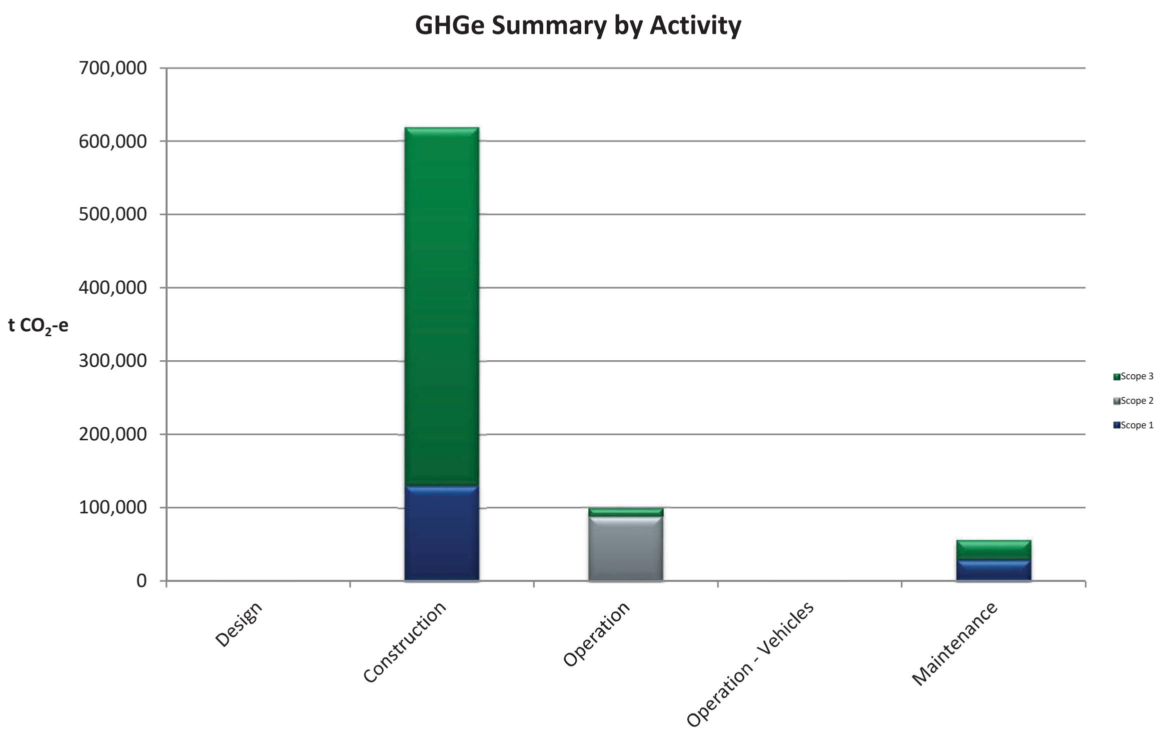
Project Value ($m)	15000
Project Duration (Months)	84

Greenhouse Gas Emissions

Scope 1 emissions	Emissions released into the atmosphere as a direct result of an activity, or series of activities (including ancillary activities) that constitutes the facility.
Scope 2 emissions	Emissions released as a result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.
Scope 3 emissions	Emissions that occur outside the site boundary of a facility as a result of activities at a facility that are not Scope 2 emissions.

Project Summary

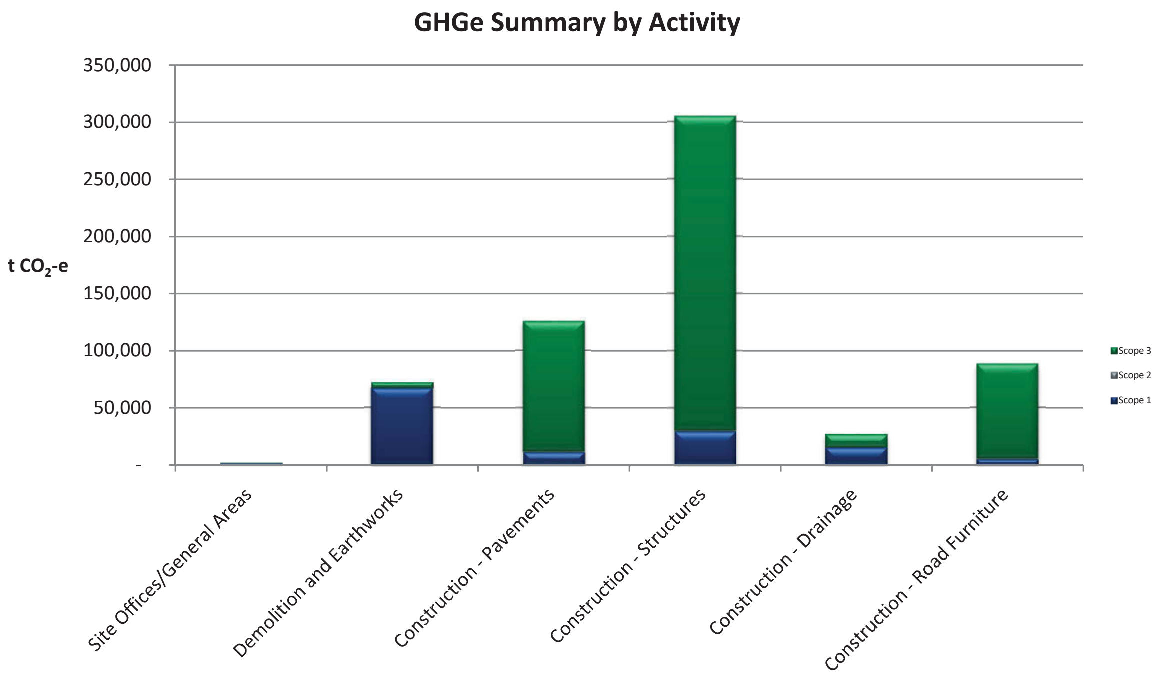
Major Activity	Scope 1	Scope 2	Scope 3	Total
Design	0	0	0	**0**
Construction	130,362	0	488,136	**618,498**
Operation	0	87,639	11,047	**98,686**
Operation - Vehicles	0	0	0	**0**
Maintenance	29,176	0	26,224	**55,400**
Total	**159,539**	**87,639**	**525,406**	**772,583**

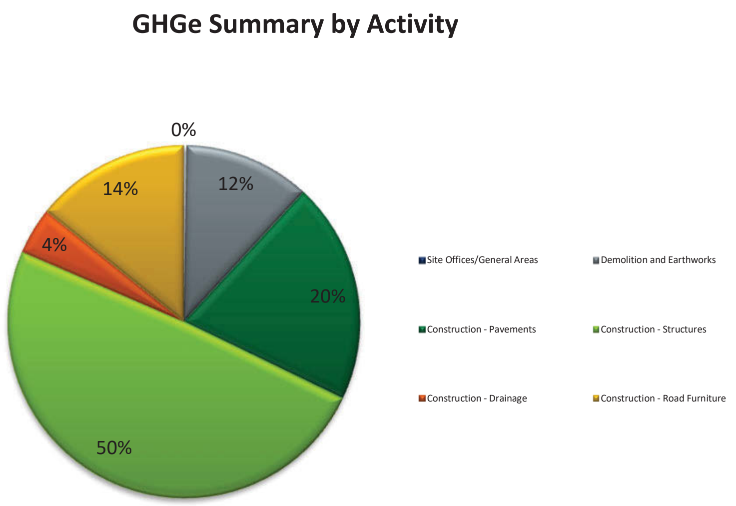


Carbon Gauge

Construction Summary

GHGe Summary by activity	Scope 1	Scope 2	Scope 3	Total
Site Offices/General Areas	1,465	0	112	**1,576**
Demolition and Earthworks	67,015	0	4,736	**71,751**
Construction - Pavements	11,462	0	114,009	**125,471**
Construction - Structures	29,778	0	275,338	**305,116**
Construction - Drainage	15,141	0	11,370	**26,511**
Construction - Road Furniture	5,502	0	82,571	**88,073**
Total	**130,362**	**0**	**488,136**	**618,498**





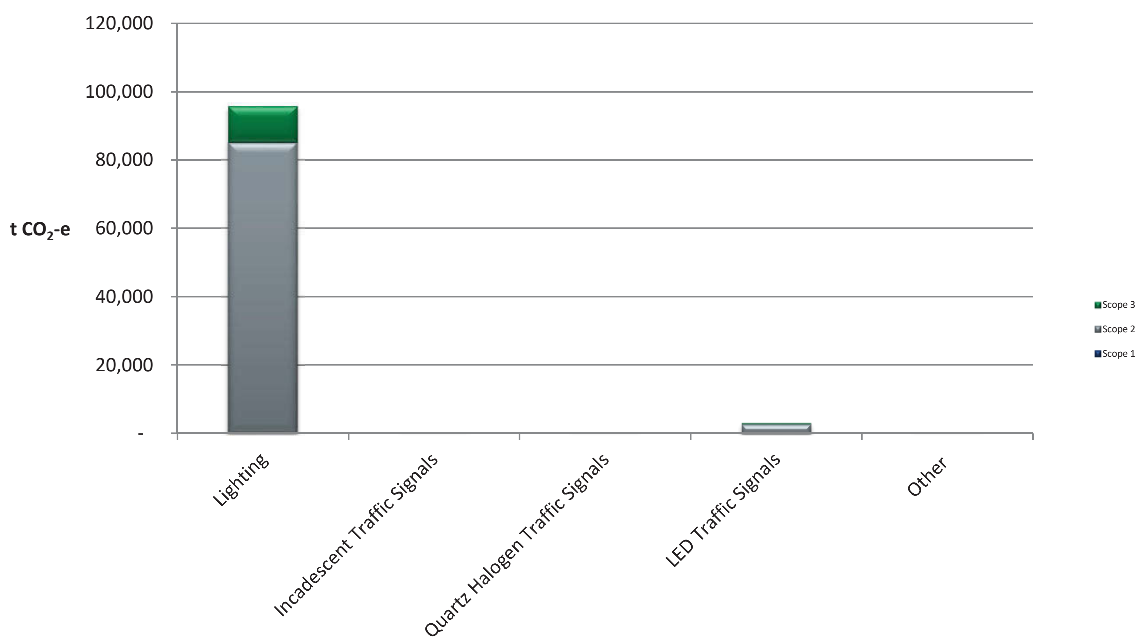
Carbon Gauge

Operations Summary (Emissions are calculated for a 50 year period)

Summary	Scope 1	Scope 2	Scope 3	Total
Lighting	-	85,015	10,716	**95,731**
Incadescent Traffic Signals	-	-	-	**-**
Quartz Halogen Traffic Signals	-	-	-	**-**
LED Traffic Signals	-	2,624	331	**2,954**
Other	-	-	-	**-**
Total	**-**	**87,639**	**11,047**	**98,686**

Summary - Vehicles	Scope 1	Scope 2	Scope 3	Total
Vehicle Use	-	-	-	**-**
Total	**-**	**-**	**-**	**-**

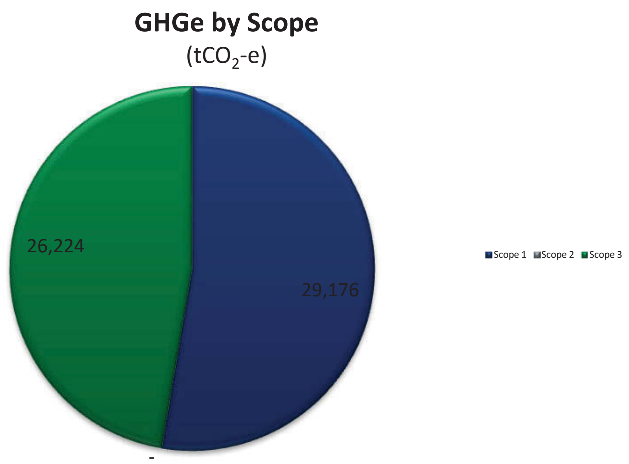
Operations GHGe Summary



Carbon Gauge

Maintenance Summary (Emissions are calculated for a 50 year period)

Summary by Pavement	Scope 1	Scope 2	Scope 3	Total
01. Full Depth Asphalt	-	-	-	0
02. Deep Strength Asphalt	19,123.86	-	24,559.84	**43,684**
03. Granular with Spray Seal	-	-	-	0
04. Stablised Pavement	-	-	-	0
04. Plain Concrete (PC)	-	-	-	0
05. Reinforced Concrete (RC)	10,052.51	-	1,663.71	**11,716**
Other	-	-	-	0
Total	**29,176**	**0**	**26,224**	**55,400**



GHG 3 Tunnel construction and operation inputs and outputs

Tunnel construction and operation inputs and outputs

Data inputs – Construction	Amount	Units	Comments
TBM electricity consumption during construction	124510.2941	MWh	Assumption made using Westgate Tunnel values converted based on tunnel lengths (x 10 km North East Link/6.8 km Westgate Tunnel).
Site electricity consumption, including site office, during construction	645.246	MWh	Assuming total construction period of 6 years, and office consumption of 107.541 MWh p.a., which was calculated for the Westgate tunnel assessment.
Indirect (Scope 2) emission factor for consumption of purchased electricity from the grid in Victoria	1.07	t $CO_{2\text{-}e}$/ MWh	National Greenhouse Accounts Factors July 2018
Indirect (Scope 3) Emission factor for transmission and distribution losses of purchased electricity from the grid in Victoria	0.1	t $CO_{2\text{-}e}$/ MWh	National Greenhouse Accounts Factors July 2018
Tunnel calculations – Materials			
Volume of concrete	2,356,322	Tonnes	Converted from m^3 value provided by the reference project engineering team. Assuming 0.435 m^3 = 1 tonne (Based on conversion factors in Appendix C of the Greenhouse Gas Assessment Workbook for Road Projects).
Volume of steel	205,000	Tonnes	Reference project engineering team
Tunnel calculations – Materials – DELIVERY			
Total number of truckloads	102,453	truckloads	25 t truckload capacity has been assumed.
Total km for tunnel materials delivery (assuming 22.5 km one way trip)	4,610,379	km	-
Total tunnel materials transportation (diesel)	2,582	kL	-
Tunnel calculations – Materials – EMISSION FACTORS			
Construction material emission factor for concrete	0.195	t $CO_{2\text{-}e}$/t	Adopted from the IS Materials Calculator v. 2.0 2018-10-26. Material type assumed to be 'Concrete 40 MPa' and 0% Supplementary Cementitious Material (SCM).
Construction material emission factor for cement	0.82	t $CO_{2\text{-}e}$/t	Adopted from the TAGG Greenhouse Gas Assessment Workbook for Road Projects 2013. Material type assumed to be 'Portland cement'.

Data inputs – Construction	Amount	Units	Comments
Construction material emission factor for steel	3.200	t CO_{2-e}/t	Adopted from the IS Materials Calculator v. 2.0 2018-10-26. Material type assumed to be 'Steel Fibres for concrete reinforcement'.
Construction material emission factor for aggregate	0.005	t CO_{2-e}/t	Adopted from the TAGG Greenhouse Gas Assessment Workbook for Road Projects 2013. Material type assumed to be 'crushed rock'.
Construction material emission factor for fly ash	0.161	t CO_{2-e}/t	Adopted from the TAGG Greenhouse Gas Assessment Workbook for Road Projects 2013.
Construction material emission factor for sand	0.003	t CO_{2-e}/t	Adopted from the TAGG Greenhouse Gas Assessment Workbook for Road Projects 2013.
Tunnel calculations – Spoil transportation			
Spoil – cut to spoil (BCM)	4,157,400	BCM	Reference project engineering team
1.2 BCM conversion to m^3	4,988,880	m^3	-
1.5 spoil conversion m^3 to tonnes	7,483,320	t	-
Total number of truckloads	299,333	truckloads	25 t truckload capacity has been assumed.
Total km for disposal of spoil (assuming 35 km trip one way)	20,953,296	km	
Diesel fuel use for heavy vehicle truck	0.00056	kL/km of diesel	Assuming the same fuel usage as trucks for the Westgate Tunnel EES.
Total spoil transportation (diesel)	11,734	kL	-
Tunnel calculations – Spoil transportation – EMISSION FACTORS			
Diesel fuel – energy content factor – Scope 1	38.6	GJ/kL	National Greenhouse Accounts Factors July 2018
Diesel fuel – emission factor CO_2 – Scope 1	69.9	kg CO_{2-e}/GJ	National Greenhouse Accounts Factors July 2018
Diesel fuel – emission factor CH_4 – Scope 1	0.1	kg CO_{2-e}/GJ	National Greenhouse Accounts Factors July 2018
Diesel fuel – emission factor N_2O – Scope 1	0.5	kg CO_{2-e}/GJ	National Greenhouse Accounts Factors July 2018
Diesel fuel – emissions factor – Scope 3	3.6	kg CO_{2-e}/GJ	National Greenhouse Accounts Factors July 2018

Data inputs – Construction	Amount	Units	Comments
Tunnel calculations – Spoil transportation – EMISSION FACTORS			
Total Waste Acid Sulfate Soil (WASS) and Rock	2,927,000	m^3	Reference project engineering team
Liming rate	186	kg $CaCO_3/m^3$	A conservative estimate taken from the liming rate calculations from the Melbourne Metro EES, in the absence of a full assessment of the acidity of the soils for the North East Link corridor.
Emissions Factor – Agricultural liming	0.12	t CO_2/t $CaCO_3$	The same emission rate as Melbourne Metro has been used for consistency. This is considered to be a conservative estimate.

Data inputs – Operations	Amount	Units	Comments
Total tunnel operations (MWh)	69,475.56	MWh	Reference project engineering team
Tunnel calculations – Operations – EMISSION FACTORS			
Indirect (Scope 2) emission factor for consumption of purchased electricity from the grid in Victoria	1.07	t $CO_{2\text{-}e}$/ MWh	National Greenhouse Accounts Factors July 2018
Indirect (Scope 3) Emission factor for transmission and distribution losses of purchased electricity from the grid in Victoria	0.1	t $CO_{2\text{-}e}$/ MWh	National Greenhouse Accounts Factors July 2018
Operation centre/FCC			
Floor space	360	m^3	Assumes 12 m x 15 m over two floors
Total electricity consumption	107,514	kWh p.a.	For the greenhouse assessment for the Westgate Tunnel, this was calculated using NABERS Energy for offices reverse calculator v. 11.0 – base building. Based on 3-star (average) electricity allowance for an office building in the city, operating 24/7. Excludes gas, coal, and diesel energy sources. In the absence of any other information we are making the same assumption.

Data outputs – Construction	Amount	Units
Tunnel construction – electricity – TBM		
Scope 2 Greenhouse gas emissions construction – TBM	133226	t CO_{2-e}
Scope 3 Greenhouse gas emissions construction – TBM	12451	t CO_{2-e}
Tunnel construction – electricity – P&E and site offices		
Scope 2 Greenhouse gas emissions construction – P&E	690	t CO_{2-e}
Scope 3 Greenhouse gas emissions construction – P&E	65	t CO_{2-e}
Scope 3 Greenhouse gas emissions from tunnel construction materials delivery to site (full fuel cycle)	7,384	t CO_{2-e}
Tunnel construction – materials		
Concrete 40 MPa	460,060	t CO_{2-e}
Steel	656,000	t CO_{2-e}
Scope 3 Greenhouse gas emissions from total tunnel material required	1,116,060	t CO_{2-e}
Spoil transportation		
Scope 1 Greenhouse gas emissions from spoil transportation	31,931	t CO_{2-e}
Scope 3 Greenhouse gas emissions from spoil transportation	1,631	t CO_{2-e}
Liming treatment		
Scope 3 emissions from production of lime used to treat acid sulfate soils	65,331	t CO_{2-e}

Data outputs – Operation	Amount	Units
Tunnel operations		
Total tunnel power demand	69,476	MWh/yr
Scope 2 Greenhouse gas emissions from tunnel operations	74,339	t CO_{2-e}/yr
Scope 3 Greenhouse gas emissions from tunnel operations	6,948	t CO_{2-e}/yr
Operation Centre		
Total Scope 2 greenhouse gas emissions from operations centre	115	t CO_{2-e}
Total Scope 3 greenhouse gas emissions from operations centre	11	t CO_{2-e}

GHG 4 VLC Zenith economics assessment model

Prepared for

North East Link Project

Transport Modelling for North East Link

Greenhouse Gas Assessment – Zenith Economics Assessment Model

October 2018

Transport Modelling for North East Link

Greenhouse Gas Assessment – Zenith Economics Assessment Model

Project 16-081

Date	Revision	Prepared By	Checked By	Approved By	Description
26/02/2018	A	AA	LS	AA	DRAFT for Comment
20/04/2018	B	LL	AA	AA	Updated Parameters in Section 3.2
24/10/2018	C	AA	AA	AA	updated due to TRG comments

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1 Introduction

This technical note describes the greenhouse gas calculation methodology, which is a subset of the Zenith transport model economic assessment model (EAM). The EAM is used to calculate the economic benefits associated with transportation projects.

1.1 Background

The Zenith EAM is a procedure implemented by Veitch Lister Consulting (VLC) within the OmniTRANS software package, which calculates the input data used in the economic assessment of transportation projects. The Zenith EAM is designed to interface with outputs produced by the Zenith Model.

The output of the Zenith EAM is stored within a specially designed Microsoft Excel spreadsheet, which can house the results of multiple modelled transport scenarios. This spreadsheet will be referred to as the "*Zenith EAM Spreadsheet*".

The scope of the Zenith EAM includes the calculation of:

- user benefits (consumer surplus);
- resource costs (i.e. vehicle operating costs);
- externalities (i.e. vehicle emissions including greenhouse gases and road accidents);
- agglomeration benefits.

The Zenith EAM can be applied to estimate the economic benefits of a wide variety of transportation projects, including:

- new road infrastructure and road upgrades;
- toll roads;
- new public transport infrastructure / services and service upgrades;
- changes in public transport fares, parking prices, etc.

The Zenith EAM can be applied to both "*variable demand*" scenarios, where the modelled trip matrices are predicted to change in response to the particular infrastructure / service improvement (so as to reflect "*induced travel*") and to "*fixed demand*" scenarios (where "*trip matrices*" are assumed to remain constant). In the case of the North East Link (NEL) project, the Zenith EAM was applied to "*variable demand*" scenarios that reflect "*induced travel*". This is discussed in more detail in Section 3.3.

The scope of the Zenith EAM does not extend to estimating the cost of constructing, operating and maintaining new infrastructure / services.

1.2 Report structure

The balance of this document is structured as follows:

- Section 2 describes the overall economic assessment framework
- Section 3 describes the calculation of environmental benefits

2 Summary of economic assessment framework

2.1 Scenarios

The economic benefits of a transportation project are generally calculated by comparing the outputs generated by two modelled scenarios:

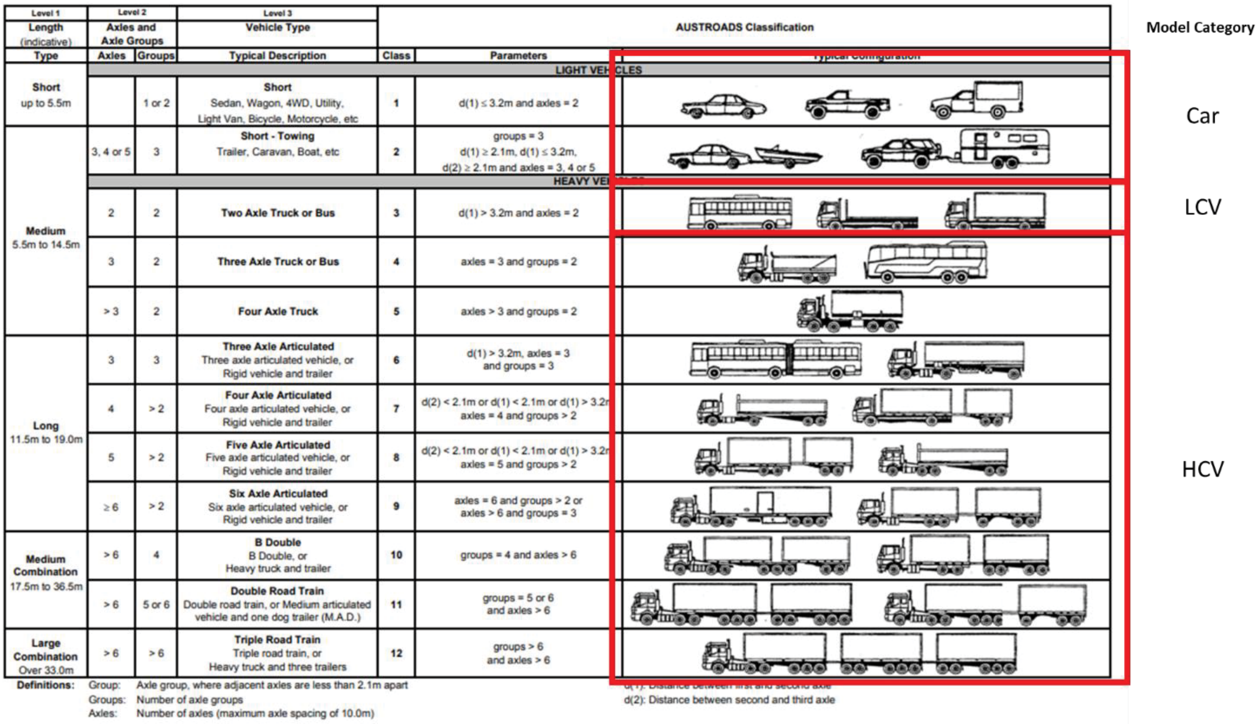
- the "Base case scenario" (sometimes referred to as the "Reference Case Scenario"). This scenario does not include the particular project which is of interest; and
- the "Project Scenario". This scenario does include the project of interest.

Generally, a series of base case and project scenarios are generated for a range of forecast years (2026, 2036 etc.), allowing the benefits of the project scenario to be forecast and appropriately discounted.

2.2 Vehicle classification

The Zenith model separately forecasts car, light commercial vehicle (LCV) and medium/heavy commercial vehicle (HCV) flows. A car is defined as Austroads vehicle classification 1 and 2, while LCV's are defined as classification 3, and HCV's are defined as classifications 4 to 12.

Figure 2.1 - Austroads vehicle classification system and model category



Level 1 Length (indicative) Type	Level 2 Axles and Axle Groups: Axles	Groups	Level 3 Vehicle Type: Typical Description	AUSTROADS Classification: Class	Parameters	Typical Configuration	Model Category
	LIGHT VEHICLES						
Short up to 5.5m		1 or 2	**Short** Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc	1	d(1) ≤ 3.2m and axles = 2		Car
Medium 5.5m to 14.5m	3, 4 or 5	3	**Short - Towing** Trailer, Caravan, Boat, etc	2	groups = 3 d(1) ≥ 2.1m, d(1) ≤ 3.2m, d(2) ≥ 2.1m and axles = 3, 4 or 5		Car
	HEAVY VEHICLES						
	2	2	**Two Axle Truck or Bus**	3	d(1) > 3.2m and axles = 2		LCV
	3	2	**Three Axle Truck or Bus**	4	axles = 3 and groups = 2		HCV
	> 3	2	**Four Axle Truck**	5	axles > 3 and groups = 2		HCV
Long 11.5m to 19.0m	3	3	**Three Axle Articulated** Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axles = 3 and groups = 3		HCV
	4	> 2	**Four Axle Articulated** Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 4 and groups > 2		HCV
	5	> 2	**Five Axle Articulated** Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups > 2		HCV
	≥ 6	> 2	**Six Axle Articulated** Six axle articulated vehicle, or Rigid vehicle and trailer	9	axles = 6 and groups > 2 or axles > 6 and groups = 3		HCV
Medium Combination 17.5m to 36.5m	> 6	4	**B Double** B Double, or Heavy truck and trailer	10	groups = 4 and axles > 6		HCV
	> 6	5 or 6	**Double Road Train** Double road train, or Medium articulated vehicle and one dog trailer (M.A.D.)	11	groups = 5 or 6 and axles > 6		HCV
Large Combination Over 33.0m	> 6	> 6	**Triple Road Train** Triple road train, or Heavy truck and three trailers	12	groups > 6 and axles > 6		HCV

Definitions: Group: Axle group, where adjacent axles are less than 2.1m apart
Groups: Number of axle groups
Axles: Number of axles (maximum axle spacing of 10.0m)

d(2): Distance between second and third axle

Source: Austroads

3 Environmental assessment

The emission of greenhouse (and other) gases cause impacts that are detrimental to both health and the environment. Emissions related to vehicular traffic (cars, light commercial vehicles and heavy commercial vehicles) are captured within the Zenith EAM, in terms of tonnages. These outputs are stored within the “report_Emissions” and “report_TonnesEmissions” tabs of the Zenith EAM Spreadsheet.

The calculation of emissions takes a two step process:

1. Calculate fuel consumption on each road link
2. Convert fuel consumption to emissions in tonnes

Each step is now described.

3.1 Calculating fuel consumption

Austroads (2005) provides the following model of fuel consumption as a function of average link speed:

$$F = A + \frac{B}{V} + C \times V + D \times V^2$$

Where: F is the rate of fuel consumption (L / 100km)

A, B, C, D are model parameters

V is the average link speed (in km / hr)

Different parameter sets (A, B, C, D) are defined for each combination of road type (freeway / non-freeway), and vehicle type (car, light commercial vehicle, heavy commercial vehicle). The parameters, drawn from Austroads (2005) are reproduced in Table 3.1and Table 3.2.

Table 3.1 - Fuel consumption parameter values on freeways

Vehicle Type	A	B	C	D
Cars	7.149	268.1	0.0	0.0003
LCV	11.365	423.0	0.0	0.0005
HCV	26.932	1276.4	0.0	0.0008

Source: Austroads (2005), Table 4.3

Table 3.2 - Fuel consumption parameter values on non-freeways

Vehicle Type	A	B	C	D
Cars	0.361	528.0	0.0	0.000785
LCV	-3.129	1017.0	0.0	0.001481
HCV	-10.495	2915.7	0.0	0.00315

Source: Austroads (2005), Table 4.4

3.2 Calculating emissions in tonnes

3.2.1 Calculating CO_2-e emission rates

Emission rates for equivalent carbon dioxide (CO_2-e) were calculated using emission factors sourced from the Australian National Greenhouse Accounts (Department of the Environment, 2017) as set out in Table 3.3 for petrol and diesel vehicles. The ABS Motor Vehicle Census data from July 2017 was used to estimate the proportion of diesel fuel vehicles of each vehicle type, to calculate a weighted average CO_2-e emission rate accordingly.

Table 3.3 – Emission factors (kg CO2- e/GJ)

Engine Type	Energy Content (GJ/kL)	CO_2 kg CO_2-e/GJ	CH_4 kg CO_2-e/GJ	N_2O kg CO_2-e/GJ
Petrol	34.2	67.4	0.5	1.8
Diesel	38.6	69.9	0.1	0.5

Source: Dept. of the Environment, National Greenhouse Accounts Factors (July 2017), Table 4

Table 3.4 shows the ABS Motor Vehicle Census data, by type of fuel and vehicle from January 2012.

Table 3.4 – Registered vehicles by fuel type across Australia

ABS category	Vehicle Type	Leaded	Unleaded	Diesel	LBG/Dual fuel/Other	Total
Passenger vehicles	Car	234,428	11,951,282	1,613,618	279,278	14,078,606
Camper vans	Car	5,130	15,242	41,456	1,822	63,650
Light commercial vehicles	LCV	69,901	1,056,737	1,845,178	107,774	3,079,590
Light rigid trucks	LCV	2,796	4,492	141,349	1,734	150,371
Heavy rigid trucks	HCV	8,852	3,511	327,487	1,328	341,178
Articulated trucks	HCV	222	818	96,879	189	98,108
Non-freight carrying trucks	Other	1,061	1,641	20,381	392	23,475
Buses	HCV	366	17,039	75,630	3,895	96,930
Motorcycles	Car	42,768	806,204	17	307	849,296
Total		365,524	13,856,966	4,161,995	396,719	18,781,204

Source: ABS Motor Vehicles Census (July 2017), Table 4: Motor Vehicles On Register (a), Type of Fuel , by Type of Vehicle—Census years

The proportion of diesel vehicles by vehicle type, as defined in Table 3.4, can be seen in Table 3.5.

Table 3.5 -Proportion of diesel vehicles by model vehicle category, based on ABS Motor Vehicles On Register data

Vehicle Type	Diesel	TOTAL*	Proportion of Diesel Vehicles
Car	1,655,091	14,991,552	11.04%
LCV	1,986,527	3,229,961	61.50%
HCV	499,996	536,216	93.25%

*Excluding non-freight carrying trucks

As a result, for the calculation of CO_2-e emission rates, it was assumed that 11.04% of cars, 61.50% of light commercial vehicles and 93.25% of heavy commercial vehicles use diesel fuel.

The energy content per engine type was then multiplied by the emission factors for each CO_2-e gas and weighted by the proportion of diesel vehicles by modelled vehicle type. This resulted in the final CO_2-e emission rates as set out in Table 3.6, which lists the rates assumed in grams per litre of fuel used, disaggregated by vehicle type.

Table 3.6 - Emission Rates (grams of emissions / litre of fuel consumed)

Vehicle Type	CO_2-e emitted, g/L
Car	2,421.01
LCV	2,591.35
HCV	2,698.50

Note that this methodology does not make allowance for changes in fuel efficiency or the petrol/diesel fleet mix.

3.3 Induced demand

In response to issues raised in several Victorian Auditor-General's Office (VAGO) reports[1], the State prepared transport modelling and economic appraisal guidelines[2] to oversee the appraisal of major projects, such as the North East Link. Table 3.7 has been modified to highlight the minimum requirements specified by the guidelines (as seen in the blue box) and the components of behavioural response incorporated in the North East Link traffic and transport impact assessment (as seen in the green boxes).

Table 3.7 - Traffic Classification by Behavioural Response

Behavioural Response	Definition	Classification from the perspective of		Description
		Demand associated with the project	**Demand within the entire multi-modal transport system**	
1. No change in behaviour	Fixed matrix, no change in journeys	Base Load or Traffic	Normal Load or Traffic	Guidelines minimum requirements NEL Project
2. Route change	Travellers have same origin and destination and make the same journeys but use the improved route	Re-assigned or Diverted Traffic		
3. Mode change	Passengers switch mode because the improvement makes the new route more attractive			
4. Destination change	Travellers decide to travel to more distant destinations because of the improvement makes the journey time acceptable (redistribution)			
5. Time of travel change	Travellers decide to travel in the commuting peak period because the improvement reduces journey times to an acceptable level	Induced Traffic		NEL Project*
6. Trip frequency increase	Travellers are willing to make additional journeys because of the improvement			
7. Generated or new (e.g. from different land use patterns)	People and businesses relocate to take advantage of the improvement and so make journeys that are new to the area.		Generated Traffic	NEL Project**

* estimated by an adjustment outside the strategic model
** generated by a project-specific land use scenario

The North East Link traffic and transport impact assessment includes six of seven components of behavioural responses, including the minimum requirements specified by the guidelines. Based on VicRoads research[3] on induced demand, the DEDJTR[4] response to VAGO's issues on induced demand and the appraisal guidelines, it has been concluded that the scale of any trip frequency increase that might possibly occur would not lead to an invalid or misleading evaluation of the North East Link.

More details relating to the induced demand in transport modelling can be found in Section 4.5.1 of the North East Link traffic and transport impact assessment.

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[1] *Management of Major Road Projects, June 2011, Managing Traffic Congestion, April 2013, East West Link Project, December 2015*
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