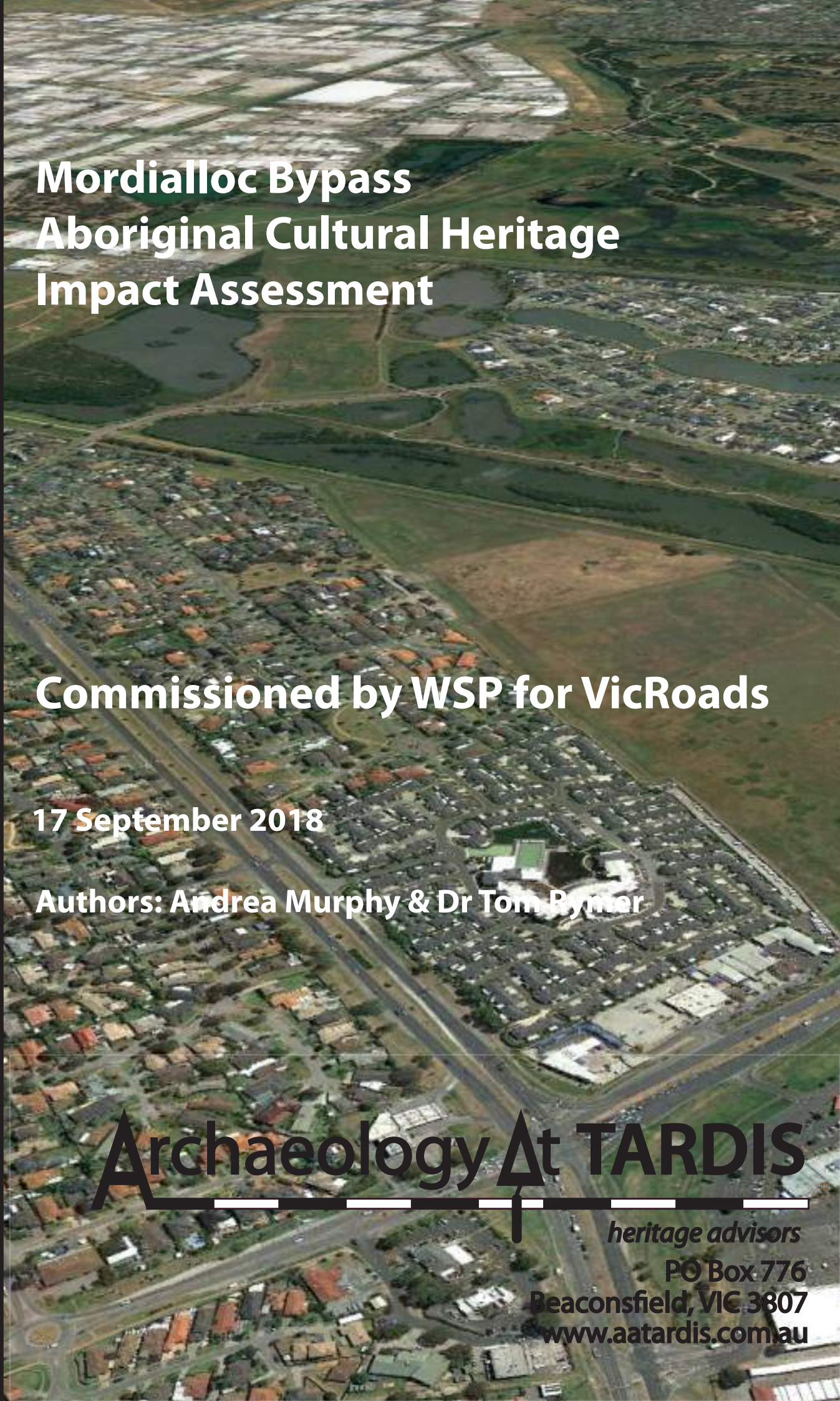
ABORIGINAL CULTURAL HERITAGE IMPACT ASSESSMENT

Mordialloc Bypass
Aboriginal Cultural Heritage Impact Assessment



Commissioned by WSP for VicRoads

17 September 2018

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MORDIALLOC BYPASS

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Commission by	WSP
Sponsor	VicRoads (ABN 61 760 960 480)
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Completed	17 September 2018

DOCUMENT HISTORY			
Version No.	Reviewed By	Edited By	Date
A	Tom Rymer	Tom Rymer	31.01.2018
B	Robert Skelly	Tom Rymer	09.03.2018
C	Tom Rymer	Tom Rymer	26.06.2018
D	Tom Rymer	Tom Rymer	01.08.2018
E	Andrea Murphy	Tom Rymer	17.09.2018

DISTRIBUTION OF COPIES			
Version No.	Distributed To	Reason	Date Issued
A	WSP	Review	31.01.2018
B	WSP	Review	09.03.2018
C	WSP	Review	26.06.2018
D	WSP	Review	01.08.2018
E	WSP	Final	17.09.2018

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Name of Organisation:	Archaeology At Tardis
Name of Project:	Mordialloc Bypass EES
AAT Project Number:	3459.2250

ACKNOWLEDGEMENTS

Archaeology At Tardis Pty Ltd would like to thank the following organisations for their assistance:

BLCAC
BWF
WSP
VicRoads

ABBREVIATIONS

AAT	Archaeology at Tardis Pty Ltd
ACHRIS	Aboriginal Cultural Heritage Register and Information System
ASTT	Australian Small Tool Tradition
AV	Heritage Services Branch, Aboriginal Victoria
BLCAC	Bunurong Land Council Aboriginal Corporation
BP	Years Before Present (1950)
BWF	Boon Wurrung Foundation
CBD	Central Business District
CHMP	Cultural Heritage Management Plan
EES	Environmental Effects Statement
EVC	Ecological Vegetation Classes
GIS	Geographical Information System
HCO	Holocene Climatic Optimum
Ka	Thousand years ago
LDAD	Low Density Artefact Distribution
LGM	Last Glacial Maximum
Ma	Million years ago
MT	Mechanical Trenches
RAP	Registered Aboriginal Party
TO	Traditional Owner
TOG	Traditional Owner Group
TP	Test Pit
WLaCCHCAC	Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation

**Throughout this report several technical terms are used that may not be familiar to some readers. An extensive glossary has been included as Appendix 1 and should be referenced for an explanation of terms.*

EXECUTIVE SUMMARY

This report assesses the potential impacts to Aboriginal cultural heritage associated with the construction of the Mordialloc Bypass. The project is for a divided arterial road comprising two two-lane carriageways, connecting the Dingley Bypass (between Boundary and Tootal Roads) with the northern end of the Mornington Peninsula Freeway at Springvale road. The project is located approximately 21km southeast of the Melbourne CBD.

The Minister for Planning decided 13 September 2017 that an Environment Effects Statement (EES) was required for the Mordialloc Bypass. One reason cited for the decisions was the potential effect of the project on indigenous cultural heritage values within the project alignment.

Prior to the referral of the project, a mandatory Aboriginal cultural heritage management plan (CHMP 15026) was commenced. The assessment was completed by the end of October 2017. It comprised a desktop, standard (ground surface survey) and complex (subsurface testing) assessment. Consultation was conducted with the relevant Traditional Owner Groups (TOs) with an interest in the project area including the Wurundjeri Land and Compensation Cultural Heritage Council Aboriginal Corporation (WLaCCHCAC), the Boon Wurrung Foundation (BWF) and Bunurong Land Council Aboriginal Corporation (BLCAC). They also participated in the assessment. The BLCAC currently have a Registered Aboriginal Party (RAP) application over the project area.

The strategy employed to assess potential impacts to Aboriginal cultural heritage associated with the methods to be used in the construction of the Mordialloc Bypass is twofold. Firstly, discussion of potential impacts is contingent upon a summary of the relevant primary legislation that applies to the project. In addition, a summary of CHMP 15026 which identifies the known Aboriginal cultural heritage values in the study area and associated existing CHMP conditions that relate to the conduct of cultural heritage investigations within the activity area are fundamental to assessing potential impacts.

LEGISLATIONS AND POLICY

Aboriginal cultural heritage is subject to both Commonwealth and State Government legislation. Commonwealth legislation includes the *Native Title Act 1993*, *Aboriginal Torres Strait Islander Heritage Protection Act 1984* and *Environment Protection and Biodiversity Conservation Act 1999*. State Government legislation includes the *Aboriginal Heritage Act 2006*, *Aboriginal Heritage Regulations 2007* and *Traditional Owner Settlement Act 2010*. The assessment of Aboriginal cultural heritage values in the activity area was conducted under the CHMP process required under the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2007*.

EXISTING CONDITIONS

The existing conditions are based on the assessment and results in the Mordialloc Bypass CHMP 15026 (Murphy & Rymer: in preparation). The desktop assessment (Section 4.2) reviewed the relevant geographic region including registered Aboriginal places; reports and published works; history and ethnohistory; landforms and geomorphology, including geology, soils and environment; landuse history and strategic values. The relevant

evidence was used to produce a site prediction model and identify areas of archaeological potential. It was predicted that there was potential for stone artefacts to be present in areas with sand dune, sand sheet and sandy rise landforms in areas least disturbed by European land use and development.

The standard assessment (pedestrian ground surface survey) (Section 4.3) across the activity area found two surface artefacts on sandy landforms south of the Dingley Bypass and at the former Braeside Treatment Plant. These artefacts were subsequently registered as components of Mordialloc Bypass, LDAD1 and LDAD 2. The findings were consistent with the desktop assessment site prediction model, that is, stone artefacts are most likely to be present on sandy landforms. The survey also found that the majority of the study area had been disturbed by European land use. The standard assessment concluded that the deflated dune at the former Braeside Treatment Plant had the highest archaeological potential for subsurface stone artefacts because it was the least disturbed sandy landform. Disturbed sandy landforms and the plain were considered to have low archaeological potential. A complex assessment was conducted to test the predictions of the standard assessment.

The complex assessment (subsurface testing) (Section 4.4) methodology was agreed to after consultation with AV and traditional owner groups. The testing methodology comprised a combination of test pits (TPs) and mechanical trenches (MTs) in the sand dune / sand sheet, plain and floodplain landforms. TPs were 1mx1m in size. MTs were typically 5mx1m in size. The total area of excavation on the different landforms was: dune / sand sheet 30m^2, floodplain 58m^2 and plain 31m^2. Stone artefacts were found in 4m^2 or approximately 13% of the excavations in the dune / sand sheet landform. The lack of artefacts found on the plain and floodplain was consistent with nearby CHMPs. The presence of artefacts on dunes is consistent with the landform context for artefact scatters and LDADs in the geographic region.

Aboriginal cultural heritage found during the assessment comprised a total of 8 stone artefacts (Section 4.5). Stone artefacts were found at two locations (Map 3):

- Mordialloc Bypass, LDAD 1. One quartzite flake was found on the surface south of the Dingley Bypass on a disturbed sand sheet. It is considered unlikely that additional stone artefacts are present. The site was assessed as having high cultural and low scientific significance.

- Mordialloc Bypass, LDAD 2. One surface quartz and six subsurface silcrete artefacts were found on the deflated dune at the former Braeside Treatment Plant. Subsurface artefacts were found in the light grey to grey sand A-horizon between 35cm and 80cm depth on the crest and upper slope of the dune. The B-horizon clays were found at a depth ranging from 50cm to 142cm. Substantial disturbance has occurred to the dune from the construction and decommissioning of the treatment plant. Disturbed soils and fill were found to a maximum depth of 79cm. It is considered likely that additional small numbers of subsurface artefacts are present. The place was assessed as having high cultural and low scientific significance.

The activity area contained evidence of Aboriginal occupation during the Late Holocene which is representative of the geographic region. The stone artefacts show that Aboriginal

groups were likely producing microliths to rearm spears for hunting. The sand dune at the former Braeside Treatment Plant was the preferred location being elevated and dry with views over the surrounding floodplain. Raw materials were brought into the activity area, with silcrete the preferred material for making stone tools. The activity area was not as important as other parts of geographic region, with larger, denser stone artefact scatters found elsewhere along the margins of Carrum Swamp. The assessment confirmed that sand dunes were more sensitive for stone artefacts compared to the plain or floodplain.

RISK ASSESSMENT

The key finding of the risk assessment identified a medium residual risk if the approved CHMP does not cover the entire project area resulting in non-compliance. The residual risk it mitigated by conducting an amendment to the approved CHMP.

IMPACT ASSESSMENT

Avoidance, Minimization, Management of Harm and Contingency Plan

Roadways in linear project areas have limited ability to avoid harm to stone artefacts on the ground surface or in surficial deposits when clear, level and grade construction methods are employed. Options to avoid harm can include changes in the alignment of the roadway, changing the angles of batters, fly-overs or fill over artefact bearing deposits. These options may not be feasible when other project constraints are taken into account.

The stone artefacts found during this investigation in both raw material and primary form are representative of those found in the region. No archaeological features such as occupation floors or high integrity occupation features such as hearths were found. No subsurface artefacts were found at LDAD 1 and due to the highly disturbed nature of the area, it is considered unlikely that there are any additional stone artefacts in the area. For these reasons, LDAD 1 is considered to have no research potential. It is considered likely that there are additional small numbers of subsurface stone artefacts on the dune associated with LDAD 2. For these reasons, LDAD 2 is considered to have low research potential. It is considered unlikely that management of LDAD 1 or LDAD 2 by archaeological salvage will make a substantial scientific contribution to knowledge of the activity area or geographic region.

During construction of the Mordialloc Bypass any unexpected Aboriginal cultural heritage can be managed by the Contingency Plan in the approved CHMP.

Cumulative Impact

The activity has both a positive and negative cumulative impact on the Aboriginal cultural heritage values of the activity area and region. This investigation has contributed additional archaeological data on the nature of the Aboriginal occupation in the geographic region and confirmed that the plain and floodplain have low archaeological potential and sand dunes have higher archaeological potential for stone artefacts. Although the activity may harm cultural heritage in the activity area, the scientific values are limited and not of the same order than that found elsewhere the geographic region where larger, denser stone

artefact scatters are found. The overall negative cumulative impact on the activity area and regional archaeological values is considered to be low.

ENVIRONMENTAL PERFORMANCE REQUIREMENTS

The minimum environmental requirement for the project is to comply with and implement CHMP 15026 which must be approved before construction commences.

CONCLUSION

This report has documented the known Aboriginal cultural heritage values in the activity area for the proposed Mordialloc Bypass. The known values comprise two low density artefact distributions, LDAD 1 and LDAD 2, that were discovered during the assessment for CHMP 15026 commissioned for the Mordialloc Bypass project. It is unlikely that there are large numbers of additional stone artefacts in the activity area which will be impacted by the project. All Aboriginal cultural heritage can be managed appropriately within the framework of CHMP 15026. The approved CHMP will provide compliance management measures (conditions) and a contingency plan which must be followed during the construction of the project.Based on the findings of this report the risk to scientifically significant Aboriginal cultural heritage is considered to be low.

1 INTRODUCTION

1.1 Project Description

The Mordialloc Bypass project (the project) is the proposed construction of a new freeway connecting the Dingley Bypass with the Mornington Peninsula Freeway; and is predominately to be constructed within an existing road reservation. The project passes between the western boundary of Braeside Park and the eastern boundary of the Woodlands Estate (constructed) wetlands, traverses constructed wetlands at Waterways and approaches to within one kilometre of the Ramsar-listed Edithvale-Seaford Wetlands. The northern and southern ends of the project pass through or border the South East Green Wedge.

The project corridor is approximately 9.7 kilometres in length, comprising two, two-lane 7.5 kilometre long carriageways (with a path for walking and cycling) along the greenfield alignment, and 2.2 kilometres of roadworks required to integrate the project with the Mornington Peninsula Freeway. It is expected that each carriageway will provide for two 3.5 metre wide lanes, with a 3.0 metre wide outside shoulder and 1.0 metre wide inside shoulder. The Mordialloc Bypass will also provide connections from the freeway onto the Dingley Bypass, Centre Dandenong Road, Lower Dandenong Road, Governor Road, Springvale Road and new north facing ramps at Thames Promenade. There will also be an overpass at Old Dandenong Road. Mordialloc Creek and the associated Waterways Wetlands will be spanned by twin 400 metre long bridges.

The proposed alignment allows for a future upgrade of the project to a six-lane freeway standard road within the construction footprint.

The proposed alignment is generally located within the existing road reservation, most of which is already covered by Public Acquisition Overlay, and some of which is already in VicRoads' ownership.

The proposed project consists of:

- Four- lane freeway standard cross-section (two lanes in each direction), divided by a centre median
- 100 km/hr posted speed limit
- Full diamond interchanges at Springvale Road, Governor Road and Lower Dandenong Road whereby Mordialloc Bypass is elevated over the arterial roadway with northbound and southbound entry and exit ramps providing access for all directions of travel.
- Half single point urban interchange at Centre Dandenong Road whereby Mordialloc Bypass is elevated over Centre Dandenong Road and southbound entry and northbound exit ramps provide accessibility to and from the south.
- Addition of northbound entry and southbound exit ramps at the existing Mornington Peninsula Freeway interchange at Thames Promenade to provide access to and from Mordialloc Bypass. The existing interchange provides ramps to and from Mornington Peninsula Freeway to the south only. The proposed entry and exit ramps will create a full diamond interchange at Thames Promenade.
- An at-grade T-signalised intersection at Dingley Bypass.

- Elevation of the bypass over Old Dandenong Road and Bowen Parkway to maintain existing connectivity on these routes.
- Shared use path running north-south along the length of the Mordialloc Bypass and connecting existing paths along the north side of Dingley Bypass and the south side of Springvale Road adjacent to Chelsea Heights Hotel.
- Bus queue jump lanes provided in intersection configurations at the proposed Springvale Road and Centre Dandenong Road interchanges.

1.2 Reasons for Preparing this Aboriginal Cultural Heritage Impact Assessment

The purpose of this report is to identify the Aboriginal cultural heritage values in the activity area and to identify the potential risk to Aboriginal cultural heritage associated with the construction of the Mordialloc Bypass. The results of the assessment provide the information for the risk assessment process in order to meet the EES assessment requirements. The Minister for Planning decided 13 September 2017 that an Environmental Effects Statement (EES) was required for the Mordialloc Bypass. Prior to the referral of the project, a mandatory Aboriginal cultural heritage management plan (CHMP 15026) had been commenced.

1.3 Activity Area

The activity area is a linear project between the Dingley Bypass and the Mornington Peninsula Freeway and is approximately 21km southeast of the Melbourne CBD. The alignment of the activity area crosses Old Dandenong Road, Centre Dandenong Road, Lower Dandenong Road, Governor Road and Springvale Road (Maps 1 & 2).

The following features are found in the activity area:

- Sand dunes and sand sheets in the north;
- The low-lying plain of the former Carrum Swamp in the south.
- Various major roads including Dingley Bypass, Old Dandenong Road, Centre Dandenong Road, Lower Dandenong Road, Governor Road, Springvale Road and the Mornington Peninsula Freeway;
- Market gardens;
- Light industrial areas including warehouses and car parks;
- Informal and formal dirt tracks with levelled areas and introduced fill;
- Various dams;
- Indigenous and exotic trees; and
- Artificial wetlands along Mordialloc Creek.

Topographic map used for Location Plan: 1:30,000 Number T7921-4-1-4 , 7921-4-4-1 & 7922-3-3-2

Legend:

Activity Area Boundary
157 hectares (approx)

Parish: *Mordialloc, Lyndhurst*
LGA: *Kingston, Greater Dandenong*

0 500 1000
Scale of Metres

N

GDA
Zone 55

Map 1 Activity Area Location (Topographic)

Aerial Photograph: Courtesy of DSE Website 2017

0 500 1000
Scale of Metres

Legend:

Activity Area Boundary
157 hectares (approx)

Parish: *Mordialloc, Lyndhurst*
LGA: *Kingston, Greater Dandenong*

N

GDA
Zone 55

Map 2 Activity Area (Aerial)

2 LEGISLATION AND POLICY

2.1 Commonwealth Government

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* established the National Heritage List and Commonwealth Heritage List. The National Heritage list includes natural, Indigenous and historic places of outstanding heritage value to the nation. The Act establishes penalties for an action that has or will make a significant impact to indigenous heritage values of a place on the National Heritage List. The Commonwealth Heritage List includes places on Commonwealth lands and waters or under Australian Government control that have Indigenous heritage significance.

2.1.2 Native Title Act 1993

With the introduction of the *Native Title Act 1993*, the acknowledgement of Indigenous ownership of land was legislated, and since then native title claims on un-alienated Crown Land have been lodged initially with the National Native Title Tribunal, and more recently to the Federal Court. Under this Act, all freehold and Crown Lease land is exempted from any future claim (unless leasehold reverts to the Crown). Un-alienated Crown Land that potentially may be subject to claim includes all forms of water (to the low water mark) air above and subsoil below, and all land in which native title has not been extinguished under the Act. Establishing native title within any area requires many conditions to be met. Essentially, claimants must be able to show that the area claimed has been continually occupied or in which direct links (physical, spiritual, traditional) have been maintained.

2.1.3 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* can protect areas and objects that are of particular significant to Aboriginal people. An Aboriginal person or group or persons can apply to the Environment Minister to consider a declaration to protect an area, object or class of objects from threat of injury or desecration.

2.2 State Government

2.2.1 Aboriginal Heritage Act 2006 and Aboriginal Heritage Regulations 2007

The primary purpose of the *Aboriginal Heritage Act 2006* is to protect Aboriginal cultural heritage in Victoria. The Act established organisations to preserve, enforce and manage Aboriginal heritage including the Victorian Aboriginal Heritage Council to provide advise the Minister for Aboriginal Affairs in regards to the management of cultural heritage and Registered Aboriginal Parties for Aboriginal groups with ties to country to be involved in decision making processes for the management of cultural heritage.

The *Aboriginal Heritage Regulations 2007* gives effect to the Act and prescribes standards, sets conditions for when a Cultural Heritage Management Plan should be prepared and sets fees and charges.

2.2.2 Traditional Owner Settlement Act 2010

The *Traditional Owner Settlement Act 2010* allows for out-of-court settlement of native title. The Victorian Government can recognise traditional owners and certain rights in Crown land. When traditional owners enter into a settlement, they must agree to withdraw any native title claim under the Commonwealth Native Title Act 1993 and agree not to make any future native title claims. The settlement can include a Recognition and Settlement Agreement, a Land Agreement, a Land Use Activity Agreement, a Funding Agreement or a Natural Resource Agreement. The traditional owner must meet the definition of 'traditional owner' under the Act before an agreement can be entered into.

Table 1 Legislative Instruments and Project Implications

Legislation	Project Implications
Native Title Act 1993	A Traditional Owner Group (TOG) can lodge a claim for Native Title Rights over land or sea anywhere in Australia at any time. A Native Title Right could be for instance; the right to fish, or to hunt, or to camp in an area. The land (or sea) in question must be unalienated Crown Land. To lodge a successful claim, the TOG is required to legally prove that the right in question has been exercised at the subject location continuously by Aboriginal people from 1770 to the present-day.
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	Application can be made to the Environment Minister for the protection of highly significant Aboriginal heritage if it were found in the activity area.
Environment Protection and Biodiversity Conservation Act 1999	Includes protections from Indigenous and Historic places that may be found in the activity area.
Aboriginal Heritage Act 2006	All Aboriginal Heritage is protected under the Act and Aboriginal Heritage found in the activity area must be managed under conditions specified in a compliant CHMP.
Traditional Owner Settlement Act 2010	Allows Native Title claimants to surrender Native Title Rights available under the *Native Title Act 1993* in exchange for a funding agreement.

3 METHODOLOGY

CHMP 15026, which is currently in preparation for the project, identified the known Aboriginal cultural heritage values and the existing conditions as a result of a comprehensive cultural heritage investigation of the activity area comprising a desktop, standard (pedestrian ground surface survey) and complex (subsurface excavation) assessment. The methodology for the assessment is briefly presented below.

3.1 Desktop Assessment

The purpose of a desktop assessment is to review information in a relevant geographic region including registered Aboriginal places and reports on the Victorian Aboriginal Heritage Register; history and ethnohistory; landforms and geomorphology, including geology, soils and environment; landuse history and strategic values in order to formulate

a site prediction model and identify areas of archaeological potential to inform the subsequent fieldwork. The relevant geographic region in the assessment was defined as land within two kilometres of the activity area.

3.2 Standard Assessment (Ground Surface Survey)

The purpose of the standard assessment is to assess ground surfaces within the activity area and test the site prediction model formulated during the desktop assessment. A standard assessment (ground surface survey) was conducted over two days, 20 and 21 July 2017 by AAT and representatives from traditional owner groups including WLaCCHCAC, BWF and BLCAC. The activity area was divided into five survey areas based on the existing road network and was subject to a systematic pedestrian ground survey (Table 1).

Table 2 Survey Areas

Survey Area	Description
Survey Area 1	Dingley Bypass to Centre Dandenong Road
Survey Area 2	Centre Dandenong Road to Lower Dandenong Road
Survey Area 3	Lower Dandenong Road to Governor Road
Survey Area 4	Governor Road to Springvale Road
Survey Area 5	Mornington Peninsula Freeway

3.3 Complex Assessment (Subsurface Excavation)

The purpose of the complex assessment is to investigate areas with archaeological potential identified during the standard assessment by conducting subsurface excavation. The subsurface testing methodology was agreed to after consultation with Aboriginal Victoria (AV) and traditional owner groups. The testing methodology comprised a combination of test pits (TPs) and mechanical trenches (MTs) in the sand dune / sand sheet, plain and floodplain landforms. TPs were 1mx1m in size. MTs were typically 5mx1m in size.

4 EXISTING CONDITIONS

4.1 Stakeholder Consultation

Traditional Owner Consultation

In relation to the activity area, there was no Registered Aboriginal Party provided for under the *Aboriginal Heritage Act 2006*; therefore, traditional owners considered to have an interest in the activity area were consulted and participated in the fieldwork assessment including the following:

- the Wurundjeri Tribe Land and Compensation Cultural Heritage Council Aboriginal Corporation (WLaCCHCAC);
- the Boon Wurrung Foundation (BWF); and

- the Bunurong Land Council Aboriginal Corporation (BLCAC).

The BLCAC currently have a RAP application over the project area.

4.2 Desktop Assessment Results

4.2.1 ACHRIS Search

The Aboriginal Cultural Heritage Register and Information System (ACHRIS) was consulted to identify registered cultural heritage values that are present or may be found within and in close proximity to the activity area, and to access details of previous cultural heritage investigations that are relevant to the activity area (Map 3).

4.2.2 Registered Aboriginal Places

A total of 66 Aboriginal places were recorded within the geographic region. The majority of Aboriginal places were scarred trees (51%), stone artefact scatters and low density artefact distributions (LDADs) (40%) followed by earth features (3%), shell middens (3%) and Aboriginal historical places (3%). There are no previously registered Aboriginal places within the activity area.

Scarred trees comprise predominantly Red Gums (n=30) with only four recorded on unknown eucalypt species. The majority of trees were either dead or in poor condition. All the scarred trees were recorded on the floodplain or plain. No mortuary trees or birthing trees have been recorded.

The regional assemblage is dominated by flakes (76%) followed by angular fragments (17%), cores (3%), tools (3%) and other artefact types (1%). The presence of microliths is indicative of the Australian Small Tool Tradition (ASTT) and date the assemblage to the Late Holocene (<5,000 years BP). Raw material is dominated by quartz (39%) and silcrete (38%) followed by quartzite (13%), chert (5%), crystal quartz (3%) and other (2%) minor types. The latter includes basalt, volcanic and hornfels. Assessments show that artefacts can be found up to 110cm below the ground surface. The majority of subsurface artefacts are found between 60cm and 80cm in depth.

The hydrological sources have been drastically modified by the draining of Carrum Swamp and associated floodplains, and the channelisation of creeks. The data suggests that Aboriginal cultural heritage is more strongly related to the presence of sensitive landforms associated with the pre-European hydrological regime rather than the location of existing waterways. The majority of artefact scatters and LDADs are recorded on dunes (61.5%), followed by low-lying plains (19%), hills (11.5%), and floodplain (4%). The landform of one Aboriginal place was not recorded.

Two soil deposits contained stone artefacts. It is not clear if stone artefacts were associated with hearths or archaeological layers.

There are two recorded shell middens and a shell midden component. Shellfish species include mussel (*Mytilus*), oyster (*Anadara*), elephant slug (*Scutus*), sea snail (*Austrocochlea*), mud oyster (*Ostrea*) and Pipi (*Donax*). They are all located within 700m of Port Phillip. Shell middens are not expected to be found within the activity area. One shell

midden is associated with the last recorded camping site of Jimmy and Eliza and Nancy Dunbar. Aboriginal historical place, Mordialloc Aboriginal Reserve, was a camping reserve for Aboriginal people established in the early 1840s.

4.2.3 Reports and Published Works

Regional Investigations

du Cros and Rhodes (1998) conducted a study of the Aboriginal archaeological sensitivities of the waterways and floodplains of Greater Melbourne which included the activity area within its broader boundaries. This study was desktop based and no ground surface survey was undertaken. The main objective of the study was to 'produce a GIS database with waterways and floodplains graded into different levels of sensitivity and an associated set of recommendations regarding further work and management of the Aboriginal archaeological heritage' (p. 1). The authors suggest that the database will not be a definitive guide as much of the study area has not been surveyed and information regarding previous modification and disturbance to waterways and floodplains is not complete (p. 5). However, areas of archaeological sensitivity were formulated from the background research undertaken during the study and two formulas were suggested; one classifying five main categories and three sub-categories; and the other with just five categories.

du Cros and Rhodes (1998) recommended that a full survey and historic research of land use activities of all sensitive (or potentially sensitive) waterways and floodplains be undertaken to accompany their database. They also recommended consultation with relevant Aboriginal communities prior to any works.

Presland (1983) undertook the first study of the Melbourne Metropolitan Area, which included the current activity area and recorded numerous scarred tree sites. The Cranbourne Sands geological unit, particularly around Braeside and Clayton was identified as having high Aboriginal archaeological potential for surface and sub-surface lithic sites.

Sullivan (1981) undertook a survey of Port Phillip Bay (south of Mt Eliza) and Bass Straight coastline. A total of 289 new sites were recorded during her study with nearly 90% of those sites identified within 100m of the shoreline. Sullivan (1981) considered that the proportionally low number of inland sites recorded during the survey was due to low ground surface visibility rather than an accurate indication of site distribution. The majority of sites recorded were middens and surface scatter sites. The dominant shellfish species exploited at midden sites were *Subninella undulate* and *Cellana tramoerica*, both rock platform species. The dominant stone materials utilised within these sites were Tertiary silcrete, Palaeozoic chert and Marine chert (Sullivan 1981: 82). The survey did not include the Mordialloc Bypass activity area.

Rhodes (2001) undertook an Aboriginal heritage study of the Greater City of Dandenong. This study reviewed all ethnographic and archaeological investigations that had been undertaken within the City's boundaries. Rhodes also included a short period of ground survey and recorded one scarred tree and one isolated artefact. The results of this research were used to construct a predictive model for Aboriginal archaeological sites. Areas of greatest potential are considered to be undeveloped areas containing numbers of pre-contact Red Gums as well as undisturbed elevated ground.

Small Scale Investigations and Cultural Heritage Management Plans (CHMPs)

Numerous small scale investigations are listed on ACHRIS. Only those adjacent to or within the activity area are discussed in detail in the relevant section below. At least 18% of the geographic region has been subject to archaeological survey (Figure 1).

Numerous CHMPs have been prepared within the geographic region (Barker & Young 2016; Burch 2015ab, 2016, 2017; Dugay-Grist et al 2012abc; Dugay-Grist & Maher 2011; Dugay & Wisniowiecka 2016ab; Green 2013; Hill 2015; Hislop 2017; Jones & Albrecht 2016; Kennedy et al 2012; Kennedy & Crocker 2013; Lever 2016; Long 2010; Matic 2013, 2014, 2016; Matic & Falvey 2012; Matic et al 2013; McAllister & Dugay-Grist 2012; Myers et al 2016; Murphy & Dugay-Grist 2008; Murphy & Thomson 2012, 2013, 2015; Schultz & Donati 2011; Nicholson et al 2008; Mitchell 2014; Nichols 2014; O'Reilly & Dugay-Grist 2012; Prideaux & Jakovljevic 2009; Shiner et al 2015; Wines 2014;). CHMPs adjacent to or within the activity area are discussed in detail in the relevant section below. CHMPs have the following characteristics:

- Thirty-two CHMPs have conducted complex assessments;
- Complex assessments have excavated approximately 315m^2 and approximately 38 m^2 (12%) has contained Aboriginal cultural heritage;
- No CHMPs have conducted radiometric dating (this is typically done during salvage); and
- Areas of archaeological potential typically identified include Mordialloc Creek, the Port Phillip foreshore, the boundaries of former Carrum Swamp, sand dunes, sandy rises and sand sheets.

Activity Area Specific Investigations

Surveys

Webb (1995) conducted a survey for the Keysborough Local Structure Plan. It intersects the east boundary of the current activity area along Springvale Road. During the survey 22 scarred trees and six isolated stone artefacts were recorded. Areas of archaeological potential were not discussed.

Marshall (1996) conducted an Aboriginal archaeological survey of Braeside Park. It intersects the central alignment from Lower Dandenong Road to Governor Road (Braeside Park). During the survey six scarred trees were recorded. Areas of archaeological potential included the northern shores of former Carrum Swamp and areas containing mature remnant Red Gums.

Marshall (1998) conducted an Aboriginal archaeological survey of Kingston Lodge. It intersects the activity area along Governor Road and the alignment south of Governor Road. During the survey no new Aboriginal places were recorded. No areas of archaeological potential were recorded within the former Carrum Swamp.

Figure 1 Archaeological Survey in the Geographic Region

Murphy and Dugay-Grist (2007) conducted a cultural heritage assessment for the road works at Lower Dandenong Road, Dingley Village. It intersects the current activity area along Lower Dandenong Road. During the survey no new Aboriginal places were recorded. The study area comprised low-lying swampy land which was assessed as having no archaeological potential.

Cultural Heritage Management Plans

Murphy and Thomson (2015) prepared CHMP 13226 for a subdivision at Lot 1, 2, 3 TP49429 and Lot A PS605114 on Springvale Road, Aspendale Gardens. It intersects the current activity area north of Springvale Road. The desktop determined there were no previous Aboriginal places within the activity area; however, an area of cultural heritage sensitivity was identified, being the former Carrum Swamp. It was concluded that due to previous ground disturbance there was a low potential for Aboriginal places to be present. No new Aboriginal places were recorded during the standard and complex assessments. The complex assessment exposed clayey A horizon deposits across the activity area indicative of a permanently inundated swamp. Some of the complex assessment was conducted within the Mordialloc Bypass activity area.

McAllister and Dugay-Grist (2012) prepared CHMP 11562 for the Dingley Bypass. It intersects the northern boundary of the current activity area. The desktop assessment identified two previously registered Aboriginal places within the activity area and areas of archaeological potential in relatively undisturbed sandy deposits below ploughed market gardens, in particular, on sand dunes and sandy rises in close proximity to fresh water sources. Low-lying swamp areas were considered to have low archaeological potential. The standard assessment identified one new Aboriginal place comprising an isolated silcrete artefact located on Old Dandenong Road surrounded by mounds of earth and gravel. The complex assessment did not find any new Aboriginal places but did confirm the disturbed nature of the site. Some of the complex assessment was conducted within the Mordialloc Bypass activity area.

As part of the same project, Wines (2014) prepared CHMP 13198 for additional small areas of the Dingley Bypass. The plan intersects the northern boundary of the current activity area. The desktop assessment determined there were no previously registered Aboriginal places within the activity area but did identify areas of archaeological potential including sandy rises and sand dunes in close proximity to fresh water sources. The low-lying swampy areas were not considered to be areas of archaeological potential. The standard assessment did not find any Aboriginal places or areas of archaeological potential; therefore, a complex assessment was not conducted. Part of the standard assessment included the Mordialloc Bypass activity area.

Kennedy and Crocker (2013) prepared CHMP 12053 for drainage works along Perry Road and Mordialloc Main Drain in Keysborough. It abuts the current activity area east of Springvale Road. The desktop assessment identified sandy rises and sand dune crests as areas of archaeological potential. Former wetlands and waterlogged areas were considered to have low archaeological potential. However, the authors cited previous studies which identified sand dune deposits below swampy gleys, and were considered to have archaeological potential depending on their formation history and age. During the standard assessment no Aboriginal places or areas of archaeological potential were recorded. A complex assessed was undertaken to confirm the nature of soils and absence

of Aboriginal places. No complex assessment was conducted along the drain east of Springvale Road because it was all significantly disturbed. No new Aboriginal places were recorded during the complex assessment and no buried dune deposits were identified.

Green (2013) prepared CHMP 12851 for a nursery development on Springvale Road in Aspendale Gardens. It abuts the current activity area north of Springvale Road. The desktop assessment determined there are no Aboriginal places within the activity area. Sand dunes and sandy rises associated with Carrum Swamp were identified as areas of archaeological potential. Swampy low-lying landforms associated with peaty clays were assessed as unlikely to contain Aboriginal cultural heritage. The standard assessment found that the entire activity area comprised a low-lying plain. The complex assessment found no Aboriginal places and confirmed the entire activity area was comprised of swamp and lagoonal deposits from the former Carrum Swamp.

Summary

The review of reports shows that sandy rises, dunes and sand sheets have the highest sensitivity for stone artefact scatters; however, development in the region has caused extensive disturbance which has resulted in reduced potential for stone artefact scatters to remain. Complex assessments on the plain and floodplain confirm these landforms have low archaeological potential.

4.2.4 Historical and Ethno-Historical Accounts

The information used to construct pre-contact Aboriginal people's spatial organisation is predominantly based on observations made by Europeans during the initial period of contact and subsequent settlement of the activity area. Most of these observations were made after 1830, by which time some groups of Aboriginal people had experienced over 30 years of contact with the sealers and whalers who frequented coastal regions. Early historical accounts of Aboriginal land use within and surrounding the activity area are scant.

In 1904 AW Howitt recorded details about Aboriginal people's language, traditions and customs by conducting interviews with Aboriginal people in Melbourne. Howitt described the cultural block of Aboriginal people in the Melbourne region as the Kulin nation. The five language groups belonging to the Kulin nation included *Woi wurrung, Taungurong, Jajowrong, Bunurong* and *Wathaurung* (cited in Presland 1994: 36-37).

The activity area is situated in the traditional lands of the *Bunurong* tribe (also spelled Bun Wurrung and Boon Wurrung) (Figure 7). The *Bunurong* territory is thought to have extended north from the coast at Westernport Bay to the Dandenong Ranges (Thomas in Gaughwin & Sullivan 1984:86). The boundary was defined by Dandenong Ranges source streams in the north, the Werribee River in the west, and the Tarwin River in the east (Gaughwin & Sullivan 1984: 87).

More specifically, the activity area is located within the *Nguruk william* and *Mayune Ballug* clan areas. The *Nguruk william* clan area included Brighton, Mordialloc, Dandenong and the area between Mounts Eliza and Martha (Clark 1990: 367). The *Mayune Ballug* clan area included the Carrum Swamp, the coastal strip at head of Western Port bay and the upper portion of Mornington Peninsula at Mordialloc. The *Nguruk William* and *Mayune*

Ballug were of the *Bunjil* (eaglehawk) moity and followed a patrilineal descent system (Clark 1990: 368). Intermarriage and exchange of goods between the *Kulin* tribes were common. The *Bunurong* had ceremonial links with, and most often married member of the *Taungurong* and *Wathaurung* tribes (Thomas ML 1: 23 March 1839). In these tribes the hunting was mainly done by men, with plant foods and small animals collected by women.

Bunurong likely came into contact with Europeans during explorations of the Port Phillip Bay and Bass Straight coastal areas. From the late 1790s sealers and whalers who frequented Bass Straight resulted in Aboriginal people being taken and used as labourers and concubines, which often resulted in hostile confrontations. Aboriginal populations were severely affected as a result of early contact with Europeans, such as loss of traditional lands and resources, disease and displacement. This led to the drastic decimation of the *Bunurong* population.

There are few descriptions of coastal Aboriginal peoples. George Gordon McCrae observed *Bunurong* people at Arthur's Seat during the period of early European settlement (GG McCrae in Gunson 1974: 4):

> There covering was the possum rug, the squares of skin on the inner surface being scored in various patterns, afterwards rubbed in with a red earth or ochre to give a better effect. They wore, also forehead bands, or fillets, of netted fibre, often coloured with red ochre. In the front of this, over the forehead, they struck ornamental feathers, and sometimes over one ear a short tobacco pipe.

Assistant Aboriginal Protector Thomas and early settlers in the Westernport region recorded that the seasonal movements and exploitation of territory by *Bunurong* occurred in circular patterns from Melbourne and the Mornington Peninsula via the geographic region (Gaughwin 1981: 75). During these travels Thomas notes that 'Blacks seldom travelled more than 8 or 9 miles per day (Thomas PRO Letter 3 July 1840). Thomas also notes the Aboriginal name for present day suburb 'Mordialloc' (located approximately 2.5 km southeast of the current activity area) as *Moody Yallock*, which was on the pathway to Arthurs Seat. Gunson (1974:10) reports that clan members usually camped by waterholes, creeks, rivers and popular coastal locations. Extensive middens were found inland and adjacent to the coast indicating intensive exploitation of shellfish in the Bay. During the winter months the *Bunurong* reportedly spent time between Port Phillip and Westernport Bays and moved into the Dandenong region during the summer. It must be noted that ethno-historical information on seasonal movements made during this time, apart from reflecting an already disrupted population, would also be dependent on the seasonal exploitation of resources.

In 1839 the Aboriginal protectorate scheme which was designed to indoctrinate Aboriginal peoples into western culture led to the establishment of Aboriginal reserves and stations across Victoria. In 1841 one of these stations was established in Mordialloc (approximately 1.2 km west of the current activity area). The Aboriginal camping place was situated between Mordialloc Creek and the Blind Creek, in an area known as 'Happy Valley' (now Attenborough Park and the beach opposite). The creek, swamp and coastal environment provided the richest resource base in the local area. The camping ground was kept open until 1878.

4.2.5 Geology and Geomorphology in the Activity Area

Geology

Geological unit: Inland dune deposits (Qd1)
Age: Quaternary: Pleistocene - Holocene (2.6-0.001 Ma BP)

Northern parts of the activity area are commonly underlain by Quaternary-age sand dunes that have formed on an earlier Miocene – Pliocene (23–5.5 Ma) Red Bluff Sandstone surface (Figure 2) (Welch et al 2011). The dunes are largely comprised of medium- to fine-grained aeolian siliceous sands deposited as northwest-southeast trending dunes. These dunes were deposited intermittently throughout the Late Quaternary, during periods of lower sea level and lower hydrological cycles, where aeolian processes had a greater impact on the landscape (Cupper et al 2003; Welch et al 2011). The inland dune deposits are likely equivalent to the Cranbourne Sands to the northeast, which were formed largely from sand being eroded and reworked during the dry and windy conditions of the Last Glacial Maximum (LGM) ~20,000ka BP (Cupper et al 2003). A strongly acidic soil profile has developed on the dunes, and features a dark grey sandy A1 horizon and light grey or white bleached A2 sand horizon, underlain by one or more indurated sand B horizons (Figure 3) (Northcote et al 1975; Conacher & Stanley 2000; Joyce et al 2003; McKenzie et al 2004). Depending on the depth of the sand within the dune, the indurated sand horizon can be underlain by more sand or by clay.

Geological unit: Swamp and lake deposits (Qm1)
Age: Quaternary: Pleistocene - Holocene (11.7-0.01 ka BP)

Some areas of the middle and northern parts of the activity area lie on Pleistocene-Holocene aged swamp and lake sediments derived from Carrum Swamp before it was drained in the late 1800s and early 1900s (Figure 2) (Welch et al 2011). These sediments are comprised of grey brown to black mud, silt, clay and peat lain down in the still-water conditions of the swamp before it was drained for agricultural use (Figure 3) (Welch et al 2011). Carrum Swamp was initially formed in the Quaternary, when a barrier sand dune system was deposited during retreat of the sea from the area. This sand barrier blocked stream outlets, resulting in the diversion or damming of the streams to form swamps. Swamp deposition is no longer occurring due to the lack of permanent surface water. The soils present on this unit occur as cracking clays with small areas of peat (Figure 3) (VRO 2015).

Geological unit: Coastal lagoon deposits (Qg)
Age: Quaternary: Holocene (11.7-0.01 ka BP)

The southern part of the activity area is underlain by Holocene-age unconsolidated sediments that were deposited in a protected lagoon environment that formed behind a double barrier dune system (Figure 2) (Welch et al 2011). The unit is comprised largely of interbedded silts and clays that were lain down in low-energy coastal swamp conditions (Hills 1940; Whincup 1944; Welch et al 2011). The clay and silt layers vary in colour from grey to black, and sometimes contain shell and sand layers (Hills 1940). Sand lenses within the swamp profile indicate marginal swamp conditions, with sand regularly being blown into the swamp from the surrounding landscape. However, clay layers in the profile are representative of fully inundated swamp conditions, where the system lacked the

energy to deposit coarser sediments such as sand. The soil profile that has developed on these coastal lagoon deposits often consists of fine layers of clay and silt, overlying coarser sandy material, which may have a white or dark grey brown mottled appearance (Figure 3).

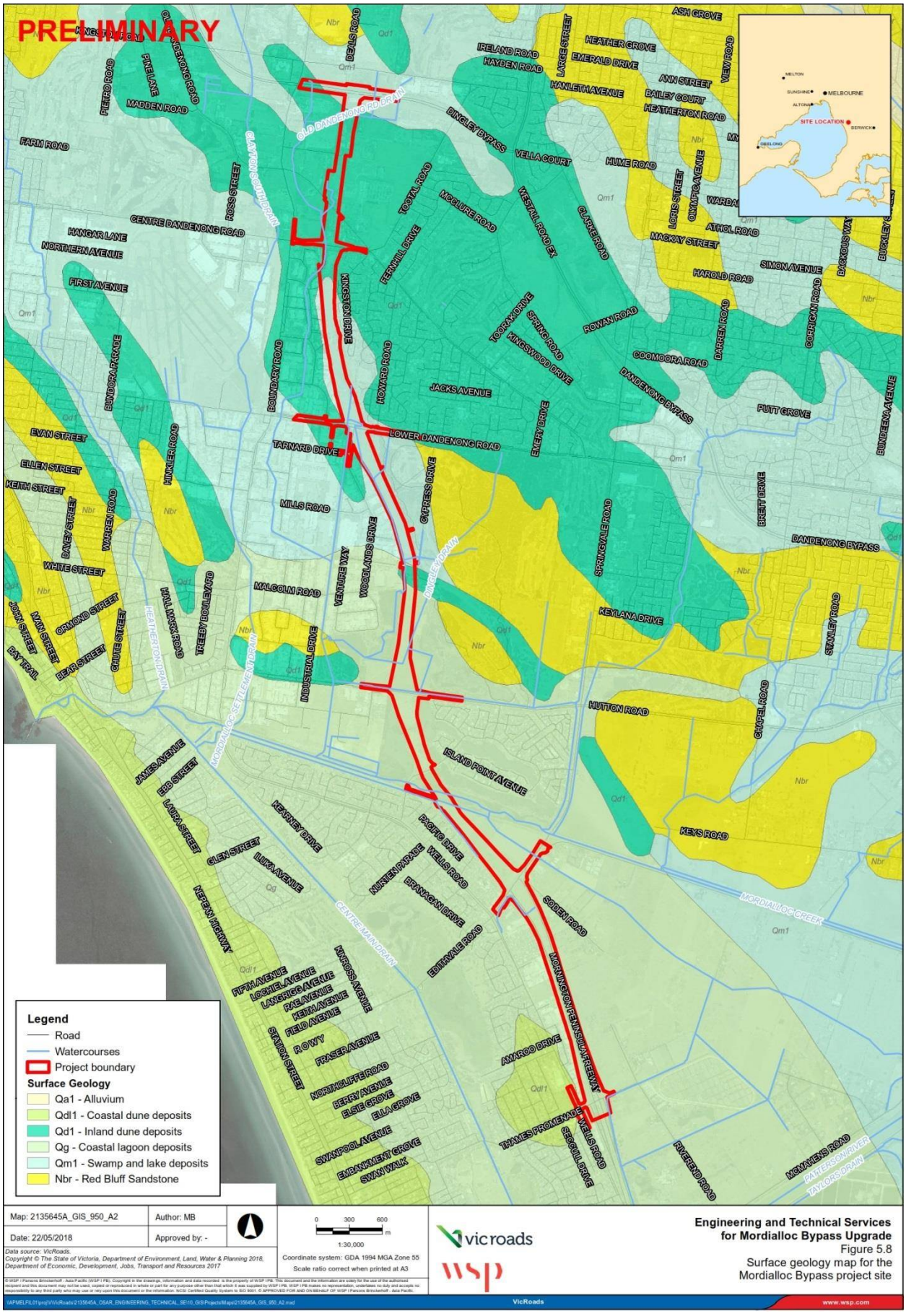

Figure 2 Surface Geology of the Activity Area

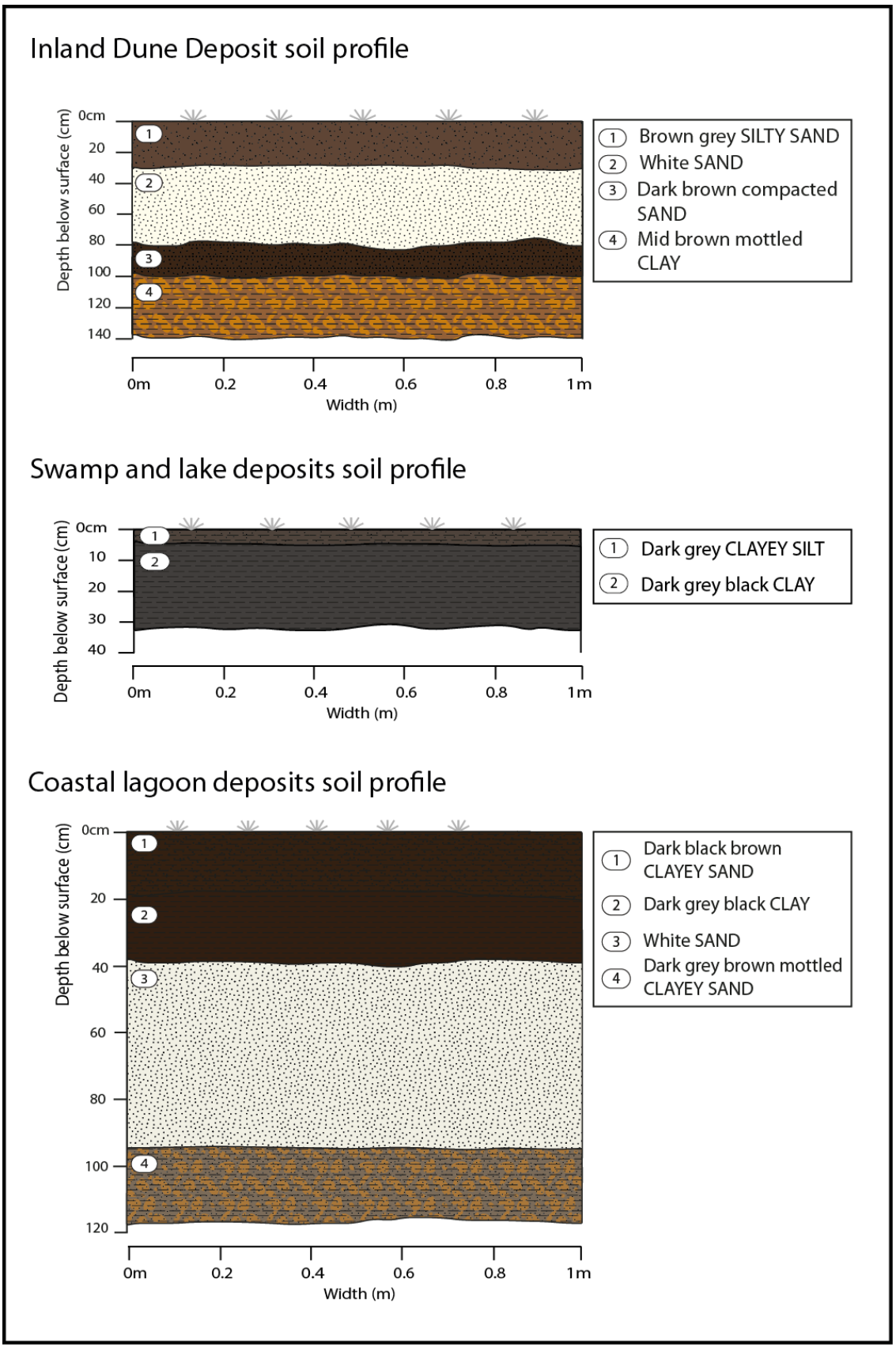

Figure 3 Stratigraphic Expression of the Soil Profile of Activity Area Sediments (Northcote et al 1975; Conacher & Stanley 2000; Joyce et al 2003; McKenzie et al 2004; VRO 2015)

Geomorphology & Landform

The activity area lies within the Central Sunklands of the Eastern Plains subdivision of Victoria (Figure 4). This region represents a broad downthrown area bounded by uplifted fault blocks, and contains the Port Phillip and Western Port Sunklands (Joyce et al 2003). The activity area occurs in the western part of the Port Phillip Sunkland, atop dunes, former swamps and lagoonal deposits (VRO 2015). The landscape represents a very low-relief coastal plain less than 60m in elevation, with undulating dunefields of terrestrial Quaternary sands and low ridges of older, marine Red Bluff Sandstone. These inland dune deposits were formed through aeolian processes, where sand derived from weathering of inland areas was transported across the landscape by wind, and redeposited as sand sheets and linear, or barchan-type dunes (Figure 2). Once deposited, vegetation stabilised the dunes, fixing them in place.

Due to its proximity to Port Phillip Bay, the landscape evolution of the region has been significantly driven by sea level fluctuations. During times of sea level fall, sand dune barriers were left stranded on the land, blocking west-flowing streams and forming swamps. Deposition of one of these sand barriers in the Holocene (11.7-0.1ka BP) resulted in the formation of Carrum Swamp. Later in the Holocene, sea levels dropped once more after the Holocene Climatic Optimum (HCO), forming another barrier dune to the west. This facilitated the growth of Carrum Swamp, which expanded past the initial barrier dune, and began depositing coastal lagoon sediments with evidence of both marine and terrestrial deposition.

The drainage of the region is poor and tends to be linear in nature. Many of the local watercourses are man-made drains that have been constructed to drain the landscape. These include Mordialloc Creek, Dingley Drain and Old Dandenong Road Drain, which intersect the activity area at various locations. Other local watercourses include the Mordialloc Settlement Drain, which runs adjacent to the activity area approximately 2km to 2.5km to the west.

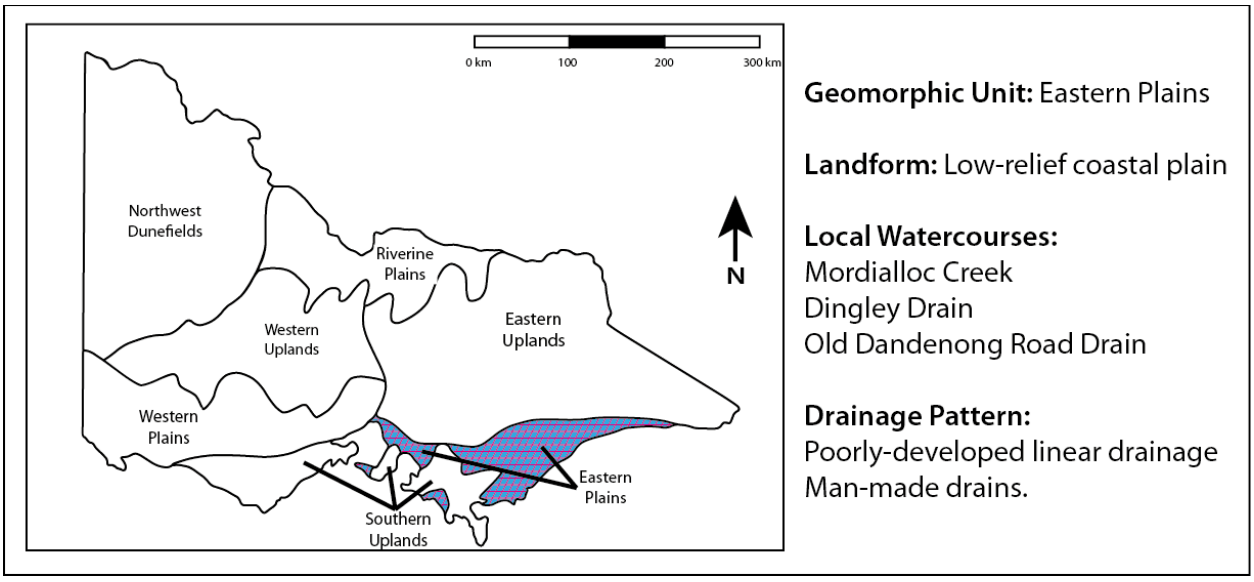

Figure 4 Activity Area Geomorphological Information

Geomorphological History

The geomorphological history of the activity area is summarised below (Cupper et al 2003; Dodson & Mooney 2002; Holdgate & Gallagher 2003; Joyce et al 2003; White & Mitchell 2003):

Table 3 Activity Area Geomorphological History

Time Period	Geological Event / Environmental Conditions	Effect
Miocene – Pliocene (23-2.6 Ma BP)	- Sea level fluctuations	Increases in sea level in the Miocene promoted marginal marine and fluvial deposition of the Red Bluff Sandstone. Sea level retreat in Mid-Late Pliocene facilitated weathering and ferruginisation of the surface rock strata, creating a Pliocene-aged surface.
Pleistocene (2.6Ma-128Ka BP)	- Sea level rise and fall	Glacial-interglacial cycles driven by variations in Earth's orbit (Milankovic Cycles) raised and lowered sea levels due to the formation of ice around the planet. During glacial periods, sea levels would drop significantly, but rise again during the proceeding warming interglacial period. During times of higher sea levels, streams deposited sediments along their floodplains; however, during glacial periods where sea levels dropped, stream deposition slowed and stream incision rates increased. The Last Interglacial began at ~128 Ka, where sea levels retreated from approximately 3-4 m above current levels.
Late Pleistocene (128–16ka BP)	- Sea level retreat - Last Glacial Period	After the Last Interglacial, sea levels retreated from approximately 3-4m above current levels. Following this, southeastern Australia experienced a long period of climatic variability in the lead up to the Last Glacial Maximum at 20-16ka BP. During this period, climates became cool & dry in southeastern Australia. Vegetation cover decreased, allowing for increased river discharge and erosion, and removal of sediment and material from surrounding slopes. Destabilisation of the landscape also mobilised large amounts of sand, resulting in the creation of widespread dunefields, and the reworking of existing sand deposits. At its lowest extent, sea level was approximately 100-120 m lower than present
Early – Mid Holocene (11.7-6ka BP)	- Holocene Climatic Optimum (HCO)	Following the end of the Last Glacial Maximum (LGM), sea levels increased to 1-3 m above present levels & climates became warmer and wetter than present. An increase in sedimentation due to an increase in base-level occurred, and swamps expanded in size. Sand barrier dunes were deposited further inland in response to the higher coastline position. Carrum Swamp formed through the damming of prior watercourses by a sand barrier deposited to the southeast of the activity area.
Middle-Late Holocene (5-0.2ka BP)	- Arid expansion	At the end of the HCO, aridification of the environment increased, with a concomitant lowering of sea level to present levels. Erosion and river incision increased in response to climatic and sea-level processes.

Time Period	Geological Event / Environmental Conditions	Effect
Recent (0.2ka BP-Present)	- European settlement	Erosion and coupled sedimentation in response to clearing increased dramatically compared to pre-contact levels. Fire regimes, drainage patterns & soil organic content also changed substantially as agriculture expanded across the landscape. Efforts to make the land productive for agriculture resulted in the excavation of many drainage channels where ephemeral streams once flowed or where swamps occurred.

4.2.6 Strategic Values

A discussion of strategic values in the activity area and surrounding region is important because variations in strategic values likely influenced Aboriginal cultural heritage place location and visitation frequency (Walsh 1987). Strategic values include strategic resources (eg potable water, flora, fauna stone sources), routes of movement (eg along waterways of ridgelines) and vantage points (eg prominent hills above plains). In general, strategic values were likely of greater importance to Aboriginal people rather than landform of soil type, that is, Aboriginal groups generally would have chosen long-term campsites close to the richest and most diverse resources within the geographic region. Information about strategic values provides insight into Aboriginal cultural heritage place patterning.

The former Carrum Swamp was the regional strategic resource in the region providing water, flora and fauna. Elevated dry sandy rises and dunes next to Dandenong Creek, Eumemmering Creek and Mordialloc Creek where these creek lines intersect the edges of Carrum Swamp would have been prime camping locations (Figure 5).

The activity area lies within the Gippsland Plain Bioregion. Prior to 1750 the activity area was comprised five main Ecological Vegetation Classes (EVCs) which would have provided abundant resources for Aboriginal people. These EVCs include:

- Plains Grassy Wetland (EVC125);
- Swamp Scrub (EVC 53);
- Creekline Grassy Woodland (EVC 68);
- Damp Sands Herb-Rich Woodland (EVC 3); and
- Plains Grassy Woodland (EVC 55).

Some of the resources that may have been utilised by Aboriginal people and would have been available within the activity area are: wetland root crops (such as *Typa, Triglochin*), dry land root crops (such as *Microseris scaigera*), crustaceans, waterfowl and land mammals. Sullivan (1981: Appendix 2) lists the following plants available within coastal scrub: Sea celery (*Apium prostratum)*, pink blind weed (*Convolvulus erubescens*), ruby saltbush (*Enchylaena tomentose*), climbing lignum (*Muehlenbeckia adpressa*), seaberry saltbush (*Rhagodia baccata*) and kangaroo apple (*Solanum aviculare*).

Large numbers of Red Gum occur to north east of the activity area, particularly around the plains of Dandenong which were once covered in Red Gum forest. It is highly likely that Aboriginal people would have travelled to this region specifically for the procurement of forest based resources to manufacture wooden implements (Murphy 2005: 23).

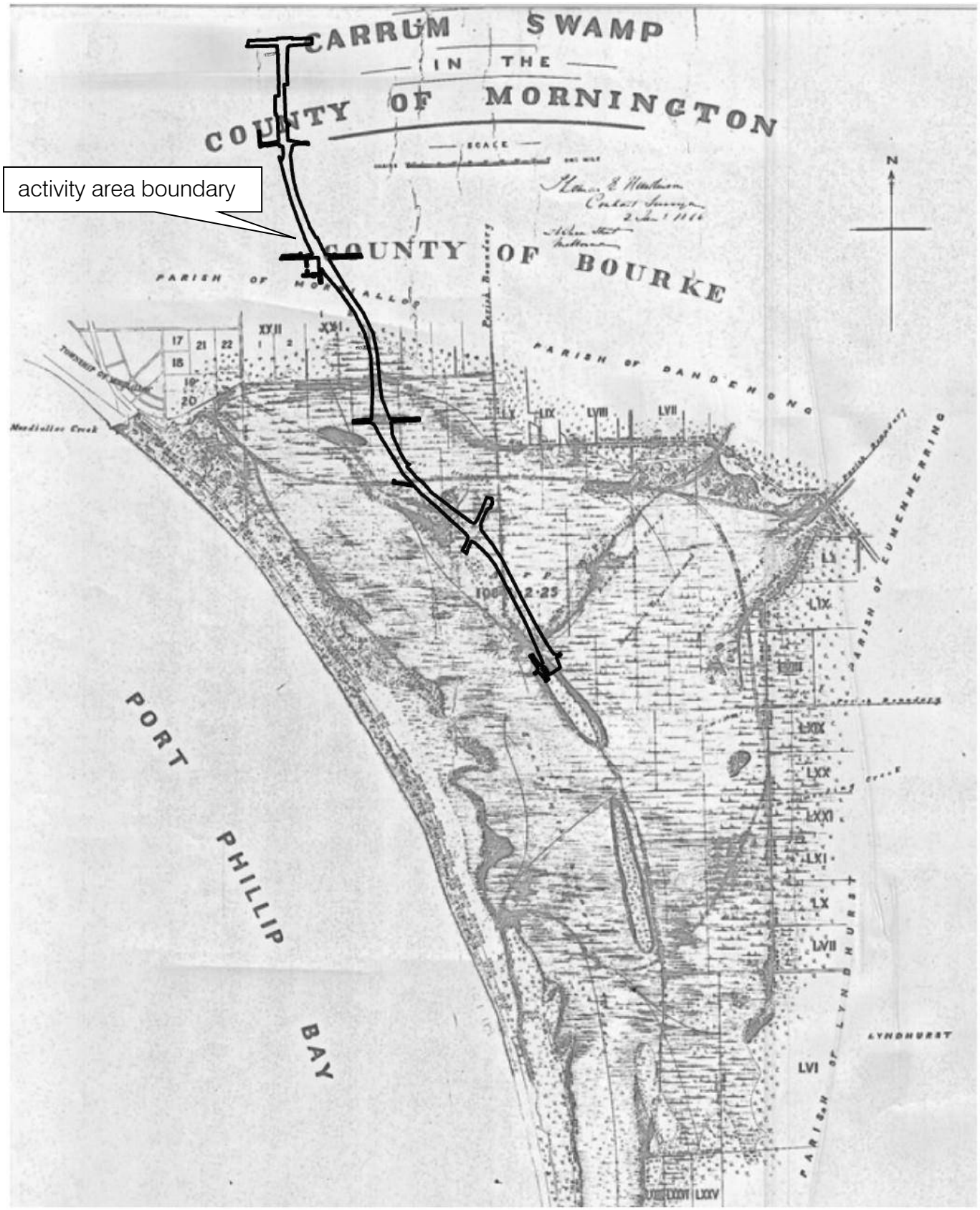

Figure 5 Carrum Swamp 1866

Although all *Bunurong* had coastal areas within their traditional boundaries, Gaughwin and Sullivan (1984: 91) argue that their economy essentially comprised land based resources, with the availability of kangaroos potentially being a major factor in camp location and duration of stays.

At the Mordialloc Reserve, Aboriginal people were known to rely upon eels and ducks caught from Carrum Swamp, often offering these as sale items. Along Mordialloc, there were a variety of fish and crustaceans that would have been available from the shoreline, and a greater variety of terrestrial resources available from the forested areas to the north and east of Carrum Swamp.

Common stone sources available for lithic tool production in the region include quartz, quartzite, chert, hornfels and silcrete (Table 5) (VandenBerg et al 2000; Welch et al 2011). Vein quartz, quartzite and chert are largely available from exposed outcrops of Silurian (444-419 Ma BP) sedimentary rocks in the uplands to the north and southeast of the activity area. Hornfels occurs within the uplands to the north in places where granite has intruded, heating surrounding Silurian sedimentary rocks, and altering them through contact metamorphism to form hornfels. Silcrete could potentially be sourced from sediments underneath the Miocene (23-5.5 Ma BP) Older Volcanic flows near Cranbourne and Berwick, where silcrete nodules may have formed through the process of sub-basaltic weathering (Webb 1995; Webb & Golding 1998). Silicification of Silurian sedimentary rocks in the uplands to the north and south may have also provided another source of silcrete. Raw materials for stone tool manufacture would have been imported into the activity area from up to 10km away which is within a relatively easy one days walk.

Table 4 Stone Sources

Stone Source	Geological Unit	Location in Relation to the Activity Area
Quartz (vein quartz & crystal quartz)	Palaeozoic metasedimentary units	7.4km+ to the north, northeast, east, and southeast of activity area; Eastern Uplands and Southern Uplands regions (Glen Waverly area; Rowville area; Langwarrin area)
Quartzite	Palaeozoic metasedimentary units	7.4km+ to the north, northeast, east, and southeast of activity area; Eastern Uplands and Southern Uplands regions (Glen Waverly area; Rowville area; Langwarrin area)
Chert	Palaeozoic metasedimentary units	7.4km+ to the north, northeast, east, and southeast of activity area; Eastern Uplands and Southern Uplands regions (Glen Waverly area; Rowville area; Langwarrin area)
Hornfels	Contact metamorphosed Palaeozoic sediments	9.75km+ to the north and northeast of activity area; Eastern Uplands region (Rowville area; Narre Warren area)
Silcrete	Palaeozoic metasedimentary units Sub-basaltic sediment	7.85km+ to the north, northeast, east, and southeast of activity area; Eastern Uplands and Melbourne volcanic plains region (Berwick area; Cranbourne area; Glen Waverley)

The coastline and margins of Carrum Swamp would have afforded the most frequently used routes of movement. Ethnography attests to Aboriginal people crossing Mordialloc

Creek at low tide. The crests of sandy rises and sand dunes would have afforded local vantage points to survey the surrounding swamp and plains.

4.2.7 Land Use History

In the 1830s the first squatters arrived and cleared native vegetation to make space for grazing and agricultural activities (Hibbens 1984: 30). With the increasing arrival of settlers, more land was made available for lease, subdividing the squatter runs (Wines 2014: 28). After population increased in the 1850s during the Gold Rush land became even more highly sought after to support food markets which resulted in specialised farming (Bate 1962: 160). Some of these market gardens were still operation until recently.

Land in Springvale, Heatherton, Tootal and Centre Dandenong Roads was subdivided in 1905 and sold as residential estates. Industrial estates were also developed in the area as a result of cheap land prices and good road and rail networks (Wines 2014: 28).

From the 1930s sandmining had become common practice due to the availability of concrete sand from remnant dune fields, which by the 1970s had become landfill sites. In the geographic region there are landfill sites close to Tootal Road and a sand quarry on Old Dandenong Road.

Around Aspendale, dramatic changes to the landscape were made as a result of European settlement from the 1830s to the 1840s. These changes are associated with pastoral activities (such as clearing of vegetation, construction of farm buildings), draining Carrum Swamp, residential and industrial development, and road construction and installation of services.

Large areas of land were made available for pastoral activities after the Carrum Swamp was drained from the 1880s to early 1900s. This resulted in the surrounding low-lying plain undergoing intensive modification. In 1879 a channel was cut in Carrum which later became the artificially constructed Patterson River. Furthermore, Mordialloc Creek underwent remodelling to mitigate the creek's deteriorated state. This occurred as a result of diverging Dandenong Creek into Mordialloc Creek to avoid inundation of properties from floods in 1934 and 1959 (Kennedy & Crocker 2013: 64). Remodelling of Mordialloc Creek included channelisation, dredging, elevation of banks and artificial levees (Kennedy & Crocker 2013: 64).

The geographic region and activity area have undergone extensive urbanisation comprising commercial, industrial and residential subdivision and development with concomitant civil infrastructure upgrades. The European land use has removed many local landforms (wetlands, dunes, Red Gum forest) and the vast majority of plants and animals once relied upon by pre-contact Aboriginal people. Thus, the local cultural landscape of pre-contact Aboriginal people has been severely impacted and now retains very little integrity (Murphy & Thomson 2015: 33).

The changes in the activity area and surrounding landscape were also investigated by comparing landuse within the last 60 years in aerial photographs from the early 1950s onwards and examining Lidar Images.

In summary, activities that have impacted archaeological sites within the activity area are:

- Initial clearing of vegetation;
- Pastoralism and agriculture;
- Draining of Carrum Swamp and floodplains for agriculture;
- Channelisation of Mordialloc Creek;
- Installation of drains;
- Market gardening, including sand management, ploughing, construction green houses and dams, etc;
- Commercial and industrial development;
- Braeside Treatment Plant;
- Artificial wetland construction;
- Road upgrades;
- Underground services (water, sewerage, electricity and drainage lines).

4.2.8 Site Prediction Model

The relevant desktop information is summarised below and is used to identify likely site-types that may be present and areas of archaeological potential:

- Carrum Swamp and tributary creeks including Dandenong Creek, Eumemmering Creek and Mordialloc Creek had regional strategic value providing water, flora and fauna resources;
- The coastline and dunes along the margins of Carrum Swamp would have been routes of movement for Aboriginal groups;
- Sandy rises, sand dunes and elevated sand sheets along the margins of Carrum Swamp and creeks would have provided good camping locations. This is where large, dense stone artefact scatters are most likely to occur;
- There are no previously registered Aboriginal places within the activity area.
- The most likely site type within the activity area will be stone artefact scatters and LDADs in a surface or sub-surface context. Stone artefact scatters will most likely be found on sandy rises and sand dunes along the margins of the former Carrum Swamp and Mordialloc Creek.
- Stone artefact scatters are unlikely to be found on the low-lying plain. The plain afforded no elevated dry locations suitable for camping. Although the geomorphological background shows that during drier periods sand may have been blown into Carrum Swamp and there may be buried sandy lenses, previous complex assessments show that stone artefacts are unlikely to be found is these contexts.
- Scarred trees may be present if any mature Red Gums remain. Since no mortuary trees or birthing trees have been recorded, they are unlikely to be present;
- Shell middens are typically found closer to Port Phillip and are not predicted to be present in the activity area;
- A large proportion of the activity area has been subject to ground disturbance which will have impacted the integrity of stone artefact scatters;
- If stone artefact scatters are found during the assessment they may have the following attributes:
    - Raw material: dominated by quartz and silcrete;

  - Technology type: dominated by flakes followed by smaller components of angular fragments, cores and tools;
  - Landform: on the crest or slope of sand dunes, sandy rises and elevated sand sheets
  - Artefact depth: up to 110cm in depth in sandy sediments
- Based on the above information areas of archaeological potential in the activity area include sand sheets, sand dunes and sandy rises.

4.3 Standard Assessment (Ground Surface Survey) Results

4.3.1 Fieldwork Results and Interpretation

Ground surface visibility during the standard assessment was typically low due to built infrastructure in developed areas and grass cover in paddocks (Table 2). Areas of disturbance included old market garden beds, earthworks and drainage channels, commercial development and use, roads and freeways, above and under-ground civil infrastructure (including the former Braeside Treatment Plant), artificial wetlands, Mordialloc Drain, horse agistment, farm tracks, sheds and buildings.

The survey examined the ground surface of the activity area. All indigenous trees were examined to determine the presence of Aboriginal cultural scars. No Aboriginal scarring was observed on any trees. No mortuary or birthing trees were identified. No caves, rock shelters or cave entrances were identified within the activity area.

Table 5 Survey Area, Ground Surface Visibility and Effective Survey Coverage

Survey Area	Ground Surface Visibility	Effective Survey Coverage
1	10%	5%
2	10%	5%
3	<5%	1%
4	<5%	1%
5	<10%	5%

Two surface stone artefacts were found during the standard assessment: one quartzite proximal flake and one quartz proximal blade. Both were associated with sandy landforms confirming the site prediction model. These artefacts were subsequently registered as components of Mordialloc Bypass, LDAD1 and LDAD 2.

The activity area comprises sandy landforms, plain and former floodplain. Sandy landforms include sand dunes and sand sheets. The plain and former floodplain are associated with the former Carrum Swamp. The majority of the sandy landforms were historically used for market gardening and later developed for commercial development and use.

Dry elevated sandy landforms on the margins of the swamp are the locations most likely to have been used for campsites and therefore have potential for stone artefact scatters.

Unfortunately most of these areas have been destroyed or significantly modified by European landuse and have little if any integrity remaining. Despite this, surface stone artefacts were found on the disturbed market gardens to the north and the deflated dune at the former Braeside Treatment Plant. The potential of the sandy landforms in the activity area are assessed as follows:

- The former market gardens in the north have been previously investigated in CHMPs 11562 and 13198 but did not record any stone artefacts. The identification of a single surface artefact on a disturbed sand dune in the former market gardens therefore warrants a complex assessment, and has been assessed as having low-moderate potential.
- The buildings associated with the Braeside Treatment Plant were built on a linear sand dune. Although the area has been disturbed by buildings and old plantings of exotic trees, this dune appears to be the least disturbed sandy landform in the activity area.
- All the other sandy areas are highly disturbed and are considered to have low archaeological potential.

The plain and former floodplain has suffered fewer disturbances from European land use compared to sandy elevated landforms. The land was drained during the 19th century and has been used primarily for grazing stock. No surface stone artefacts were found, and despite the low ground surface visibility, the lack of artefacts is consistent with the site prediction model.

The results of the standard assessment were consistent with the predictions of the desktop assessment, that is, the majority of the activity area was disturbed by European land use but that sandy landforms had the highest archaeological potential.

4.3.2 Standard Assessment Site Prediction Model: Areas of Archaeological Potential

Based on the results of the desktop and standard assessment the activity area was assessed as having areas of archaeological potential associated with sandy landforms. Stone artefacts were the most likely Aboriginal cultural heritage to be present. The least disturbed sandy landforms were considered to have the highest archaeological potential for subsurface stone artefacts.

4.3.3 Standard Assessment Conclusions

The standard assessment demonstrated that (Maps 6a-c):

- No Aboriginal scarred, mortuary or birthing trees were identified.
- Two surface stone artefacts were found during the standard assessment: one quartzite proximal flake and one quartz proximal blade. Both were associated with sandy landforms confirming the site prediction model;
- The artefacts were subsequently registered as components of Mordialloc Bypass, LDAD 1 and LDAD 2.
- The deflated sand dune at the former Braeside Treatment Plan had moderate archaeological potential for stone artefacts. The other sandy landforms were disturbed and had low archaeological potential for stone artefacts;
- The plain was assessed as having low archaeological potential;

- Severely disturbed areas and the built environment had no potential for stone artefacts;
- All other place-types were considered unlikely to be present; and
- A complex assessment was required to test the site prediction model.

4.4 Complex Assessment (Subsurface Excavation) Results

4.4.1 Fieldwork Results and Discussion

A total of six TPs and 23 MTs were excavated. A total area of 119m^2 was excavated and 4m^2 found Aboriginal cultural heritage. Six subsurface stone artefacts were found during the complex assessment. All of the subsurface artefacts were found on the sand dune at the former Braeside Treatment Plant. Testing therefore generally confirmed the site prediction model, that is, subsurface stone artefacts are most likely to be found on sand dune landforms. However, it should also be noted that no subsurface stone artefacts was found on sand dune / sand sheet south of the Dingley Bypass. No stone artefacts were found on the plain and floodplain which confirmed the low archaeological potential of both landforms.

At the former Braeside Treatment Plant, subsurface artefacts were found in the light grey to grey sand A-horizon between 35cm and 80cm depth on the crest and upper slope of the dune. The B-horizon clays were found at a depth ranging from 50cm to 142cm. A layer of disturbed soils and fill comprising metal fragments and rubbish was found up to 79cm in depth. Thick layers of disturbed soils were also found south of the Dingley Bypass.

Clear macroscopic evidence of disturbance and fill was also identified in excavations on the floodplain or plain. Excavations encountered disturbed deposits or fill up to a maximum depth of 200cm but more typically up to 44cm. The majority of these excavations are located north of the former Braeside Treatment plant. Below the disturbance profiles comprised varied silty sand / sandy silt / sand A-horizons above clay B-horizons varying widely in depth.

The total area of excavation on the different landforms was: dune / sand sheet 30m^2, floodplain 58m^2 and plain 31m^2. Stone artefacts were found in 4m^2 or approximately 13% of the excavations in the dune / sand sheet landform. The lack of artefacts found on the plain and floodplain is consistent with nearby CHMPs (eg, 13226, 12053 & 12851). The presence of artefacts on dunes is consistent with the landform context for artefact scatters and LDADs in the geographic region (Section 3.2.1).

The subsurface artefacts were all made from silcrete and comprised blades (n=4) or flakes (n=2). The raw material and primary forms are consistent with the regional assemblage (Section 3.2.1).

4.4.2 Complex Assessment Conclusions

The conclusions from the complex assessment were as follows:

- A total of six subsurface stone artefacts were recovered on the dune landform at the former Braeside Treatment Plant;
- No TP or MT on the floodplain or low-lying plain found subsurface stone artefacts.
- Artefacts were found to a maximum depth of 80cm in the grey sand A-horizon.

- Artefact raw material comprised silcrete (n=6).
- Primary forms comprises blades (n=4) and flakes (n=5).
- Artefact raw material and primary form are consistent with the regional assemblage.
- The subsurface artefacts were registered as components of Mordialloc Bypass, LDAD 2.
- The complex assessment confirmed the site prediction model, that is, subsurface stone artefacts are most likely to be found on the dune and unlikely to be found on the plain and floodplain.

After the complex assessment was completed, the activity area was extended from south of Springvale Road to Thames Promenade. The results of the desktop, standard and complex assessment demonstrated that Thames Promenade extension was unlikely to contain Aboriginal cultural heritage because it was located on the floodplain, has been disturbed by construction of the Mornington Freeway and surrounding development, and prior subsurface testing in this and other CHMPs has demonstrated that Aboriginal cultural heritage is unlikely to be present in the southern half of the activity area.

4.5 Aboriginal Cultural Heritage (Standard and Complex Assessments)

A total of 8 stone artefacts were recorded comprising two artefacts found during the standard assessment and six stone artefacts found during the complex assessment. Silcrete (n=6) was the dominant raw material followed by quartz (n=1) and quartzite (n=1). This is consistent with the geographic region (Section 4.1). Known silcrete, quartz and quartzite sources are more than 7km from the activity area (Section 6); therefore, raw material was likely imported into the site.

Primary form was dominated by blades (n=5) followed by flakes (n=3). This is not consistent with the geographic region due primarily to the higher percentage of blades in this assemblage (see Section 4.1). However, this can be attributed to the small sample size in this investigation. Although no microliths were identified, the presence of blades indicates that the assemblage is not inconsistent with the Australian Small Tool Traditions (ASTT) and therefore the assemblage likely dates to the Late Holocene.

Stone artefacts were found at two locations (Map 3):

- Mordialloc Bypass, LDAD 1. One quartzite flake was found on the surface south of the Dingley Bypass on a disturbed sand sheet. It is considered unlikely that additional stone artefacts are present. The site was assessed as having high cultural and low scientific significance.
- Mordialloc Bypass, LDAD 2. One surface quartz and six subsurface silcrete artefacts were found on the deflated dune at the former Braeside Treatment Plant. Subsurface artefacts were found in the light grey to grey sand A-horizon between 35cm and 80cm depth on the crest and upper slope of the dune. The B-horizon clays were found at a depth ranging from 50cm to 142cm. Substantial disturbance has occurred to the dune from the construction and decommissioning of the treatment plant. Disturbed soils and fill were found to a maximum depth of 79cm. It is considered likely that additional small numbers of subsurface artefacts are present. The place was assessed as having high cultural and low scientific significance.

Map 3 General Location of Aboriginal Cultural Heritage Places in the Activity Area

The activity area contained evidence of Aboriginal occupation during the Late Holocene which is representative of the geographic region. The stone artefacts show that Aboriginal groups were likely producing microliths to rearm spears for hunting. The sand dune at the former Braeside Treatment Plant was the preferred location being elevated and dry with views over the surrounding floodplain. Raw materials were brought into the activity area, with silcrete the preferred for making stone tools. The activity area was not as important as other parts of geographic region, with larger, denser stone artefact scatters found elsewhere along the margins of Carrum Swamp. The assessment confirmed that sand dunes were more sensitive for stone artefacts compared to the plain or floodplain.

5 RISK ASSESSMENT

5.1 Methodology

As outlined in the Ministerial Guidelines for Assessment of Environmental Effects (2006) and the Scoping Requirements for the Mordialloc Bypass Project EES (2018), a risk-based approach was adopted for the EES studies to direct a greater level of effort at investigating matters that pose relatively higher risk of adverse environmental effects. The following definitions were adopted for the assessment:

- *Environmental impact:* is described as any change to the environment as a result of a project activities.
- *Environmental risk:* As defined by the Ministerial Guidelines for Assessment of Environmental Effects Under the Environment Effects Act 1978 (DSE, 2006), *"Environmental risk reflects the potential for negative change, injury or loss with respect to environmental assets".*

The purpose of the risk assessment was to provide a systematic approach to identifying and assessing the environmental risks, including heritage, cultural, social, health, safety and economic aspects as a result of the project. It articulates the likelihood of an incident with environmental effects occurring and the consequential impact to the environment.

The impact assessment and risk assessment processes were integrated throughout the development of the EES. The environmental risk assessment (ERA) process allowed the project team to identify as many environmental risks as a result of the project as possible and refine and target impact assessments accordingly. The impact assessments ensured the project team has a robust understanding of the nature and significance of impacts and the mitigation measures developed to minimise and control those impacts.

The risk and impact assessment processes were essential components of the project design process and in the formulation of construction and additional mitigation measures to minimise environmental impacts. These assessments also underpin the establishment of the Environmental Performance Requirements (EPRs), which set out the desired environmental outcomes for the project.

The below methodology was developed to assess the potential impacts of the Mordialloc Bypass on Aboriginal cultural heritage and sets out the process, methods and tools used to complete the impact and risk assessments.

5.1.1 Risk Assessment Methodology

The risk assessment is a critical part of the EES process as it guided the level and extent of impact assessment work required and facilitated a consistent approach to risk assessment across the various technical disciplines. The risk assessment process was based on the approach defined in *ISO 31000:2018 Risk Management – Principles and Guidelines*, which describes an environmental risk management process which is iterative and supported by ongoing communication and consultation with project stakeholders. The ERA process incorporated VicRoads key risk management requirements, specifically from the VicRoads Environmental Risk Management Guidelines (2012) and the VicRoads Environmental Sustainability Toolkit (2017).

Scope and Boundaries

The ERA assessed all project phases, namely: Initial Phase (the current approvals and concept design stage); Construction Phase; and Operations and maintenance Phase. The risk process evaluated environmental risks that would result from the development of the project based on the concept designs for the project, the draft construction methodology and the existing conditions of the study area, as well as the draft environmental impact assessment reports which were in development during the ERA.

Risk Identification

To effectively and comprehensively recognise all potential environmental risks that may result from the project, it was necessary to identify impact pathways for all project activities during all its project phases. An impact pathway is the cause and effect pathway or causal relationship that exists between a project activity and an asset, value or use of the environment.

Environmental impact pathways were identified under two categories:

- Primary environmental impacts: The impacts to environmental values that are directly attributable to project activities within a cause and effect paradigm. Project activities cause environmental impacts (effects) on environmental values through an environmental impact pathway such as construction activities. The assessment of these impacts and their associated risks assumes that all standard mitigation measures are in place and working as intended.
- Cumulative impacts: The potential cumulative impacts to environmental values that may result from the implementation of the project. This allowed for the identification of:
    - Secondary environmental risks which may result from the implementation of a risk response in mitigating a primary environmental risk;
    - On-site aggregate risks resulting from multiple on-site project activities on an environmental asset (risks were assessed in two ways, as a single project phase and as a whole project risk);
    - Off-site cumulative environmental risks which accounted for potential off-site cumulative impacts of the Mordialloc Bypass project in conjunction with surrounding off-site projects in the local area.

Risk Analysis

With risks identified for each discipline, VicRoads and industry best practice and standard mitigation controls that are considered intrinsic to a project of this nature were identified, including requirements under relevant sections of the VicRoads Standard Specifications, EPA guidelines and Government environmental management policies.

Risk Evaluation

The ERA process developed for the project is based on the risk analysis matrix used on recent and similar VicRoads projects, as presented in Table 6. It follows the standard industry semi-quantitative risk analysis methodology that utilises pre-defined consequence and likelihood criteria as the factors to arrive at a risk rating.

Table 6 Risk Assessment Matrix

			LIKELIHOOD				
CONSEQUENCE	Risk Categories		Rare	Unlikely	Possible	Likely	Almost Certain
			A	B	C	D	E
	Catastrophic	5	Medium	High	High	Extreme	Extreme
	Major	4	Medium	Medium	High	High	Extreme
	Moderate	3	Low	Medium	Medium	High	High
	Minor	2	Negligible	Low	Low	Medium	Medium
	Insignificant	1	Negligible	Negligible	Negligible	Low	Low

Based on the project objectives and context, a set of project-specific and appropriate likelihood and consequence criteria were developed in consultation with VicRoads, the TRG and technical specialists (Tables 7 & 8).

Table 7 Risk Assessment Likelihood Categories

LIKELIHOOD				
Less than once in 12 months OR 5% chance of recurrence during course of the contract	Once to twice in 12 months OR 10% chance of recurrence during course of the contract	3 to 4 times in 12 months OR 30% chance of recurrence during course of the contract	5 to 6 times in 12 months OR 50% chance of recurrence during course of the contract	More than 6 times in 12 months OR 100% chance of recurrence during course of the contract
The event may occur only in exceptional circumstances	The event could occur but is not expected	The event could occur	The event will probably occur in most circumstances	The event is expected to occur in most circumstances
It has not happened in Victoria but has occurred on other road projects in Australia.	It has not happened in the greater Melbourne region but has occurred on other road projects in Victoria	It has happened in the greater Melbourne region	It has happened on an road project in the region in the last 5 years	It has happened on a road project of similar size and nature in the region within the last 2 years. OR It has happened multiple times on a road project in the region within the last 5 years.
Rare	Unlikely	Possible	Likely	Almost Certain
A	B	C	D	E

Table 8 Environmental Risk Assessment Consequence Descriptors

Aspects	Insignificant	Minor	Moderate	Major	Catastrophic
Aboriginal cultural heritage	No impact to Aboriginal cultural heritage values	Destruction of common occurrence Site containing: (a) a small number (e.g. 0-10 artefacts) or limited range of cultural materials with no evident stratification. AND Site destroyed or in a deteriorated condition with a high degree of disturbance; some cultural materials remaining.	Destruction of occasional occurrence Site containing: (a) a larger number, but limited range of cultural materials: and/or (b) some intact stratified deposit remains. AND Site in a fair to good condition, but with some disturbance. Occasional occurrence	Destruction of rare occurrence Site (e.g. burned mounds) containing: (a) a large number and diverse range of cultural materials; and/or (b) largely intact stratified deposit; and/or (c) surface spatial patterning of cultural materials that still reflect the way in which the cultural materials were laid down. AND Site in an excellent condition with little or no disturbance. For surface artefact scatters this may mean that the spatial patterning of cultural materials still reflects the way in which the cultural materials were laid down.	Destruction of Site containing: (a) a burial. (a response to Aboriginal Victoria (AV) and the Registered Aboriginal Party (RAP) identifying that these sites types were of high cultural heritage significance and their presence could prevent construction of an alignment).
Cumulative Effects	Within 2 km of the Project Boundary				

For all risks rated medium, high or extreme in the initial risk rating, technical specialists were required to identify additional controls which could be implemented to further reduce risk and to perform the residual risk rating. Additional controls specify management measures over and above those considered as Standard Controls to ensure the residual risk has been effectively avoided or mitigated to as low as reasonably practicable.

Where risks could not be eliminated or sufficiently reduced (e.g. by engineering controls or re-design), these will typically be addressed by specific conditions in a site Environmental Management Plan (EMP), or be the subject of a separate management plan, including adaptive management plans based on ongoing studies or monitoring.

Environmental Performance Requirements

Following the evaluation of risk and through consultation with VicRoads, EPR's were developed to define, relevant, achievable and measurable environmental outcomes for the project. The mitigation measures identified during the risk assessment process were used to inform the EPRs and also specify the means by which the EPRs are to be satisfied. The EPR to Aboriginal cultural heritage is referenced in Table 9 and outlined in Table 11.

5.2 Key Findings

The primary environmental risks identified for Aboriginal cultural heritage are provided in Table 9. The initial risk ratings presented below for both project and cumulative impacts consider standard inherent controls as listed in the Environmental Risk Assessment Report. The additional controls listed in the tables below are those recommended to further mitigate and minimise the primary environmental risks which were risk rated as medium or above. Primary environmental risks which were scored as low did not require additional controls to be applied.

Also included in the table below are any identified on-site project related cumulative risks, including: secondary risks (resulting from the implementation of a risk response in mitigating a primary environmental risk) and on-site aggregate cumulative risks (the aggregate / combined primary environmental risks resulting from diverse project activities having an impact on the same environmental asset.

Table 9 Aboriginal Cultural Heritage Environmental Risk Assessment Register

Risk ID	Impact Pathway	Primary Environmental Risk Description	Secondary Env. Risk	Initial risk			Additional Mitigation / Controls	EPR	Residual risk		
				Consequence	Likelihood	Rating			Consequence	Likelihood	Rating
R-ACH1	*Preconstruction activities*	*Uncovers / harms matters of cultural significance*		*Minor*	*Unlikely*	*Low*	*Not required*	*H1*	*Minor*	*Unlikely*	*Low*
R-ACH2	*Construction*	*Uncovers / harms matters of cultural significance*		*Moderate*	*Unlikely*	*Medium*	*Comply with Contingency Plan in approved CHMP*	*H1*	*Moderate*	*Rare*	*Low*
R-ACH3	*Operation / Maintenance*	*Uncovers / harms matters of cultural significance*		*Minor*	*Rare*	*Negligible*	*Not required*	*H1*	*Minor*	*Rare*	*Negligible*
Cumulative Impacts - On-Site Aggregate											
R-ACH4	*Multiple*	*Uncovers / harms matters of cultural significance*		*Moderate*	*Unlikely*	*Medium*	*Comply with contingency plan within the approved CHMP*	*H1*	*Moderate*	*Rare*	*Low*

6 IMPACT ASSESSMENT

6.1 Avoidance, Minimisation, Management of Harm and Contingency Plan

Roadways in linear project areas have limited ability to avoid harm to stone artefacts on the ground surface or in surficial deposits when clear, level and grade construction methods are employed. Options to avoid harm can include changes in the alignment of the roadway, changing the angles of batters, fly-overs or fill over artefact bearing deposits. These options may not be feasible when other project constraints are taken into account.

The stone artefacts found during this investigation in both raw material and primary form are representative of those found in the region. No features or high integrity occupation features were found. No subsurface artefacts were found at LDAD 1 and due to the highly disturbed nature of the area, it is considered unlikely that there are any additional stone artefacts in the area. For these reasons, LDAD 1 is considered to have no research potential. It is considered likely that there are additional small numbers of subsurface stone artefacts on the dune associated with LDAD 2. For these reasons, LDAD 2 is considered to have low research potential. It is considered unlikely that management of LDAD 1 or LDAD 2 by archaeological salvage will make a substantial scientific contribution to knowledge of the activity area or geographic region.

During construction of the Mordialloc Bypass any unexpected Aboriginal cultural heritage can be managed by the Contingency Plan in the approved CHMP.

Given the presence of subsurface stone artefacts at LDAD2, the likelihood of the project impacting on unexpected Aboriginal cultural heritage is considered to be unlikely or rare, meaning that artefacts may be impacted once in 12 months (Table 7). In addition, the consequence of impacting Aboriginal artefacts is considered minor to moderate (Table 9). The residual risk of the project impacting Aboriginal cultural heritage is low to negligible.

6.2 Cumulative Impact

The activity has both a positive and negative cumulative impact on the Aboriginal cultural heritage values of the activity area and region. This investigation has contributed additional archaeological data on the nature of the Aboriginal occupation in the geographic region and confirmed that the plain and floodplain have low archaeological potential and sand dunes have higher archaeological potential for stone artefacts. Although the activity may harm cultural heritage in the activity area, the scientific values are limited and not of the same order than that found elsewhere the geographic region where larger, denser stone artefact scatters are found. The overall negative cumulative impact on the activity area and regional archaeological values is considered to be low.

Table 10 Aboriginal Cultural Heritage Cumulative Effects Environmental Risk Assessment

RISK ID	IMPACT PATHWAY	PROJECTS CONSIDERED	CUMULATIVE RISK DESCRIPTION	ADDITIONAL MITIGATION / CONTROLS	EPR	CUMULATIVE RISK RATING		
						CONSEQUENCE	LIKELIHOOD	RATING
R-ACH1	*Pre-construction activities*	*CHMPs in the activity area and geographic region*	*Stone artefacts and scarred trees*	*N/A*	*H1*	Minor	Unlikely	Low
R-ACH2	*Construction*	*CHMPs in the activity area and geographic region*	*Stone artefacts and scarred trees*	*Comply with Contingency Plan in approved CHMP*	*H1*	Moderate	Rare	Low
R-ACH3	*Maintenance*	*CHMPs in the activity area and geographic region*	*N?A*	*N/A*	*H1*	Minor	Rare	Negligible

7 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

The EPR outlined in the table below setS out the desired environmental outcomes for the project. The EPR IS applicable to all project phases and provided certainty regarding the projects environmental performance.

Table 11 Aboriginal Cultural Heritage Environmental Performance Requirement

EPR Number	EPR	Project Phase
H1	Cultural Heritage Management Plan Comply with and implement the Cultural Heritage Management Plan (CHMP) approved under the Aboriginal Heritage Act 2006.	Detailed design, Construction

8 CONCLUSION

This report has documented the known Aboriginal cultural heritage values in the activity area for the proposed Mordialloc Bypass. The known values comprise two low density artefact distributions, LDAD 1 and LDAD 2, that were discovered during the assessment for CHMP 15026 commissioned for the Mordialloc Bypass project. It is unlikely that there are large numbers of additional stone artefacts in the activity area which will be impacted by the project. All Aboriginal cultural heritage can be managed appropriately within the framework of CHMP 15026. The approved CHMP will provide compliance management measures (conditions) and a contingency plan which must be followed during the construction of the project. Based on the findings of this report the risk to scientifically significant Aboriginal cultural heritage is considered to be low.

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APPENDIX 1 – GLOSSARY

Aeolian Sediments: Wind-borne, wind-blown or wind-deposited material, usually sand, but also silt and clay.
Alluvium: Sedimentary unconsolidated deposits lain down through the action of running water. Usually found in or near rivers and floodplains. It is usually applied to coarser sediments such as sands and gravels, but sometimes to finer particles such as silt and clay.
Anvil: A portable flat stone, usually a river pebble, which has been used as a base for working stone. Anvils that have been used frequently have a small circular depression in the centre where cores were held while being struck. An anvil is often a multifunctional tool used also as a grindstone and hammer stone.
Archaeological Site: A place/location of either Aboriginal or non-Aboriginal origin. Aboriginal archaeological sites have been formed prior to the European settlement of Australia, and may be in any of the forms outlined above.
Artefact: Any product made by human hands or caused to be made through human actions.
Artefact Horizon: A discernible horizontal distribution of artefacts within a natural soil horizon. An artefact horizon has generally suffered a degree of post depositional disturbance that has affected the spatial and temporal integrity of the deposits and associated artefact assemblage.
Artefact Scatter: A scatter of cultural material, most commonly stone artefacts. Artefact scatters are often the only physical remains of places where Aboriginal people have camped, prepared and eaten meals and worked stone material.
Basalt: Fine-grained, hard, but easily weathered dark-grey igneous rock formed by the cooling of lava.
Bedrock: Solid rock at the surface or rock at depth that has been undisturbed by weathering.
Blade: A long parallel sided flake from a specially prepared core. Blade flakes are twice as long as they are wide.
Bipolar: A core or a flake, which, presumably, has been struck on an anvil. That is, the core from which the flake has been struck has been rotated before the flake has been struck off. Bifacial platforms tend to indicate that the flake has come off a heavily worked core.
Broken Flake: Defined by the part of the flake remaining, ie proximal (where the platform is present), medial (where neither the platform nor termination is present), or distal (where the termination is present).
Calcareous: A sediment containing calcium carbonate in concentrations of up to 50%.
Coffee Rock: A term used to describe a hardened iron- and organic-rich cemented deposit that when wet, resembles coffee grains. It is usually found in sandy soils that have a source of iron and organic matter.
Colluvium: An unconsolidated mixture of weathered material (gravel, sand, silt and clay) transported downslope by the force of gravity.
Complete Flake: An artefact exhibiting a ventral surface (where the flake was originally connected to the core), dorsal surface (the surface that used to be part of the exterior of the core, platform and/or flake scar).
Core: An artefact from which flakes have been detached using a hammer stone. Core types include blade, single platform, multiplatform and bipolar forms. These artefacts exhibit a series of negative flake scars, each of which represents the removal of a flake. Core types are as follows:
Unidirectional cores - These cores have scars originating from a single platform, and all the flakes struck from the core have been struck in the same direction from that platform.
Bidirectional cores - These cores have two platforms, one opposite the other; flakes have been struck from each of the platforms, and thus from opposite directions.
Bifacial cores - These kinds of core have a single platform, but the flakes struck from it have been detached from two core faces.
Multidirectional cores - These cores have two or more platforms and there is no clear pattern, either in the orientation of the platforms or in the orientation of the scars resulting from the striking of flakes from those platforms.
Bipolar core - Nodules or cobbles that are flaked using an anvil. The resulting artefacts exhibit crushing on their proximal, distal and often their lateral margins, where they have been rotated.
Cultural Heritage: Something that is inherited or passed down because it is appreciated and cherished. Categories of cultural heritage include; built structures and their surrounds, gardens, trees; cultural landscapes; sites; areas; precincts; cemeteries; ruins and archaeological sites; shipwrecks; sites of important events; commemorative sites; contents of buildings and significant relics, objects artefacts and collections of objects.
Burials: Burial places may occur in association with campsites, in mounds or shell middens or in specific burial grounds that lack any other cultural material. Softer ground was chosen for burials, and any sandy area can be expected to contain burials. Burial places can contain one or a number of individuals. Burials places and cemeteries are a common archaeological place type in the sand country adjoining the Murray River, though are a rare feature in the southern part of Victoria.
Contact Place: These are places relating to the period of first contact between Aboriginal and European people. These places may be associated with conflict between Aboriginal people and settlers, mission

stations or reserves, or historic camping places. The artefact assemblage of contact places will often include artefacts manufactured from glass.

Dune: A mound or ridge of wind-blown granular material (usually sand) that is partially, fully or bare of vegetation, and capable of being moved from one location to another while still retaining its characteristic shape.

Ferruginous: Rocks or soils containing a large percentage of iron.

Ferruginisation: The process by which iron minerals move in the sediment and/or regolith, staining and cementing the substrate to form a hard, iron-rich layer.

Fluvial: Referring to rivers and their processes. E.g. stream erosion and deposition.

Gilgai: An undulating surface of mounds and depressions resulting from the uneven shrinking and swelling of the soil. Usually present on basalt soils, but also on alluvial soils.

Granite: A coarse-grained intrusive igneous rock, usually comprised of quartz, feldspar and micas.

Groundwater: Water that lies within the saturated zone of rock and soil. It moves between pore spaces, cavities and fractures in the sediment and rock under the influence of gravity. Groundwater can transport trace minerals and elements dissolved in the water.

Hearth: Usually a subsurface feature found eroding out of a river or creek bank or in a sand dune - it indicates a place where Aboriginal people cooked food. The remains of a hearth are usually identifiable by the presence of charcoal and sometimes clay balls (like brick fragments) and hearth stones. Remains of burnt bone or shell are sometimes preserved within a hearth.

High Integrity Occupation Deposit: The laying down of deposits by human activities that bury artefacts to form distinct stratigraphic entities such as layers (eg dense lens of stone artefacts & bone between environmental deposits, stratified shell deposits) or features (hearths, occupation mounds). High integrity occupation deposits have a high degree of spatial and temporal integrity.

Holocene Period: The time from the end of the Pleistocene Ice Age (c 10,300 BP) to the present day.

Hydrothermal Quartz: Also known as milky quartz. Formed by the intrusion of hydrothermal water containing dissolved silica and other minerals into folded bedrock (commonly metasediments). The hydrothermal water reaches a natural trap such as an anticlinal fold or a fault before cooling, allowing the silica to precipitate into quartz.

Igneous: Rocks that have formed through the crystallisation of magma.

Intrusion: The act of an intrusive igneous rock rising up through the Earth's crust and breaking through the lower levels of the bedrock.

Iron Staining: Where a crust of iron oxide enriched clay coating precipitates on the surfaces of individual sediment grains, giving an orange-red-yellow stain to the sediment or soil as a whole.

Last Glacial Maximum: A period of cold, dry conditions on Earth when the ice caps on the polar regions were at their largest extent. This period lasted between approximately 18-24 ka BP.

Lava: Molten material extruded from a volcano or fissure in the Earth's surface.

Lithic: Anything made of stone.

Metamorphism: The process by which rocks are transformed by recrystallisation due to increased heat and/or pressure in the Earth's crust. Metamorphism can be either on a regional scale or on a contact scale.

Middens: Midden is a term borrowed from the Danish. It originally applied to the accumulations of shell and other food remains left by Mesolithic man. Australian middens are an accumulation of hearth and food debris, which has built up a deposit over a length of time. Middens are generally comprised of charcoal and either freshwater or coastal shell species, depending on the place's location. Middens may also contain stone artefacts, and the food refuse of other native animals such as small mammals. The thick deposit of burnt shells and dark grey/black deposit can distinguish middens within the landscape. Coastal shell middens are often found in close association with rock platforms. Freshwater shell middens are found in close proximity to areas with freshwater mussels.

Mounds: Mounds are accumulation of hearth (fire place) debris, which has over time built a thick deposit on the ground's surface. Mounds are generally comprised of charcoal; burnt clay balls and burnt food refuse (eg native animal bones). Mounds may also contain stone artefacts. On rare occasions mounds may also contain human burial remains. Mounds can be distinguished in the landscape by their characteristic dark grey/black deposit and height above surrounding land. Mounds that have been utilised over long periods can obtain dimensions of over 100 metres in length and 1 metre in height. Mounds are generally situated close to major streams, and large water bodies. In times of flood, mounds are often become marooned, and provide dry land points from which surrounding resources could have been exploited.

Occupation Surface: A distinct layer or interface between depositional strata upon which human activities were carried out and artefacts/features deposited. Most commonly this may be a prior land surface (eg soil horizon) that has been subsequently buried by later environmental deposits (eg dune deposits).

Pisolith: Hard, iron-cemented spherical particles of sediment (usually sand). These range in size from 3mm to 6mm.

Pleistocene: The geological period corresponding with the last or Great Ice Age. The onset of the Pleistocene is marked by an increasingly cold climate. The date for the start of the Pleistocene is not well established, and estimates vary from 3.5 to 1.3 million years ago. The period ends with the final but gradual retreat of the ice sheets, which reached their present conditions around 10,300 BP.
Raw Material: Organic or inorganic matter that has not been processed by people.
Regolith: An incoherent mantle of varying thickness that lies above fresh rock. This is usually the decomposed, weathered and broken up derivative of the fresh bedrock. The soil profile lies above this layer.
Sand Sheet: A thin, continuous deposit of sand with no large topographic features on the surface.
Scarred Tree: Scars on trees may be the result of removal of strips of bark by Aboriginal people for the manufacture of utensils, canoes or for shelter; or resulting from small notches chopped into the bark to provide toe and hand holds to climber after possums, koalas and/or views of the surrounding area. A scar made by humans as opposed to naturally made by branches falling off, *etc*. is distinguished by the following criteria: symmetry and rounded ends, scar does not extend to the ground, some re-growth has occurred around the edges of the scar, and no holes or knots present in the heartwood.
Scoria: Pyroclastic volcanic rock containing numerous gas pockets and spaces. Colour ranges from red-brown to black.
Sensitivity: Based on collated existing data and place inspection an area or specific place may contain sensitivity for extant or archaeological deposits. Background research will present the most likely place types, contents and state of preservation.
Siliceous: Rocks and sediments that contain an abundance of silica.
Stony Rise: Irregular, hummocky and stony ground formed on younger lava flows. Caused by uneven cooling and slumping of basalt flows.
Swale: A linear depression that runs between two ridges. This is usually applied to dune environments where the swale is located between two dune ridges and is occupied by a swampy environment.
Terrace: A gently sloping or flat step-like structure usually associated with a fluvial environment and bounded by steeper slopes on the outer margins. Streams commonly flow along terraces. Terraces can be paired or unpaired according to the depositional environment.
Uplift: Upward surface movement attributed to faulting or movement of the continental plates.
Visibility: Refers to the degree to which the surface of the ground can be observed. It is generally expressed in terms of the percentage of the ground's surface visible for an observer on foot (Bird 1992). For example 10% visibility equates to 10cm^2 per 1 m^2 of ground surface that is not covered by vegetation or soil deposit. The following applies to descriptions of ground surface visibility within this report.

0%	No visible ground surface	50 – 70%	Good
0 – 10%	Very Poor	70 – 90%	Very Good
10 – 30%	Poor	90 – 100%	Excellent
30 – 50%	Fair		

Weathering: The process by which fresh rock degrades/breaks down at or near the surface. This process modifies rock chemically, organically, and/or physically, whereby a mantle of waste known as regolith will remain *in situ* until it is eroded away.