Officer South Employment Precinct Structure Plan

Land Capability Assessment

Victorian Planning Authority

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Executive Summary

Aurecon Australasia Pty Ltd (Aurecon) was commissioned by the Victorian Planning Authority (VPA) to complete a Land Capability Assessment of the Officer South Employment Precinct Structure Plan (PSP) (the 'precinct'). The key objective was to assess the existing environmental conditions of the precinct and identify areas of constraints relating to environmental variables that may affect the viability of developing land within the precinct. To achieve the project objectives, Aurecon completed the following scope of work:

Stage 1: A desktop review of data from various environmental databases that may present as potential constraints on the developability of the precinct as part of the PSP process.

Stage 2: Based on the desktop findings, a targeted site inspection to assess these geotechnical, hydrogeological and contamination uncertainties was completed at accessible key sites in the precinct.

Stage 3: Documentation of Stage 1 and Stage 2 findings in this report.

Stage 4: Update of report delivered at Stage 3 to reflect the following changes of legislation:

- New Environment Protection Act 2017 (as commenced 1 July 2021)
- Updated Environmental Audit Overlay (EAO)
- Updated Planning Practice Note 30
- Updated Ministerial Direction 1.

Conclusions and Recommendations

Geotechnical / soil assessment

The subsurface profile across the project site is expected to largely comprise clay or sandy clay alluvial materials which were deposited by ancient watercourses removing the eroded by-products of the elevated interbedded siltstones and sandstone materials to the north of the site. In isolated areas of the site, shallow lenses of fill and/or pockets of swampy material will be present. Both dispersive soils and materials which upon disturbance could generate acid sulfate materials are expected to be present.

The ground conditions will present difficulties during construction due to the presence of surface water weakening the surface clays making trafficking difficult during the wetter months. For much of the site, following typical site preparation works, typical shallow foundations are expected to perform adequately for low rise residential and commercial structures. Where weaker swampy conditions are present, or structures with large, or unusual loading are proposed, specific engineering design will be required.

In order to better understand the risk of dispersive soils, acid sulfate soils and general ground conditions present to support the preliminary recommendation within this report, further investigation is recommended and a scope of work for an intrusive fieldwork is provided.

Hydrology and hydrogeology assessment

The hydrology of the precinct that features two significant waterways, a major overland flow path and additional water treatment assets related to water management within the locality, affords opportunities to integrate water into the precincts future urban structure in a manner that will facilitate amenity, connectivity and liveability for its future occupants. The hydrogeology of the precinct that consists of shallow groundwater and high salinity water requires further assessment and monitoring to ensure that local waterways, downstream ecosystems, including Ramsar wetlands, and groundwater quality within the Koo Wee Rup Water Supply Protection Area (WSPA) is maintained and potentially improved.

The conversion of rural land to urban provides an opportunity to rehabilitate the land and assist the natural water balance to support sustainable development. This approach to water management should be incorporated into the drainage strategy for the precinct. As part of the precinct's development planning Integrated Water Management (IWM) should be incorporated to address the current constraints that exist within the precinct's hydrology and hydrogeological context. These IWM opportunities within the precinct

consist of stormwater and rainwater harvesting, flood management, reduction of discharges into Cardinia and Lower Gum Scrub Creeks and Western Port Bay, and provision of recycled water.

Stormwater capture and its use for irrigation within the precinct along with stormwater capture integration with infrastructure for water supply should also be explored as part of the future drainage strategy for the precinct. The precinct's linear drainage system that runs from its north- western boundary to its south-eastern boundary also provides opportunities to co-locate vegetation/open space with drainage assets to facilitate corridors that further support ecological and biodiversity values, provide flood management, improve groundwater salinity, and create urban forest connections.

If opportunities arise, co-location of future drainage assets within the existing transmission easement at the southern portion of the precinct and within the riparian corridors (approx. 100 m) adjoining both Cardinia Creek and Lower Gum Scrub Creek, has the potential to result in a reduction in land take and could be explored as part of future drainage planning works. Where drainage assets and other infrastructure (i.e. pump stations, storage tanks etc.) can be co-located on already encumbered land, net developable area within the precinct is maintained for urban development. The provision of recycled water for residential areas (managed by South East Water) has the capacity to be extended through the precinct to include industrial and employment areas where manufacturing customer bases are likely to exist.

Further testing and work are recommended within this report.

Ecology

The precinct includes two sections of Conservation Area 36 and this land is unable to be developed and will be retained, enhanced and managed for Growling Grass Frog habitat. Planning of developments within the precinct should aim to integrate with the Conservation area in a manner that will not degrade the habitat values, such as introducing weeds, pest animals, contaminants and major alterations to the hydrology. Activities that may adversely alter or effect the Conservation Area may require a Works in Conservation Area permit from the Department of Environment, Land, Water and Planning (DELWP).

Development within the precinct should also take into consideration any effects that development may cause downstream on the Western Port Ramsar wetland. Increased sediment or contaminant loads should not increase above current baseline conditions. This may require some developments to store and treat stormwater on site and have appropriate controls for contaminant spills or leaks. Any activities that may have a likely significant impact above limits of acceptable change, and above described impacts in the Program Report on the Western Port Ramsar wetland may require Referral to the Commonwealth Department of Agriculture, Water and the Environment to determine if the activity requires assessment under the *Environment Protection and Biodiversity Conservation Act* 1999.

Removal of native vegetation and scattered native trees will be subject to approvals under the Planning Scheme. The removal of native vegetation will require offsets in the form of financial developer contributions.

Contamination assessment

The preliminary findings of this desktop study did not identify significant high-risk areas for potentially contaminated land and groundwater, with the exception of inferences made for the BP Truck Stop Service Station at 94 Princes Freeway. Given the size of this precinct and level of assessment completed, it is possible that not all contamination issues have been identified at this stage and that sites identified as low risk may be re-classified as medium risk PCL sites upon further investigation. As it is noted that agricultural practices still have the potential to contaminate land at generally lower levels, further assessment is generally recommended to confirm or rule out the presence of significant contamination issues. Despite the above, the majority of land within this precinct has not been heavily industrialised and hence many opportunities to redevelop the land within the precinct for various sensitive and less sensitive uses are still available.

Based on the findings of this preliminary assessment, it is inferred that localised low-level contamination may be encountered on a precinct-wide scale during further development of the precinct due to historical imported fill and general agricultural activities. Due to the nature of existing infrastructure and activities at the BP Truck Stop Service Station, there is a higher potential for contaminated land at this site and it is this site that may trigger the requirements of the Ministerial Direction No. 1 (2021) and No. 19 (2018), and the Victorian Environment Protection Act (2017), and should be investigated in accordance with the framework outlined in Table 3 of *Planning Practice Note 30* (2021).

Where current agricultural and reserve land is proposed to be developed into sensitive land uses (e.g. residential, child-care centres, playgrounds, pre-schools and elementary and secondary schools) and less sensitive land uses (e.g. commercial, industrial), then general duties under Section 12(2)(b) and Section 60(1)(a)(iii) of the *Planning and Environment Act* 1987 apply, which involves the Planning Authority being satisfied the site is not contaminated.

To support future waste classification at the precinct and confirm the low inferred risk of contamination, an exploratory baseline soil and groundwater intrusive assessment could be undertaken. The investigation is considered optional, and should be conducted to further inform area-specific or lot-specific development plans and assist with construction soil management which is likely to be required. It should be noted that high-level desktop-based site histories such as this assessment do not always accurately inform the risk or presence of contamination.

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Abbreviations

Abbreviation	Definition
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999 as amended 2013
AASS	Actual acid sulfate soil
ASS	Acid sulfate soils
Aurecon	Aurecon Australasia Pty Ltd
BCS	Biodiversity Conservation Strategy
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries (now part of DELWP)
DO	Dissolved oxygen
DS	Drainage scheme
DSE	Department of Sustainability and Environment (now part of DELWP)
EC	Electrical conductivity
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
FFG Act	*Flora and Fauna Guarantee Act* 1988
FO	Flood Overlay
General Practice Note	Refers to 'Potentially Contaminated Land General Practice Note' (DSE 2005)
IWM	Integrated Water Management
LSIO	Land Subject to Inundation Overlay
m AHD	Metres (above) Australian Height Datum
m bgl	Metres below ground level
m bTOC	Metres below top of casing (groundwater level physical measurement point)
MD1	Ministerial Direction No. 1 (Victorian Government 2001)
MD19	Ministerial Direction No. 19 (Victorian Government 2018)
MNES	Matter(s) of National Environmental Significance
MSA	Melbourne's Strategic Assessment
NVIM	Native Vegetation Information Management
NVPP	Native Vegetation Precinct Plan
PAN	Pollution Abatement Notices
PASS	Potential acid sulfate soils
PCL	Potential contaminated land (per General Practice Note)
PCV	Permissible Consumptive Volume

Abbreviation	Definition
PFAS	Per- and poly-fluoroalkyl substances
Precinct	Officer South Employment Precinct (the study area and extent described within this report)
PSA	Planning scheme amendment
PSP	Precinct structure plan
Redox	Reduction oxidation potential
SEW	South East Water
SWL	Standing water level
TDS	Total dissolved solids (as a measure of water salinity)
VPA	Victorian Planning Authority
WSPA	Water Supply Protection Area

1 Introduction

Aurecon Australasia Pty Ltd (Aurecon) were commissioned by the Victorian Planning Authority (VPA) to complete a Land Capability Assessment for the Officer South Employment Precinct Structure Plan (PSP), hereafter referred to as 'the precinct' throughout the report, with the study extent shown in **Figure A1**.

1.1 Background

According to the South East Growth Corridor Plan (VPA 2012), the precinct has been identified as future land supply for industrial, commercial and residential opportunities, which will complement existing surrounding developments. Immediately surrounding the precinct, several PSPs have already been completed – such as those for Officer, Cardinia Road, Cardinia Road Employment, Minta Farm, Clyde North and Cardinia Creek South.

The precinct is included in the Melbourne Strategic Assessment area and includes two Biodiversity Conservation Strategy Conservation Areas along Cardinia Creek and Gum Scrub Creek, respectively. The boundaries of the precinct are broadly defined by Princess Freeway to the north, Lower Gum Scrub Creek to the east, the Urban Growth Boundary to the south and Cardinia Creek to the west.

The precinct comprises approximately 1,069 hectares of land and 48 parcels of land (of which some are reserve land). Via a review of the current land planning cadastre boundaries (DELWP 2020) there are approximately 23 key properties immediately surrounding the precinct and five road reserves along the northern boundary of the proposed precinct (Princes Freeway).

This assessment aimed to provide the necessary amount of information for the VPA to plan the future urban structure of the precinct with greater certainty by identifying environmental issues and constraints relating to land development capabilities.

1.2 Project Objective

The key objective of this project is to assess the existing environmental conditions of the precinct and identify areas of issues and constraints that may affect the viability of developing land within the precinct.

1.3 Scope of Work

To achieve the project objective, Aurecon completed the following scope of work:

- Completion of the assessment in general accordance with relevant standard National and Victorian environmental regulatory frameworks for each representative discipline (refer **Section 3**);
- Completion of a desktop review which identified the following key existing items (refer **Section 4**);
  - Current or historical land uses likely to result in soil and groundwater contamination
  - Soil or groundwater contamination through review of publicly available environmental audit reports
  - Environmental conditions where close inspection of potential areas of concern on site were required and subsequently inspected via a site walkover
  - 'High', 'moderate', 'low' risk sites for contamination (i.e. land parcels within the precinct that were prioritised based on potential contaminated land (PCL) indicators from desktop review findings)
  - 'High', 'moderate', 'low' risk sites for hydrological, hydrogeological and geotechnical constraints
  - Comments on constraints related to key known ecological variables such as protected species and conservation areas that may alter the way other environmental variables need to be assessed in this report.
- Reporting of the findings of this assessment, which included the following summaries (refer **Section 5**);

- Advice on where and when further assessment may be required as necessary (i.e. based on findings of the reviews and identified constraints regarding general site setting, ecological values, hydrology, hydrogeology and geology/geotechnical constraints and contamination).
- Advice on contamination matters related to the current Victorian environmental regulatory regime (*Environment Protection Act* 2017).
- A summary of key relevant regulatory requirements to be met, relating to the above factors, during the preparation of the PSP and subsequent urban development of the site.
- Figures visually showing the key desktop findings and identified constraints (refer **Figures A1-A14 within Appendix A**).

2 Method

This section describes the assessment approach that is relevant to each of the environmental aspects reviewed for this project.

2.1 General Assessment Approach

2.1.1 Stage 1 – Desktop Assessment

Data Sources

The findings of the desktop assessment relied on a review of the following information databases (as retrieved by data-provider Lotsearch; a copy is provided in **Appendix B**) and as supplemented by Aurecon as required for each discipline:

- Officer South Employment Precinct Structure Plan (https://vpa.vic.gov.au/project/officer-south-employment/);
- Adjoining PSPs of Cardinia Creek South PSP, Cardinia Road Employment PSP, Minta Farm PSP (VPA various dates);
- Cadastre data (Department of Environment, Land, Water and Planning (DELWP) supplemented by the VPA for the precinct);
- Surface and basement elevation maps (DELWP);
- State geological maps (soils, geological formations, zones, key structures) (DELWP);
- Geological maps at 1:25,000, 1:63,360 & 1:250,000 scales (Geological Survey of Victoria);
- Potential acid sulfate soil mapping (Australian Bureau of Agricultural and Resource Economics and Sciences, Commonwealth Scientific and Industrial Research Organisation);
- Hydrogeology maps (water table, salinity) (DELWP, Geoscience Australia);
- Registered groundwater borehole databases – various (DELWP, Federation University);
- 1:100-year flood and coastal inundation maps (DELWP);
- Groundwater- and inflow-dependent ecosystems maps (Bureau of Meteorology);
- Bushfire-prone zones and fire history (DELWP);
- Native vegetation and Ramsar maps (DELWP);
- Current certificates of titles only;
- Current (as of 30 April 2020) and former (as of 4 November 2019) Environment Protection Authority (EPA) Victoria priority sites register (EPA Victoria);
- Current and former EPA-licenced activities and works approvals lists (EPA Victoria);
- Completed environmental audit reports (EPA Victoria);
- EPA-listed groundwater restricted use zones (EPA Victoria);
- Worksafe Victorian Dangerous Goods database search;
- Per- and poly-fluoroalkyl substances (PFAS) site investigation lists (Airservices Australia, Department of Defence and EPA Victoria);
- National and State-wide liquid fuel, waste, prescribed waste, landfill and resource recovery facilities lists (EPA Victoria, Geoscience Australia, Sustainability Victoria);
- Current and historical aerial photographs (dated from 1925 to 2020, respectively);

- Historical business directories including dry cleaners, motor garages and service stations (Sands & McDougall directories of various dates);
- Heritage databases – various (Australian Government Department of Agriculture, Water and the Environment, DELWP and Department of Premier and Cabinet);
- Planning scheme zones and overlays (DELWP); and
- Cardinia Industrial Drainage Scheme (DS), Officer DS, Lower Gum Scrub Creek DS (Interim) and Officer South DS (Interim) Melbourne Water.

Where online publicly accessible databases (such as the Victoria Unearthed Online Database) were available, the information provided by Lotsearch was reasonably cross-checked for newer information for this project. Lotsearch indicate in their report that any third-party who access or rely on their provided information acknowledges that the data provided does not constitute an exhaustive set of information sources and should not be used to determine saleability or value or making any other decisions in relation to any property. Lotsearch express that the end user of its report should undertake their own inspections of any relevant parcels to satisfy itself that there are no defects or failures. Full details of the Lotsearch terms, conditions and limitations are provided in the Lotsearch Report within **Appendix B**.

Qualitative Risk Ranking Approach

Based on the findings of the desktop review, areas where ***subjectively higher risk issues may arise*** for precinct planning and development phases have been identified. In general, a high-level qualitative 'traffic light' risk ranking system was utilised in this report to code the inferred / identified constraints within the precinct and surrounding where practicable.

This system is intended to provide a holistic understanding of environmental risk profiles for the precinct and identification of the possible strategies required to manage such risks – such as provision of indication of potentially problematic areas for the precinct moving forward in precinct planning processes and where targeted further assessments will be helpful.

For contaminated land, this approach has been formed and completed in-line with the *Planning Practice Note 30*. Parcels identified as 'potentially contaminated' with potentially contaminating features or activities were assigned a 'potential for contamination' ranking. This ranking identifies the potential to impact the precinct planning and the likely level of management required to mitigate key outstanding contamination risks posed to the project.

Three possible PCL categories were identified, with the category of 'high' PCL representing the greatest risk and 'low' PCL representing the lowest risk. A broad definition of each category is described below. Complete details of further requirements aligned with the 'Low' to 'High' PCL rankings are provided in the Practice Note document available online.

High Potential for Contaminated Land (HPCL)

- Potential contaminated land constraints and/or known pollution in exceedance of quality objectives is likely such that risks are likely to be 'elevated' unless managed. The nature and extent of contamination is uncertain, and/or the potential contaminant profile is complex. The complexity and potential extent of exceedance(s) over quality objectives may have a moderate to significant impact on the construction/development approach.
- The preliminary conceptual site model (CSM) should be refined through onsite investigations, which will likely lead to the requirement of a detailed site investigation being completed to inform remediation and/or management plans for the site. A preliminary CSM in the context of contaminated land consists of information regarding the site layout, environmental setting, and potential sources and receptors of contamination.
- Example industries considered to have a 'high potential for contamination' may include (but not limited to) the following (PPN30):
  - Abattoirs

- Airports
- Manufacturing works (asbestos, asphalt / bitumen, brick, ceramics, chemicals, coke, batteries, compost, electrical components, explosives, gasworks, iron / steel works, lime, various metal works)
- Heavy industry (automotive repairs, recycling, waste depots, council depots, fuel depots, dry cleaning, foundries, landfill sites, service stations, sewage treatment plant, tanneries, timber treatment, underground storage tanks, waste treatment/disposal/storage sites).

Medium Potential for Contaminated Land (MPCL)

- Potential contaminated land constraints and/or known pollution in exceedance of quality objectives is possible such that risks are 'marginal'. The nature and extent of contamination is uncertain, and/or the potential contaminant profile is less complex.
- The preliminary CSM should be refined through onsite investigations, which would provide an indicative assessment of soil and/or other environmental media conditions. This may lead to the requirement of a detailed site investigation being completed to inform management plans for the site. A preliminary CSM in the context of contaminated land consists of information regarding the site layout, environmental setting, and potential sources and receptors of contamination.
- Example industries considered to have a 'medium potential for contamination' may include (but not limited to) the following (PPN30):
  - Chemical and fuel storage
  - Market gardens
  - Waste disposal
  - Filling (imported soil)
  - Generic less heavy industrial activities such as warehousing of goods and wash bays areas.

Low Potential for Contaminated Land (LPCL)

- If the identified land use or site activities do not fall within the high and medium potential categories, and there is reasonable doubt for the current land use to significantly contaminate the land, then the land is considered to have a 'low potential' for contamination.

2.1.2 Stage 2 – Site Inspection

For this project, a site inspection was undertaken by experienced scientists and engineers in areas where data required ground-truthing against desktop findings. The site inspection was completed on the following basis:

- Comprised of a number of potentially moderate to higher risk constraints for geotechnical and hydrogeological variables that required further site inspection.
- Comprised of access to private properties where land-owners have provided VPA explicit consent for site inspections for this project. Where access was restricted, no site inspections have been undertaken and is recommended for inspections to be undertaken in future phases of works as required (refer Figure A2 for map).
- Comprised of the supply coordinates and/or photographs of potential areas of concern (if any).
- For geotechnical variables, it was proposed that where geological and water features intersected, a site walkover was completed to gain a sensible understanding of erosion and acid sulfate soil potential. Where possible during the walkover, other pertinent visible observations relating to those found during the desktop geotechnical review were also made.
- For hydrogeological variables, it was proposed that available and potentially accessible publicly registered groundwater bores were measured for in-bore groundwater levels, salinity and general water quality parameters.

- For contamination assessment, the properties that were visited for geotechnical and hydrogeological purposes were noted for the following signs of potential contamination where it could not be identified by desktop review:
  - Signs of landfilling, waste dumping and other areas of soil disturbance (if any)
  - Site infrastructure (e.g. fuel / chemical storage if any)
  - Waste, staining and other indications of possible contamination.

2.1.3 Requirements for Further Intrusive Investigation

The completion of further intrusive investigations was not within the scope of this project; however, it is noted that some higher risk sites may warrant further intrusive sampling of soil, groundwater, surface water, site infrastructure, and/or subsurface and indoor air where a site's history indicates the requirement to do so. Such requirements have been noted in the recommendations section of this report where relevant (refer **Section 4**).

3 Regulatory Framework

This assessment was undertaken in accordance with various applicable legislation, policies, guidelines and standards for each environmental aspect. The details, nuances and key notes for the application of each of these guidance documents have been summarised in this section.

3.1 Legislation and Policies

Relevant state-level legislation and associated policies pertaining to the assessment are discussed in **Table 3-1.**

Table 3-1 Relevant legislation and policies

Instrument	Description	Applicability
***Planning and Environment Act* 1987**	The *Planning and Environment Act* 1987 provides the requirements of planning authorities when preparing planning schemes or amendments to planning schemes. This Act requires planning authorities to "take into account any significant effects which it considers the scheme or amendment might have on the environment or which it considers the environment might have on any use or development envisaged in the scheme or amendment". Under Section 12 (2) (a) of this Act, the Ministerial Direction No. 1 – Potentially Contaminated Land requires planning authorities to satisfy themselves that the environmental conditions of land proposed to be used for a sensitive use, agriculture or public open space are, or will be, suitable for that use. This is generally done through the completion of an environmental site assessment and audit process.	Current and applicable
Ministerial Direction No. 1 (MD1) Potentially Contaminated Land 2021	MD1 states that in preparing a planning scheme amendment which would have the effect of allowing (whether or not subject to the grant of a permit) potentially contaminated land to be used for a sensitive use, agriculture or public open space, a planning authority must satisfy itself that the environmental conditions of that land are or will be suitable for that use.	Current and applicable
Ministerial Direction No. 19 (MD19) Ministerial Direction on the preparation and content of amendments that may significantly impact the environment, amenity and human health 2018	MD19 requires the planning authority to seek the advice of EPA when preparing planning scheme reviews and amendments that could significantly impact on the environment, amenity and human health. This consultation requirement is triggered when one of the situations in the 'Application' section of the document apply, which include (as relevant to current purposes) when a PSA is being prepared that may: ■ Allow the use or development of potentially contaminated land, and/or trigger the requirements of Ministerial Direction No. 1. ■ Allow the use or development of land that could result in water, noise, air or land pollution impacts on the environment, amenity or human health, including as defined by State Environment Protection Policies. Section 2 of the MD19 designates specific circumstances triggering requirements of MD19; by its wording, the Section 2 triggers the requirements of MD19 for a broad range of developments, including if the development triggers requirements of the State Environment Protection Policy (Prevention and Management of Contamination of Land).	Current and applicable

Instrument	Description	Applicability
***Environment Protection Act* 2017 / *Environment Protection Amendment Act* 2018**	In 2017, the Victorian Parliament passed the *Environment Protection Act* 2017 (2017 Act) which repealed the *Environment Protection Act* 1970. The Amendment Act (dated 2018) amends the 2017 Act. From 1 July 2021, the 2017 Act and supporting regulatory framework will be the principal environmental legislation for Victoria. From a legislative perspective, the 2017 Act may require duty holders to update their site management practices in order to comply. The key changes under the 2017 Act that are relevant to site management are: ■ Changes to the permissions framework. ■ Introduction of the 'General Environmental Duty'. ■ Specific duties relevant to the identification and management of contaminated environments.	Current and applicable
Environmental Reference Standards (ERS)	The SEPPs were replaced on 1 July 2021. The changes are as follows: ■ **Land:** The ERS adapts the environmental values, indicators and objectives contained within the SEPP (Land) with minor changes. ■ **Waters:** The ERS adopts the environmental values, segments, indicators and objectives contained within SEPP (Waters) with minor changes. There will be some transitional provisions in the ERS (this is unique to the water component).	Current and applicable
***Environment Protection and Biodiversity Conservation Act* 1999**	The *Environment Protection and Biodiversity Conservation Act* 1999 is the Australian Government's key piece of environmental legislation which commenced 16 July 2000. This Act enables the Australian Government to join with the states and territories in providing a truly national scheme of environment and heritage protection and biodiversity conservation. This Act focuses Australian Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance. https://www.environment.gov.au/epbc/about	Current and applicable
***Flora and Fauna Guarantee* Act 1988**	The *Flora and Fauna Guarantee Act* 1988 is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. This Act places importance on prevention to ensure that more species do not become threatened in the future. This Act emphasises the importance of cooperative approaches to biodiversity conservation and recognises that all government agencies and the community need to participate in the conservation effort. https://www.environment.vic.gov.au/conserving-threatened-species/victorias-framework-for-conserving-threatened-species	Current and applicable
***Wildlife Act* 1975**	All native wildlife is protected in Victoria. It is an offence to kill, take, control or harm wildlife under the *Wildlife Act* 1975. It is also an offence to use poisons to kill, destroy or take wildlife. Severe penalties (including imprisonment and fines) apply to those found guilty of an offence under the *Wildlife Act* 1975. Anyone wishing to control wildlife must have an authorisation from DELWP. The most common authorisation is an Authority to Control Wildlife. https://www.wildlife.vic.gov.au/managing-wildlife/wildlife-management-and-control-authorisations	Current and applicable

Instrument	Description	Applicability
***Water Act* 1989**	The *Water Act 1989* (Vic) provides the legal framework for managing Victoria's water resources. The purpose of this Act is to provide for the integrated management of all elements of the water cycle, promote equitable and efficient use of water resources, conserve and properly manage water resources for all Victorians, increase community involvement in conserving and managing water resources, define and protect public and private rights to water, define administration for water Authorities and foster responsible and efficient water services, provide protection and enhancement of environmental qualities of waterways, catchments and instream use. **https://www.legislation.vic.gov.au/in-force/acts/water-act-1989/130**	Current and applicable.
Planning Practice Note 30 (2021)	*Planning Practice Note 30* (PPN30) was issued in July 2021 and pertains to land use planning and potentially contaminated land, in particular, how to identify potentially contaminated land, determining the appropriate level of assessment for contaminated land, determining the appropriate provisions in planning scheme amendments, and determining the appropriate conditions on planning permits.	Current and applicable

3.2 Guidelines and Standards

Relevant guidelines and standards applicable to the general standard practice of assessment at various stages (e.g. desktop, site inspection, intrusive works where warranted) have been summarised in **Table 3-2**. For each specialist, these guidance documents provide recommendations for the appropriate conduct of this assessment.

Table 3-2 Relevant guidelines and standards

Document	Description	Applicability
National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999 as amended 2013 ('ASC NEPM')	The ASC NEPM is the national guideline for assessing contaminated sites and was prepared by the National Environment Protection Council (NEPC). The original NEPM published in 1999 and was amended in May 2013. The NEPM document ensures there is a nationally consistent approach to the assessment of site contamination. The NEPM provides guidance on the approaches, methods and reporting requirements of site contamination assessment and data quality indicators.	Current and applicable
EPA Victoria Publications and Guidelines	The following publications and guidelines from EPA Victoria are commonly applied and referenced for intrusive soil and groundwater site assessments: ■ EPA Victoria 2022. *Groundwater Sampling Guidelines.* Publication 669 ■ EPA Victoria 2006. *Hydrogeological assessment (groundwater quality) guidelines.* Publication 668 ■ EPA Victoria 2009a. *Sampling and analysis of waters, wastewaters, soils and wastes.* Publication IWRG701 ■ EPA Victoria 2009b. *Soil sampling*. Publication IWRG702. From time to time, depending on the nature of the complexity of site contamination, documents from other EPAs in other Australian states or International jurisdictions may be referenced for guidance.	As intrusive works were not within the scope of this assessment, these guidance documents were not strictly referenced.
Australian Standard AS1170.4-2007 Earthquake actions in Australia	Section 3 site hazard and Section 4 Site sub-soil class provides suitable parameters for classification of the site for structural consideration of earthquake effects. This study is limited to desktop sources for classification of sub-soil class which shall be updated upon recent of further intrusive data.	Current and applicable
Australian Standard AS1726-2017: Geotechnical site investigations	Section 5 of the standard recommends that phases of investigation are conducted for each project. For this project, a desktop study is an appropriate level of work to better understand geotechnical conditions. Future site investigations will be required to better the geotechnical risk as refinement of the proposed project is advanced.	Current and applicable
Australian Standard AS2870-2011: Residential footings and foundations	Section 2 Site Classification provides the standard method for cauterisation of site based on the expected level of ground surface movement and the depth to which this movement extends. Analysis is based on desktop data and generalised guidelines of Appendix D.	Current and applicable
Australian Standard AS4482.1-2005: Guide to the investigation and sampling of sites with potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds	Australian Standard 4482.1 provides guidance on the reliable collection of sufficient site data when assessing potentially contaminated sites. While this standard focusses the assessment of sites potentially contaminated with non-volatile and semi-volatile compounds, this standard covers key elements of preliminary site investigations (i.e. Stage 1 or Phase 1 ESAs), detailed site investigation methods (i.e. Phase 2 ESAs), data quality objectives and the appropriate development of sampling design and implementation strategies.	Current and applicable

Document	Description	Applicability
Australian Standard AS4482.2-2005: Guide to the sampling and investigation of potentially contaminated soil – Part 2: Volatile substances	Part 2 of the AS4482-2005 provides more specific guidance on field screening and sample collection techniques when assessing sites that may be contaminated with volatile compounds.	Current and applicable
Integrated Water Management Framework for Victoria (DELWP 2017)	The Integrated Water Management (IWM) Framework for Victoria provides a guide to government, the water sector and the community to plan, manage and deliver water in Victoria's urban environment together. Through consistent and strategic collaboration within the water sector – including water corporations, local governments and catchment management authorities – and their links to land use planning, greater community value will be delivered. The approach works with and feeds into existing water and land planning processes.	Current and applicable
Waterway corridors – Guidelines for greenfield development areas within the Port Phillip and Westernport Region (Melbourne Water 2013.)	As the caretaker of river health for waterways in the Port Phillip and Westernport region they have a duty of care to establish and maintain riparian zones along all waterways to improve waterway health. These guidelines have been developed to provide a consistent, strategic approach to the management of riparian zones in greenfield developments, in the South-east Growth Corridor.	Current and applicable
Biodiversity Conservation Strategy for Melbourne's Growth Corridors (DEPI 2013a)	The Biodiversity Conservation Strategy (BCS) is the overarching strategy for protecting biodiversity in Victoria's growth corridors. It outlines all relevant matters of national and state environmental significance, including matters covered in the *Environment Protection and Biodiversity Conservation Act 1999*.	Current and applicable
Sub-regional Species Strategy for the Growing Grass Frog (DEPI 2013b)	Informs the Biodiversity Conservation Strategy and Growth Corridor Plans by identifying important populations of Growling Grass Frog, habitat to be protected, and the use of habitat corridors.	Current and applicable

4 Desktop Review

For this desktop assessment, Aurecon engaged Lotsearch Pty Ltd to complete the retrieval of georeferenced site history and environmental data for the precinct. A copy of this report ('LS012581_EP') is provided in **Appendix B**. The key findings of Aurecon's review of the Lotsearch data package are summarised in this section. A list of data sources review has been provided in **Section 2.1.1** above.

4.1 Precinct Description

The precinct is located approximately 46 km south-east from Melbourne's Central Business District in Victoria, Australia. The precinct is bounded by the Princes Freeway to the north, Gum Scrub Creek to the east, Patterson Road to the south and Cardinia Creek in the west and southwest, which forms a meandering natural boundary until it intersects Patterson Road (refer **Figure A1**).

Within **Appendix A**:

- The precinct locality is shown on **Figure A1**, and basic site details describing the precinct are provided in **Table 4-1** below.
- The 48 parcels (and relevant site inspection parcels) included in this desktop study are identified in **Figure A4**.
- Identified planning zones and overlays are shown on **Figure A3**.
- Current land uses are shown spatially in **Figure A4**.

Table 4-1 Basic setting details of the precinct

Item	Description
Name	Officer South Employment Precinct, Victoria
Local government	Cardinia Shire Council
General layout	Generally flat, low-lying area situated between 12-40 metres Australian Height Datum (m AHD), gently sloping from higher areas in the north-west to lower lying in the south-east.
Size and title information	The precinct comprises 1,069 hectares and 48 parcels of land. Copies of current titles and associated title plans are provided in **Appendix C** and details discussed further in **Section 4.5.1**. The precinct is included in the Melbourne Strategic Assessment area and includes two Biodiversity Conservation Strategy Conservation Areas along Cardinia Creek and Gum Scrub Creek, respectively. The boundaries of the precinct are defined by Princess Freeway to the north, Lower Gum Scrub Creek to the east, the Urban Growth Boundary to the south and Cardinia Creek to the west.
Current land zoning	As shown in **Figure A3**, the precinct is currently zoned as: ■ Urban Growth Zone (majority of the precinct) ■ Public Conservation and Resource Zone (encompassing the embankments and some of the northern arm of Cardinia Creek located along the western boundary of the precinct.
Current land uses	As shown on **Figure A4**, the precinct can presently be described as: ■ Northern and southern portions: Primarily agricultural land with some identifiable private, local residential properties and a freeway service station with McDonald's and other cafes along the Princes Freeway. ■ Southern portion: Additional agricultural properties.

Item	Description
Surrounding land zoning	The following planning zones located immediately adjacent to the precinct: ■ North-west boundary – Urban Growth Zone – Special Use Zone ■ Eastern boundary – Road Zone – Category 1 – Special Use Zone – Schedule 4 ■ Southern boundary – Green Wedge Zone – Schedule 1 ■ Western boundary Urban Growth Zone – Schedule 3.
Planning overlays within the precinct	Planning overlays that are present in the precinct include: ■ Development contributions plan (two marginal areas) – Schedule 13 and Schedule 3 (along Cardinia Creek) ■ Environmental Significance (three areas) – Schedule 3 (one area) and Schedule 6 (two areas) ■ Floodway (two areas) ■ Heritage (two areas) – HO91 (one area) and HO92 (one area) ■ Incorporated Plan (two areas) – Schedule 2 (one area) and Schedule 3 (one area) ■ Infrastructure Contributions (two areas) – Schedule (one area) and Schedule (two areas) ■ Land Subject to Inundation (five areas) ■ Public Acquisition (4) – Overlay 1 (3) and Overlay 2 (1) ■ Specific Controls Overlay – Schedule 1. It was also noted that some of the above overlays appear to marginally overlap along Cardinia Creek and depending on the exact future precinct boundaries, may not explicitly apply. The boundaries used in this assessment was procured from the current VPA database and assumed to be the most accurate until further information about the precinct boundary is made available. Environmental Significance overlays were located 41 m west and 950 m north of the precinct boundary.
Fire Risks	The precinct is within designated bushfire prone areas for the Casey and Cardinia local government authorities (LGA), which was gazetted in March 2020. There have been two recorded bushfire events in 2013 and 1983, which affected the north-eastern corner of the precinct (2013 fire) and a narrow corridor 150 m to the north in Officer (1983 fire).

4.2 Geotechnical Assessment

4.2.1 Regional and Local Geology

A review of the Geological Survey of Victoria geology surface mapping of the precinct has been conducted for this project, including a review of the 1:25,000 'Berwick' Sheet, 1:25,000 'Pakenham' Sheet, 1:63,360 'Cranbourne' sheet, 1:250,000 ''Queenscliff' Sheet and 1:250,000 seamless map of Victoria. A summary of key geological features from the descriptions herein is presented in **Figure A5**.

The geology mapping indicates that the surface geology throughout the precinct is largely Quaternary aged alluvial deposits. Alluvial deposits cover a large area east of Beaconsfield and have been created by the outwash of historic drainage paths being deposited over the eroded surface of the underlying geologic units.

The 1:25,000 'Pakenham' Sheet indicates a zone of Quaternary aged lacustrine-paludal deposit to the north and south of Paterson Road (which may intersect parcels 1\TP119293, 1\TP897476, 1\TP2151018 and 1\TP8153).

Tertiary aged sediments of the Baxter Formation are predicted to underlie alluvial deposits within the precinct; however, it is possible that all Tertiary deposits were eroded from the surface prior to alluvial deposition, particularly in the north. Tertiary aged Monbulk Volcanic Group basalt flows (subgroup of former Older Volcanics) are present within the local area, which may be present below Baxter Formation deposits in former depressions of the underling surface during volcanic activity. A secondary Tertiary sediment deposit, the Werribee Formation, may be present underling the Baxter Formation and potentially intercalated with the basal part of the Monbulk Volcanic Group.

Silurian bedrock underlies the Tertiary units, or directly below Quaternary units where the Tertiary units have fully eroded, with a large unconformity representing a significant period of weathering and erosion during the geological history of precinct. The Silurian bedrock within the area is classified as belonging to the undifferentiated Murrindindi Supergroup, a group of geological units covering the siltstone, mudstone and sandstone rocks which underlie Victoria.

A stratigraphic summary of the units is provided in the table below.

Table 4-2: Geological Unit Summary (in geological age, youngest to oldest)

Geological Age	Formation	General Description
Quaternary	Lacustrine-Paludal (lake/marsh)	Clay, silt, sandy clay
	Alluvial	Sandy silty clay, sand
Tertiary	Baxter Formation	Sand, clayey sand; minor gravel and clay-generally consolidated
	Monbulk Volcanic Group (Older Volcanics)	Basalt flows
	Werribee Formation	Fissile clay, poorly consolidated sand & clayey sand, brown coal (in places intercalated with basalt part of older Volcanics)
Silurian	Murrindindi Supergroup	Siltstone, mudstone and sandstone

4.2.2 Anticipated Soil/Ground Conditions

A **theoretical ground model** is presented below in sequence from shallowest layer to deepest layer, based on the available geological information, published borehole lithology from drillers logs (registered bores retrieved as provided in **Appendix B,** refer pages 64-78 of the Lotsearch Report), and previous project experience from nearby projects completed by Aurecon. This ground model is presented as a conceptual model suitable for high level commentary on the geotechnical constraints for the precinct. It is noted that lot-

specific / area-specific intrusive geotechnical assessments will be able provide the details not yet able to be identified on a precinct-wide scale.

Anthropogenic Material

Localised areas of man-made filling and ground modification for farming and building activities are likely to exist. These materials are anticipated to be limited in extent and generally present as shallow deposits. No extensive earthwork projects within the project area are known to Aurecon which would lead to significant volumes or depths of fill, with the exception being farm dams where fill banks can be expected. Fill is highly variable in material consistency, and where it is present this material should not be utilised for structural construction purposes.

Alluvial Deposits

Alluvial soil deposits overlie the majority of the precinct and are present as part of a widespread alluvial deposit which covers low lying plains to the east of Beaconsfield. Alluvial deposits covering the area are anticipated to be derived from the Silurian bedrock of the mountain ranges located to the north, and now form a variable soil consisting of beds of silts, sands and clays. Alluvial soils can range in material classification associated with the energy of deposition, which results in variability in material strength and compressive properties over relatively small horizontal distances. Previous project experience within this geological unit indicates that the unit comprises of a sandy clay of firm consistency. The deposit is anticipated to be approximately 10 m thick. Public borehole logs provide insufficient descriptive detail to distinguish alluvial deposits.

Lacustrine-paludal deposits

Lacustrine-paludal deposits are formed in base of lakes or swamps, dominated by very low energy environments, which result in fine-grained and typically consolidated materials. Materials within this area are anticipated to have lower strength and higher compressibility to that of the surrounding alluvial deposits. These soils are likely to provide poor engineering performance for most structures. Public borehole logs provide insufficient detail to distinguish lacustrine-paludal deposits.

Baxter Formation

The Baxter Formation (otherwise referred to as Red Bluff Sandstone) is a ferruginous sandstone commonly weathered to interbedded sands, clays; variably iron stained and cemented; at depth the unit may transition to interbedded sandstone and siltstone (if present). This unit is anticipated to increase in depth to the south, with depths ranging from not present to approximately 10 m deep. Public borehole logs provide insufficient detail to distinguish Baxter Formation deposits.

Monbulk Volcanic Group basalt

Monbulk Volcanic Group basalt, is derived from basaltic flows which cooled on dry land, creating a hard rock jointed rock mass. This rock mass has been exposed to significant weathering from the surface and water flow within joints, resulting in a variable mixture of highly plastic clays and basalt core stones. The basalt where present is anticipated to be confined to localised infilled zones. Basalt is recorded within the drillers logs of six public bores accessed (**Appendix B**), five boreholes are located outside the boundary of the precinct, however bore 87412 is located in lot 1/PS602663 to the south east of the corner of Officer South Road and Lecky Road. Within bore 87412, basalt is logged from 14 m below ground level (m bgl) to 31 m bgl where the borehole terminated.

Werribee Formation

The Werribee Formation deposits are not likely to be widespread within the precinct and may be completely absent. Where present, it is likely this unit will be encountered as a thin clay layer above the Silurian bedrock. The Werribee Formation is described as a fissile clay, poorly consolidated sand and clayey sand.

Public borehole logs provide insufficient detail to distinguish Werribee Formation deposits. Materials described as 'white' within some boreholes may reflect the presence of Werribee Formation.

Silurian Siltstone/Mudstone (Bedrock)

Silurian bedrock is generally comprised of mudstone interbedded with claystones or clayey siltstones and minor beds of fine-grained sandstone. This unit has been subjected to multiple phases of chemical weathering. Bed thicknesses generally range from 25 mm to 50 mm; with thicker beds of sandstone up to 1.6 m thickness. Bedding dip ranges from horizontal to vertical reflecting the folding the unit has been subjected to since deposition. The rock mass has been intruded by igneous dykes increasing the weathering of the rock within proximity of the dyke. Weathered material is typically yellow-brown tending to dark blue-grey when fresh. Material strength varies with weathering from very low to high strength.

The regional basement rock elevation across the precinct predicted to be approximately 28 m bgl to 35 m bgl based on the logs from public boreholes.

4.2.3 Sodic/Dispersive Soils

According to the Atlas of Australian Soils, the mapped soil types across the precinct are podosols (central and south-eastern areas), sodosols (north and north-western areas) and an area of hydrosol-type soils, which has also been mapped within a 1 km buffer of the precinct to the southeast. **Figure A6** indicates the approximate location of these identified soil types.

Podosols include mottled yellow, leached sandy soils found in dunes that includes sandy acidic soils typical of coastal plains and marsh areas. Sodosols are typical of low lying, undulating hills and flat areas that are hard, acidic, yellow mottled soils with some areas of grey-brown sandy soils. Sodosols are similar to podosols, but with less acid potential. Sodosols also include soils typical of marsh areas with greater clay and peaty components. Hydrosols mapped in the south-eastern area are typically moist to wet with higher peat and clay content, with leached sands and greatest acid potential of the mapped soils across the precinct.

In contrast, the Victorian Landscapes Soil Type Mapping databases has recorded brown chromosols, grey dermosols, kurosols and grey/brown sodosols in the area. The mapped distribution of soils types also corresponds to surface features (creeks, topography). This indicates that the Victorian Landscape Soil Type Mapping database is more accurate than the Atlas of Australian Soils map and has therefore been adopted as the primary resource within this assessment.

Sodic (sodosols) soils are prone to erosion due to their dispersive nature, caused by weak chemical bonds between soil particles. Dispersive soils collapse under inundation of water resulting in volume loss (slump), reduced porosity and increased bulk density, thus restricting root growth of most plants. In addition to agricultural constraints on plant growth, dispersive soils are more susceptible to erosion and water logging. This can cause issues for drainage networks, from displaced banks and increase silt build-up, and creates poor trackability for vehicles when wet.

Visual indicators of dispersive soils were observed throughout the site during the site inspection and the recorded visual indicators are positive for the presence of dispersive soil across the majority of the precinct which warrant further targeted assessment analysis (refer observation descriptions in **Section 4.2.13**). In summary, these observations included:

- The soil being prone to becoming boggy when wet;
- Slow water infiltration; and
- Erosion of the banks of Cardinia Creek, displayed by the deep channel, undercutting of profile and cracks forming in drier areas of the exposed soil banks (refer photo reference G18-G19 on **Figure A5**).

4.2.4 Acid Sulfate Soils

Acid sulfate soils (ASS) are soils which generate acid production (specifically sulfuric acid) when oxidised due to the presence of iron sulfides (commonly pyrite) which forms iron compounds and sulfuric acid. An

ASS can be classified as either a 'Potential ASS' (PASS) or an 'Actual Acid Sulfate Soil' (AASS) depending on acidity levels and if further acid production can be generated. An ASS will generate acid when it is exposed to oxygen, which can occur by lowering the groundwater level or excavating the material from its in-situ state. Therefore, in practice, an ASS must be in a permanently saturated or recently saturated condition, whereby it has not oxidised its pyrite minerals.

A PASS has the ability to create acid upon oxidation, however, has not yet been exposed to oxygen. In contrast, an AASS has already produced acid and therefore will have a lower pH. AASS have pH levels below 4.0 and can be much lower as the pure sulfuric acid produced has a laboratory pH of 2.75. Very low pH in soil and groundwater can cause significant environmental and civil issues, soils can cause issues for vegetation growth, increases rates of corrosion requiring thicker steel and/or higher strength concrete and separation barriers, acid leached into waterways can result in issues for the aquatic ecosystem.

To determine the risk of ASS being encountered within the precinct, this desktop study has reviewed the geological history, landform and public risk maps. There is a higher likelihood of occurrence of ASS in waterlogged recent deposits; therefore, the conditions present along waterways such as Cardinia Creek is considered to align with a higher probability of occurrence.

The mapped ASS potential within the precinct are predominantly 'extremely low' (1-5%), with exceptions to the north-west extent, where it increases to 'low' potential (6 -70%). Two mapped areas of high probability of occurrence (>70%) exist along the banks of Cardinia Creek, along the north / north-western boundaries of the precinct. A high probability of occurrence is also mapped to the south of the precinct. It is also considered likely that other locally mapped paludal deposits have higher risk than the mapped extent. A figure depicting PASS extent over the precinct is shown in **Figure A7**.

Visual assessment of the highest risk area of Cardinia Creek was not possible during the site inspection due to restricted site access. However, a review of available aerial imagery indicated the presence of marshes or similarly permanent wetlands which are a strong indicator for the presence of ASS. Other areas of the precinct inspected during the site visit contained reed growth and localised areas of pooled or stagnant water, while an organic odour was noted at the south end of Cardinia Creek. It is noted that the inspection has occurred following during an abnormally wet period. Further investigation by 'field' testing for the presence of ASS should be conducted.

4.2.5 Site Classification (AS2870-2011)

In accordance with Australian Standard AS2870-2011: Residential footings and foundations, a site can be classified with respect to the predicted levels characteristic surface movement, providing a guideline for required foundation of lightweight buildings such as single or double storey houses. Table D1 of the standard provides a method of preliminary classification based on typical soil profiles in Victoria and the climatic zone.

The precinct lies within 'Climatic Zone 2', which represents a predicted depth of design suction change (Hs) of 1.8 m. The ground profile within the upper strata of the precinct is predicted to contain alluvial clay soils. Therefore, from Table D1 a site classification of M to H1 is appropriate for the project area provided the specific site location is not subject to problematic factors outlined under clause 2.1.3 of the standard. This reflects a characteristic surface movement in order of 20 to 60 mm.

In order to found structures above flood level (if applicable) imported, non-reactive fill could be placed which is likely to result in a less severe site classification.

The specific site shall be classified as Class P where conditions exist that will result in inadequate bearing strength, or where ground movements may be significant effected by factors other than normal moisture variations. Typical factors which are present within the precinct include: existing buildings, roads, pavements, trees, new plantation of trees, and fill exceeding 0.4 m in depth. Specific locations which are classified as Class P require engineering design of any residential foundations.

4.2.6 Bearing Capacity

The presence of alluvial and lacustrine-paludal deposits as the upper most soil strata may lead to areas of low bearing capacity. It is anticipated that any lacustrine-paludal deposits will have low bearing capacity and would likely require ground improvement for support of structures at surface or piled solutions for

foundations. Alluvial soils have a variable classification and strength, based on previous experience it is anticipated that near-surface alluvial soils will provide sufficient strength for shallow foundations. However, it is anticipated that weaker zones within the alluvial deposits will exist within the full extent of the precinct.

4.2.7 Foundations

Foundations for proposed structures within the precinct will depend upon the structural loads, movement tolerance and ground conditions at the site. In general, it is assumed that structures are to consist of detached or semi-detached residential/commercial building, light weight commercial buildings with possibility of localised higher density and heavy industrial construction.

Waffle Raft (above ground beams with Styrofoam void formers) or Conventional Raft (trenched beams) foundations are considered to be suitable for most residential and light weight commercial buildings where movement tolerance is within typical limits. Footings shall be designed to accommodate for the predicted seasonal surface movements. Stiffened raft foundations or piled footings may be required resist movements on Class P sites where higher surface movements are predicted. Surface soils across the site are predicted to vary in strength, therefore an assessment of bearing capacity of the upper unit is required prior to adoption of shallow foundations. Additional chemical assessments may be required on individual lots to confirm the levels of acid sulfate soils or sodic soils pending the outcomes of recommended additional investigation scope as part of the planning process.

Piled foundations may be adopted to support most structures, most conventional residential and light weight commercial buildings may be supported on unreinforced bored piles used to transfer compression loading to deeper strata. Structures with higher structural loading or requiring lateral or moment resistance shall be supported on reinforced piles. Displacement and non-displacement piles are suitable for the precinct, the relatively shallow groundwater table may require use of temporary casing within bored piles in the presence of sand beds. Displacement piles such as driven or screw piles may be required in ASS to avoid excavation of material below the groundwater level. Piles may be supported in alluvial, Tertiary sediments, basalt or Silurian bedrock depending on the structural loading requirements. Heavily loaded piles should be extended into the Silurian bedrock or basalt (where present).

4.2.8 Settlement

Consolidation settlements are expected to occur in normally consolidated lacustrine-paludal deposits and alluvial deposits. The extent of consolidation will be dependent upon the existing stress conditions, compressibility and void ratio of the soil. Lacustrine-paludal deposits are anticipated to undergo primary and secondary (creep) movements upon loading, minor creep movements may occur under the current loading. Consolidation settlement can result in the following issues:

- Differential settlements resulting in issues with drainage and cracks within structures;
- Downwards drag forces (negative skin friction) upon piles caused by the consolidation of adjacent soil relative to the pile;
- Damage to underground services or connections of service with the relative structure.

4.2.9 Basements

Basement construction within the precinct will require additional provision for drainage during excavation to maintain a dry work site below the water table. Minimal strength is available within the upper soil unit to install wall supports such as anchors or soil nails, therefore it is anticipated that cantilevered single level basements will prove to be more economical. It is not anticipated that multi-level basements are planned within the development. Planning the construction of carparks or other basement facilities above ground is likely to provide the most cost-efficient design.

4.2.10 Excavation / Trenching

Excavation within precinct will be readily achieved using relatively light weight conventual earth moving requirement (excavators, bulldozers). Excavation below the water table (e.g. 1 m bgl to 3 m bgl) may result in collapse and is to be avoided in ASS areas to prevent acid production. For the purpose of trenching and bulk excavation a temporary batter angle of 45 degrees can be adopted in stiff alluvial soils, a lesser angle of 30 degrees should be implemented in soft alluvial, lacustrine-paludal deposits or fill material. Where vertical trenching exceeding 1.5 m is required, passive shoring is required to maintain stability.

Excavations may encounter both permanent and perched water tables, perched water can result in localised instability and should be monitored by suitability experienced personnel for stability during excavation.

Excavations required in confirmed ASS or PASS will require detailed investigations prior to investigation to determine the net acidity and preparation of an acid sulfate soil management plan for the works. This will likely involve minimum liming rates to neutralise the pH of the excavated material.

4.2.11 Trafficability

The precinct is located in a low-lying area comprised of alluvial and lacustrine-paludal deposits at the surface, with historical topographical maps indicating it was historically at least partly marsh lands, and includes significant zones of sodosol soils. This ground environment is commonly swampy under foot and has a tendency to become waterlogged. Therefore, trafficability of the precinct is likely to degrade quickly in the presence of rain or groundwater infiltration. During dry periods (generally through summer), a hard crust is likely to form on the surface which may provide a false sense of good trafficability for wheeled machinery. It is anticipated that trafficability of unvegetated and unpaved areas will be limited to tracked machinery during wet weather or throughout winter.

4.2.12 Earthquake Classification

The precinct has an earthquake hazard factor (Z) of 0.09 for the 1 in 500-year annual probability of exceedance in accordance with the Earthquake Hazard Map of New South Wales, Victoria & Tasmania (2003), AS1170.4 Earthquake actions in Australia.

The precinct sub-soil is anticipated to be classified as Class Ce – Shallow Soil site or Class Be – Rock, depending on the stiffness of the soil which overlies bedrock. It is predicted that a Class Ce is the most probable classification for the site.

4.2.13 Site Observations

A site inspection was conducted on 16 June 2020 by an experienced Aurecon Geotechnical Engineer, who completed a site walkover of public areas and accessible private property. The site visit was during a period of recent heavy rainfall, described anecdotally by several residents as ‘the wettest year they have experienced’. At the time of visit, the weather was cool, overcast with occasional light rainfall.

Key geotechnical observations made during the site visit are provided in **Table 4-3** below. A photo index has been spatially presented in **Figure A5**.

Table 4-3 Geotechnical site inspection observations (16 June 2020)

SPI	Location	Photo Index Reference	Observation
N/A	Lecky Road West service road	G1 – G4	Drainage issues, water pooled on surface, boggy surface especially in unvegetated areas. Waterlogged soil.
2\PS705115	Western boundary of Area at end of Lecky Rd service road	G5	Pooled water, not flowing. Maybe a branch of Cardinia Creek. Water does not appear to permeate well into surface

SPI	Location	Photo Index Reference	Observation
24A\PP3363	Cardinia Creek Reserve North	G6-G7	Access to Cardinia Creek blocked by thick vegetation and lack of private land access, visual inspection of potential wetland area not possible on the day.
4\PS446665	Handford Lane Paddock	G8	Wet underfoot, waterlogged upper soil, pooled water in cattle footprints. Landform: plains.
2\LP219940	135 Stephens Rd	G9	Man-made dam likely local cut/fill, minimal erosion on banks dam. Property wet under foot. Landowner advised 2020 was wettest year in past 23 years (his land ownership). Well on property near dam. Landform: plains.
2\LP126079	NW corner Lecky Rd/Officer S Rd	G10	Wet under foot, pooled water in low areas, apparent poor drainage, drainage channels installed in paddock. Functional windmill water well. Landform: plains.
1\PS602663	235 Lecky Rd	G11	Waterlogged surface, pooled water. Paddocks were less boggy than other visited during the day, no livestock present. Landform: plains.
1\TP128503 & 1\TP411329	East of Officer S Rd	G12-G16	Wet paddocks, waterlogged surface, pooled water, boggy in areas trafficked by livestock. Non-function windmill on property, previous water channels present. Landform: plains.
1\TP215018 & 1\TP897476	425 Officer South Road	G17	Location of Lacustrine-paludal deposits, driven over in 4WD, very difficult to traffic. Waterlogged, pooled water on surface, bogged soil, reeds growing. Landowner reports heavy recent rainfall, and notes paddocks can often be wet. Landform: plains
RES1\LP205103	Cardinia Creek South	G18-G20	Banks of Cardinia Creek towards south of lot. Deep eroded creek bed ~3m, tree roots holding some banks together, undercut eroded areas. Previous weir built from basalt boulders (~300mm). Low energy environment contains marshy appearance with organic odour. Landowner notes that previous stabilisation works have been completed over past 50 years, including: rock beaching, dams and tree growth. Has reduced erosion on creek.

4.2.14 Identified Development Constraints

The key geotechnical constraints for the development of the precinct identified within this preliminary study are summarised in **Table 4-4** below. The risk ratings applied within the table are based on professional engineering judgement applied to the following guidelines:

- **High Risk:** a significant cost implication or major constraint against development of the site for all civil, structural land uses (e.g. buildings, roads, bridges etc). Areas are best left as open space with minimal ground disturbance where practical.
- **Medium Risk:** an increased cost of construction or limitation to construction/planning methodology over and above typical development areas for civil and structural land uses (e.g. buildings, roads, bridges etc).
- **Low Risk:** adverse cost implications are considered unlikely, and typical construction/planning methods are considered sufficient for civil and structural land uses (e.g. buildings, roads, bridges etc).

Table 4-4 Identified key geotechnical planning constraints

Constraint	Figure & Photo Index Reference	Risk to Development	Comments
Soft Soils / Settlement	**Figure A5** **G13, G14, G17**	Medium - High	The extent of soft and compressible soils cannot be confirmed without further intrusive investigations. However, all lacustrine-paludal deposits should be assumed to have low shear strength an are likely to undergo primary and secondary consolidation under relatively low loading. Localised soft areas within the alluvial deposits are likely to exist throughout the site, which may also pose bearing or settlement issues. Alluvial deposits are generally anticipated to be suitable for light weight structures without ground improvement. These soils will result in higher construction and maintenance cost for foundations and pavements.
Sodic/Dispersive Soils Erosion Trafficability Waterlogging	**Figure A6** **G10, G14, G15, G18, G20**	Low - High	Most soils across the site are mapped as sodosols, which are expected to be dispersive based on visual identifiers onsite. The risk of erosion along Cardinia Creek is evident by previous activities taken to control it, this must be further managed. A preliminary buffer zone of approximately 20 m from the banks of the Cardinia Creek is recommended to avoid future structural development without improvement to the management strategies for erosion of the creek bank. This buffer zone is an estimated safe distance based on the level of erosion observed in one section of creek banks and the assumptions that erosion levels would increase as the permeable paddocks are sealed with development. The buffer zone should be revisited following confirmation of erosion potential (dispersive soil levels) and development of management strategies for the creek. It is anticipated that most of the site will become difficult to traffic during in wet periods, boggy ground is predicted in wet periods. The negative impacts of dispersive soils can be managed through planning, design and construction practices. Given the large extent this is overall considered to pose a risk for development. Management strategies for civil works include construction of access tracks, use of tracked equipment, careful management of compaction requirements, higher compactive effort, chemical amelioration, raising the ground level. Further investigation into dispersive soils are required.
Acid Sulfate Soils	**Figure A7** **G19**	High	Acid sulfate soils will create structural and environmental issues during construction. Areas with the highest probability of containing acid sulfate soils are likely to also be soft soils with high water tables, it is advised to avoid disruption of these soils where possible. Further investigation into acid sulfate soils are required.
Excavation Collapse	**Precinct wide**	Low	All soils hold the risk of trench collapse, good earthworks practice will control this risk.
Low Basement Wall Retention Support	**Precinct wide**	Low	All upper soils are anticipated to provide low strength for basement wall retention support (anchors, soil nails) therefore deep basement construction is not recommended. Deep basement construction are likely to have high construction costs.

4.2.15 Further Geotechnical Investigations

Based on the findings of the desktop review and site inspection observations, the following further geotechnical investigations have been identified to support the future phases of precinct planning:

- Systematic progression of test pits or boreholes across the entire precinct to establish the material properties of the upper 1.5 to 3 metres of soil. The density of testing will typically be limited by available resources and funds for the overall planning process; however, for planning purposes, a density of 0.1 to 0.2 locations per hectare (200 to 400 m spacing) is acceptable for an initial impact assessment (Handbook of Geotechnical Investigation and Design Tables 2014). Aurecon recommends for the purpose of high-level classification of the site to determine if the risk of dispersive soils or ASS are present then a lesser test density could be adopted. As a guide a spacing of 600 m would provide sufficient data Aurecon to ascertain the level of risk posed to development and the types of development which would not be suitable.
- Strength testing of the upper soil strata. Dynamic Cone Penetrometer, Standard Penetrometer, Shear Vane and Pocket Penetrometer testing are considered the most cost-effective methods.
- Laboratory testing soils for:
  - Dispersive soil behaviour (Exchangeable Sodium Percentage, Emerson Crumb)
  - Acid sulfate soils (field testing, SPOCAS, Chromium Suite)
  - Salinity (EC)
- Investigations should be conducted throughout the precinct as development progresses, however acid sulfate soil testing could be targeted to medium and high-risk areas as identified within **Figure A7**.
- Should the presence of dispersive soils or ASS/PASS be found through further testing it is recommended that appropriate controls be put in the PSP and Urban Growth Zone to manage this issue. Additional testing may be required by developers or restrictions placed onto potential developments.

4.3 Hydrology and Hydrogeology Assessment

4.3.1 Topography and Drainage

The precinct is relatively flat, with minimal fall from the north-western corner to the south-eastern corner. The land surface gradients are typically very low across the precinct, with surface elevation differences at points located 1 km or more from streams ranging between 0.5 m and 1 m. As low-lying land water sits in this local environment and during rain events it experiences sheet flows. Stream and drain beds are generally incised by up to 2.5 m bgl, in the northern section of the precinct, increasing in depth as the precinct progresses south, particularly along Cardinia Creek.

The precinct includes several surface water bodies as shown on **Figure A8** which consist of;

- Cardinia Creek which forms the precincts western boundary and Lower Gum Scrub Creek which forms its eastern boundary, both draining into Western Port Bay.
- An unnamed minor drainage channel to the east of Cardinia Creek which runs from two farm dams in the central-western area feed back into Cardinia Creek at the southern end of the precinct.
- A second minor drainage channel that incorporates several dams/wetland systems and three holding/treatment ponds north of Handford Lane, that runs parallel to Stephens Road and ultimately feeds back into Cardinia Creek in the south.
- An overland flow path that runs parallel to Officer South Road, known as Officer South Drain, is defined by a Land Subject to Inundation Overlay (LSIO) and feeds back into Cardinia Creek at the southern end of the precinct.
- Other unnamed minor drainage line also run across the precinct in a north-western to south-eastern direction across Patterson Road and into the Lower Gum Scrub Creek to the south of the precinct.

- Several farms dams also exist across the precinct.

The two major waterways of Cardinia Creek and Lower Gum Scrub Creek both support biodiversity attributes and natural habitats for fauna and consequently their riparian corridors are 100m wide either side of each waterway. These riparian areas are generally consistent with the Conservation Area 36 for the protection of Growling Grass Frog, providing some opportunities for Dwarf Galaxis and within Cardinia Creek also support the Australian Greyling.

Land required for drainage purposes across the precinct is expected to focus on water treatment to ensure water is adequately treated and water quality is maintained to Melbourne Water standards prior to entry into Cardinia Creek and Lower Gum Scrub Creek. General retardation is not expected as maintaining water flows to the Koo Wee Rup Water Supply Protection Area (WSPA) and Western Port Bay, are a priority. These parameters are subject to a detailed drainage report (to be commissioned in the future).

However existing active DSS, Cardinia Industrial DS 1510 (MW 2017) and Officer DS 1315 (MW 2017a) include water quality treatment assets to be provided within the precinct as detailed in their respective DS. For Cardinia Industrial DS a wetland WL2 north of Lecky Road and a retention basin at the southern end of the precinct within the transmission lines is shown, while for the Officer DS a wetland, OSW1 is shown in the northern section of the precinct due to its relocation south of Princes Freeway as part of the Officer PSP. As these are required drainage assets for Melbourne Water, they will form a key consideration within the drainage strategy for the precinct.

In addition to active DSS, two interim DS, Lower Gum Scrub Creek DS (MW 2017b) and Officer South DS (MW 2017c) also have implications for the precinct. As they are not active DS their current base rates are subject to change as these DS are finalised in association with precinct-based drainage strategies.

The Officer South Drain is expected to support a series of treatment ponds down the east side of Officer South Road as part of its treatment train to Cardinia Creek. However due to the precinct's flat nature these drainage assets could be located up to 200m east of this road and options to split the catchment, given its large volume of flow may be possible. The width of this corridor for the Officer South Drain is expected to be between 50-80m in accordance with Melbourne Water's *Waterway corridors – Guidelines for greenfield development areas within the Port Phillip and Westernport Region* (MW 2013).

4.3.2 Flood Risks

Land within the precinct is subject to two water related overlays that address the land's flooding risks. The Floodway Overlay (FO) which applies to both Cardinia Creek, Lower Gum Scrub Creek and their surrounds (up to 100 m on either side) identifies these waterways as major flood paths which have the highest likelihood of flood risk or hazard and/or frequency of being affected by flood waters. The second overlay is the LSIO, which identifies land used for flood storage, or flood fringe areas, that are affected by the 1 in 100-year flood. The LSIO that applies to the precinct runs along Officer South Road and includes the Officer South Drain, as this provides an overland flow path for flood waters within and through the precinct (**Figure A8**). Sea level rise (SLR) is covered in the VPPs under clause 13.01-25. Expect increase of 0.2m over the 1 in 100 flood level.

4.3.3 Hydrogeology

Regional Aquifer

The Pakenham employment corridor lies on the coastal plains of Western Port Bay where the soil profiles consist of clay rich sediments to 10 m deep or more. This thick clay sediment, which is underlain by Silurian bedrock forms a low permeability fractured rock 'aquifer' in which lateral groundwater flows, across the Western Port plains.

The precinct is located within the Koo Wee Rup WSPA (**Figure A9**), declared in response to significant groundwater use and declining water levels. The purpose of the WSPA is to protect groundwater supply for future users, by maintaining appropriate groundwater levels. Within the Koo Wee Rup WSPA allocations of groundwater are in excess of the Permissible Consumptive Volume (PCV), which means that future

applications for groundwater extraction are unlikely, potentially affecting local food and agricultural production.

The precinct is constrained by its hydrogeology given its regional context for food production and further consideration of the shallow water table, groundwater quality and quantity, and appropriate management strategies should be considered as part of the planning process for the future urban development of the land.

Groundwater Depths

The precinct features a shallow water table with groundwater sitting or perched on the clay sediment which directly interacts with existing drainage lines. Previous assessments of depth to water table (SKM 2005) indicate a likely depth range of 1-3m can be expected across this portion of the Pakenham growth corridor, particularly in the northern section of the precinct where the land is very flat. Groundwater depths generally increase across the precinct to between 3 - 5m in the southern area as the soil structure transitions to sandier material, typical of converging drainage lines across the plains, as they descend into the Western Port Bay coastal environment.

Data collected as part of the site inspection (refer **Table 4-6** below), for groundwater depth was limited due to access restrictions, inaccessibility due to overgrown vegetation and disuse, limiting landmark locations. However, the data that was obtained confirmed that the groundwater depth varied between approximately 4 m and 6 m with readings at 4.75 m and less than 6 m spread across the precinct apart from surface water bodies.

Regional Water Quality

The effects of urban development on groundwater recharge and baseflows in Cardinia Creek and Lower Gum Scrub Creek are yet to be confirmed. However, research to date (SKM 2005) indicates a slight increase in baseflows are anticipated in summer, due to the use of reticulated water through summer and autumn months in urban residential areas, while a slight decrease in baseflows in winter are expected due to the increase in hard paved surfaces and a reduction in natural surface infiltration, however this will be offset by reduced evapotranspiration through reduced vegetated areas in the developed precinct. The associated increase in groundwater recharge are likely to result in an increase in discharge to these local waterways, where they are hydrologically connected to groundwater systems. Therefore, salinity of water within these waterways has the potential to increase in low flow conditions, during summer and autumn.

Regional groundwater salinity has been reported at a concentration range of 3,500-7,000 mg/L (Lotsearch report in **Appendix B**) across the precinct. Data collected as part of the site inspection (refer **Table 4-6** below and **Figure A9**), for groundwater salinity indicates low levels within Cardinia Creek at less than 400 mg/L at the precinct's western boundary. However, within the precinct salinity varies from 5,257 mg/L in the northern section of the precinct to 1,276 mg/L in the southern section, consistent with increasing groundwater levels and the transition in soil permeability. Planning and building controls for management of drainage and groundwater adopted for the Officer Precinct should be extended to the Officer South Employment Precinct.

Based on these findings, the salinity in the precinct ranges from high salinity water to extremely high salinity water in the context of rural/agricultural land (DEDJTR 2018). These salinity levels require salinity management controls as this water should not be used on soils with restricted drainage, and salt tolerance of vegetation should be considered. For the extremely high salinity water its use should be confined to emergency situations for salt tolerant crops on permeable soils only.

The impacts on downstream ecosystems who may be sensitive to changes in low flow salinity variability needs to be considered. Further assessments and monitoring of water levels and salinity for these waterways is required to ensure water quality is maintained at current levels as part of the precinct's future development. The potential return of deep-rooted vegetation as part of the precincts urban development may present an opportunity to reduce base flow increases to drainage lines during summer months. Providing trees are strategically planted and located within riparian corridors and 'capture zones' along drainage lines and are of appropriate species to accommodate the local groundwater salinity.

4.3.4 Registered Boreholes

There are approximately 189 registered boreholes within a 1 km radius of and including the precinct (refer **Figure A9**). Borehole data was retrieved from DELWP's (former Department of Environment and Primary Industries) Water Measurement Information System and the Earth Resources Victoria State Database. There is overlap between the two databases however, and current operational states of the groundwater wells, or current standing water level data was not able to be retrieved from the databases. **Table 4-5** summarises the available details of the retrieved groundwater bore data.

Table 4-5 Registered groundwater bores within and surrounding the precinct (1 km buffer)

Bore Use	Number	Installation Dates (year)	Installation Depths (m)
Dairy	2	1983	17.5
Dairy, Irrigation & Stock	1	1976	39
Domestic & Stock	39	1970-2017	7.0-38
Domestic, Dairy & Stock	2	1972	20.7-41.5
Irrigation	1	2007	28.50
Stock	33	1970-2009	11.3-30
Investigation	13	2017-2018	4-8.5
Observation	39	2011-2018	5-11
Non-groundwater	45	1952-1975	Unknown (no data)
Unknown	2	1975	50
No data	9	-	-

4.3.5 Site Inspection

As part of this scope, on 16 June 2020, Aurecon completed groundwater level gauging and in-bore measurement of water quality parameters at groundwater bores identified by desktop and opportunistic surface water measurements at two locations along Cardinia Creek within the Officer South Employment Precinct. A summary of the findings is provided in **Table 4-6** below. Referenced bores and a spatially presented photo index are provided in **Figure A9**. Equipment calibration certificates are provided in **Appendix D**.

Table 4-6 Groundwater bore and Cardinia Creek water measurements (16 June 2020)

Location or Bore ID (Photo Index Reference)	Total Depth	SWL* (m bTOC*)	SWL* (m bgl*)	Casing Height	Temp.* (°C)	pH (units)	EC* (µS/cm)	TDS (0.55^)	Redox* (mV)	DO* (mg/L)	Comment
Cardinia Creek (North) (**E5**)	-	-	-	-	11.8	6.93	376	207	-35	4.14	Redox not stabilising decreasing during measurement
Cardinia Creek (South) (**E8**)	-	-	-	-	13.1	7.57	353	353	50.1	11.2	Moderate stream flow, brown, mild turbidity.

Location or Bore ID (Photo Index Reference)	Total Depth	SWL* (m bTOC*)	SWL* (m bgl*)	Casing Height	Temp.* (°C)	pH (units)	EC* (µS/cm)	TDS (0.55^)	Redox* (mV)	DO* (mg/L)	Comment
Bore 87487[b] 1\TP215018 (425 Officer South Rd) (**E7**)	19.5	<6	<5.85	0.15	16.4	7.09	2,320	1,276	50.1	2.92	SWL rising, had just pulled out agricultural pump and irrigation piping.
Bore 87435 2\LP12607 (Lot 2 Officer South Rd) (**E14**)	N/A[a]	4.25[a]	4.05	0.20	15.9	6.81	9,559	5,257	226	7.13	Bore under pressure, SWL likely not accurate.
Bore 325895[b] 2\LP219940 (135 Stephens Rd) (**E17**)	13.54	4.74	4.52	0.22	16.2	8.53	4,052	2,229	252.7	1.41	Bore not sealed - gatic cover is missing.

Notes:
Headers: SWL = standing water level; Temp. = temperature; EC = electrical conductivity; TDS = total dissolved solids conversion from field-measured EC by a factor of 0.55 (SA EPA 2015); Redox = reduction oxidation potential; DO = dissolved oxygen
a: Bore (ID: 87435) has a pressurised reticulation system installed – an attempt to measure was made and the visible casing had a depth of ~6.1 m; however, it is very likely that this was the water level in the annulus, not the true depth / SWL of the bore. Registered total depth is 61.0 m.
b: No public data on drilled bore depth.

Groundwater bores that were indicated to be present on some properties were not able to be found (87462 and 87432 on 1\TP215018 (425 Officer South Road) and bores 87493 and 87412 on 1\PS602663 (235 Lecky Road). In addition, some were inaccessible due to overgrown vegetation (87494 on 1\TP128503 at 345 Officer South Road). Three additional properties where groundwater bores were identified via desktop analysis (2\PS705115 at 290 Officer Rd, L\PS805124 at Cardinia Rd, 1\TP8153 at Patterson Rd) were not able to be accessed to due to access agreement restrictions. A map of groundwater borehole locations within the project buffer is found in the Lotsearch Report within **Appendix B**.

Table 4-7 Hydrogeological site inspection observations (16 June 2020)

Photo ID: Description & Address	Photograph
E5 and E6: Side Stream of Cardinia Creek, the main stream was unreachable due to Sheoak and weeds (blackberries)	
E7: Groundwater bore (ID:116200) at 425 Officer South Road.	 
E8: Cardinia Creek, adjacent to Lot 1 Officer South Road.	

Photo ID: Description & Address	Photograph
345 Officer South Road E9: Old Brick Water tank, fed by a groundwater bore (based on anecdotal information provided by the property owner).	
E10: Old windmill attached to a concrete tank and stock trough	 
E11: Stock Trough due south of windmill, where a bore is supposedly located (ID: 116207).	
E12: Groundwater bore registered at 235 Lecky Road – no evidence that this bore still exists. Anecdotal information provided by tenant (Mr. Ron Chivers) indicated that is was due south of the tree wind break further east (yellow circle). No evidence of a bore was found in either location).	 

Photo ID: Description & Address	Photograph
E13: Windmill and groundwater bore (ID: 116150) filling a water tank at Lot 2, Officer South Road	 
E14: 2 unregistered bores observed in a paddock north of 235 Lecky Road	 
E15: Bore (ID: 61565) north of farm dam at 135 Stephens Road.	

Photo ID: Description & Address	Photograph
E16: Groundwater bore (ID: 116208) observed from a distance, south of the corner of Lecky and Stephens road.	

4.3.6 Identified Development Constraints

The hydrology of the precinct that features two significant waterways, a major overland flow path and additional water treatment assets related to water management within the locality, affords opportunities to integrate water into the precincts future urban structure in a manner that will facilitate amenity, connectivity and liveability for its future occupants. The conversion of rural land to urban provides an opportunity to rehabilitate the land and assist the natural water balance to support sustainable development. This approach to water management should be incorporated into the drainage strategy for the precinct.

The hydrogeology of the precinct that consists of shallow groundwater and high salinity water requires further assessment and monitoring to ensure that local waterways, downstream ecosystems, including Ramsar wetlands, and groundwater quality within the Koo Wee Rup WSPA is maintained and potentially improved. The undertaking of more extensive hydrological testing consistently across the precinct is required to confirm findings to date and ensure development of the precinct for urban purposes provides management opportunities for restoration of waterways, protection of ecosystems and reduction of salinity through the revegetation of land within the future urban environment.

As part of the precinct's development planning IWM should be incorporated to address the current constraints that exist within the precinct's hydrology and hydrogeological context. Some IWM opportunities that may be explored within the precinct consist of:

- Stormwater and rainwater harvesting as an alternative water source for greening local parks, sporting reserves and private open space, or for wash-down in retail and/or commercial areas;
- Flood management, including green/blue corridors, that maintain water in place, reduce salinity and support natural groundwater recharge, base flows and the Koo Wee Rup WSPA;
- Reduction of discharges into Cardinia Creek, Lower Gum Scrub Creek and Western Port Bay;
- Provision of recycled water to residential areas through a third pipe scheme including the ability to extend the scheme to provide recycled water for commercial and industrial uses, where customer/user demand exists;
- Recycled water use for drought proofing critical open space or ecological corridors including support for increased canopy cover, urban forest and buffer zones; and
- Clyde-to-Pakenham Regional Sewerage Treatment Plant, supporting *'water for work'*, including agriculture (food bowl) and manufacturing uses within employment areas.

Stormwater harvesting is an excellent system of achieving pollutant reduction targets and contributes significantly to achieving a *Water Sensitive City* when supplementing water supply. Proposed stormwater infrastructure for the precinct should be positioned to be co-located within areas of planned local parks or

open space to enable stormwater harvesting capabilities. Stormwater capture and its use for irrigation within the precinct along with stormwater capture integration with infrastructure for water supply should also be explored as part of the future drainage strategy for the precinct.

The precincts linear drainage system that runs from its north- western boundary to its south- eastern boundary also provides opportunities to co-locate vegetation/open space with drainage assets to facilitate co-located corridors that further support ecological and biodiversity values, provide flood management, improve groundwater salinity, and create urban forest connections. Ongoing assessment and monitoring of groundwater levels and salinity within the precinct is required to ensure water quality does not have future implications for downstream water supply or ecosystems.

Co-location of future drainage assets within the existing transmission easement at the southern portion of the precinct and within the riparian corridors (100 m) adjoining both Cardinia Creek and Lower Gum Scrub Creek, has the potential to result in a reduction in land take. Where drainage assets and other infrastructure (i.e. pump stations, storage tanks etc.) can be co-located on already encumbered land, net developable area within the precinct is maintained for urban development.

The provision of recycled water through the established third pipe scheme for residential areas, managed by South East Water (SEW), has the capacity to be extended through the precinct to include industrial and employment areas where manufacturing customer bases are likely to exist. Provision for these opportunities to use additional water sources should be considered as part of the overall IWM strategies for the Officer South Employment precinct.

4.4 Ecology

The Urban Growth Boundary for Melbourne was reviewed and established through the Delivering Melbourne's newest sustainable communities. Growth Corridors have been established as part of the integrated planning undertaken by the Victorian Government. One of these Growth Corridors includes the South East Growth Corridor that the subject precinct forms a component. **Figure A10** shows a summary of the understanding of the nature and extent of the growth areas.

Strategic planning associated with the Delivering Melbourne's newest sustainable communities program included addressing biodiversity values within the growth corridors. Biodiversity protection and management is addressed at a Commonwealth level under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), and at a State level under the *Planning and Environment Act 1987* that incorporates the *Flora and Fauna Guarantee Act* 1988 (FFG Act) and the *Wildlife Act* 1970. The Commonwealth EPBC Act requires referral and assessment of impacts from activities such as urban development that are likely to have a significant impact on a Matter of National Environmental Significance (MNES).

At a State level the FFG Act directs the State to prepare a Biodiversity Strategy to assist the State to achieve the objects of the FFG Act of conserving all of Victoria's native plants and animals. The current biodiversity Strategy is 'Protecting Victoria's Environment – Biodiversity 2037' (DELWP 2017). Coupled to this Strategy are the Victorian Native Vegetation Clearing Regulations and the predecessors of that regulation being Victoria's Native Vegetation Management – A Framework for action.

The Delivering Melbourne's newest sustainable communities program identified that the growth corridors contained significant biodiversity values (flora, fauna, ecological communities and Ramsar wetlands) listed as threatened at a Commonwealth and State level. To address and appropriately manage these values at a landscape level a strategic approach was required.

In June 2009, a Strategic Assessment commenced of the Delivering Melbourne's newest sustainable communities' program by the Victorian and Commonwealth Government. The assessment was made under Part 10 of the EPBC Act. The assessment known as Melbourne's Strategic Assessment (MSA) required the State Government to make commitments to biodiversity conservation outcomes of MNES through a BC). The BCS was developed with the purpose of (DEPI 2013a):

- "The BCS is the overarching strategy for the protection of biodiversity in the growth corridors. It sets out all the conservation measures required for matters of national environmental significance and state significance to satisfy the commitments to the Commonwealth Government and to meet state

requirements, including Victoria's Native Vegetation Management: A Framework for Action (Native Vegetation Management Framework) (DNRE, 2002)".

The BCS identifies conservation measures within the urban growth boundary including (See **Error! Reference source not found.**):

- The protection and management of land of high biodiversity value within defined conservation areas and areas outside the Urban Growth Boundary;
- Requirements to provide offsets for removal of native vegetation and threatened species habitat on land not required for conservation and suitable for urban development; and
- Requirements to salvage and translocate certain threatened species prior to removal of habitat on land not required for conservation and suitable for urban development.

These conservation measures are directly applicable to the subject precinct and are summarised in the following subsections. Further planning through the Victorian Planning Authority coordination of the Precinct Structure Plan process will address these requirements.

4.4.1 Conservation Areas

Conservation Areas are identified within the Precincts of the Growth Corridor Plans. A total of 36 conservation areas have been identified. Two sections of Conservation Area 36 are within the subject precinct. These conservation areas and their location are identified in Error! Reference source not found.. The Western portion of the conservation area is located along Cardinia Creek, the Eastern portion is located along Lower Gum Scrub Creek.

Growling Grass Frog conservation and conservation areas within Urban Growth Corridors are further informed by the Growling Grass Frog Sub-Regional Strategy (DEPI 2013b). The Sub-Regional Strategy identifies areas of strategic importance for Growling Grass Frog (Category 1 habitat). In this case the identified conservation area within the precinct was included in the Urban Growth Corridors as an 'Area of Strategic importance for Growling Grass Frog (*Litoria raniformis*).

Areas of strategic Importance for Growling Grass Frog must be protected and enhanced to ensure the long-term viability of Growling Grass Frog within the Growth Corridor (DEPI 2013b). To do so a hydrological regime beneficial to both the waterway and to the long-term use of these areas by Growling Grass Frog within Category 1 habitat will need to be achieved. Management of Category 1 habitat will include the construction and maintenance of frog ponds (constructed wetlands) and mown and unmown areas to allow movement of frogs between ponds. Passive recreation will be allowed within these areas.

Threats to the conservation areas that contain Category 1 habitat for Growling Grass Frogs include:

- Degradation of the habitat within the conservation area from activities such as unauthorised incursion of construction activities;
- Chemical spills that may degrade water quality within the waterways or groundwater, or may destroy terrestrial habitat through poisoning of plants;
- Reduction of suitable hydroperiod of the wetlands of waters such as increased flooding or wetlands being dry for extended periods.

The risk of these threats occurring can be minimised through considered development planning that maintains the ecological values of the conservation area. If works are required within the conservation area an approval in the form of a 'Works in Conservation Area' permit from DELWP is required.

4.4.2 Salvage and Translocation of Threatened Species

Salvage and translocation of threatened species is in some circumstances required by the BCS. Only three categories require salvage and translocation. These include:

- Matted Flax-lily;
- Spiny Rice Flower; and

- Seasonal Herbaceous Wetland Species.

DELWP undertakes the salvage and translocation of these species. The triggering of salvage and translocation will occur through the VPA PSP managed process.

4.4.3 Groundwater-dependent and Inflow-dependent Ecosystems

Aquatic and terrestrial ecosystems that are dependent on either groundwater (GDEs) or surface water inflow (IDEs) potentially occur within the precinct in proximity to Cardinia and Upper/Lower Gum Scrub Creeks. **Table 4-8** summarises the recorded GDEs and IDEs in the precinct.

Table 4-8 Water-dependant ecosystems within the precinct

Type	Name	Potential occurrence	Ecosystem type	Geomorphology	Aquifer
Groundwater-dependant Ecosystems*					
Aquatic	Cardinia Creek	High	River	Low fault blocks, mainly of tilted and dissected sandstone; granite hills and islands, in two parts either side of Port Phillip Bay.	Unconsolidated sedimentary
Aquatic	Lower Gum Scrub Creek	High	River		
Terrestrial	-	High	Vegetation		
Terrestrial	-	Moderate	Vegetation		
Aquatic	-	Unclassified	Wetland		n/a
Inflow-dependant Ecosystems*					
Aquatic	Cardinia Creek (3)^	8 – 10	River	Low fault blocks, mainly of tilted and dissected sandstone; granite hills and islands, in two parts either side of Port Phillip Bay.	Unconsolidated sedimentary
Aquatic	Lower Gum Scrub Creek (2)^	8 – 9	River		
Terrestrial	-	3	Vegetation		
Terrestrial	-	7	Vegetation		
Terrestrial	-	8	Vegetation		
Terrestrial	-	9	Vegetation		
Terrestrial	-	10	Vegetation		
Terrestrial	-	4	Vegetation		
Terrestrial	-	6	Vegetation		
Terrestrial	-	5	Vegetation		

Notes: * IDE likelihood of occurrence is ranked on a scale of 1-10, while GDE likelihood of occurrence is ranked as High, moderate and Low.
^ Separate ecosystems have been identified along these waterways.

4.4.4 Ramsar Wetlands

The subject precinct is within the Cardinia Creek catchment that flows into Western Port Bay (refer **Figure A10**). Westernport Bay is a Ramsar wetland, a wetland of international importance particularly for its waterfowl habitat (KBR 2010). Australia has an obligation to manage the ecological character of Ramsar wetlands and does so through the listing of wetlands such as the Westernport Bay Ramsar Wetland under the EPBC Act. These wetlands are considered a 'Matter of National Ecological Significance' (MNES) and likely significant impacts to them are assessed under the EPBC Act Significant Impact Criteria.

The Western Port Ramsar wetland is also a key component of the Mornington Peninsula and Western Port Biosphere Reserve that includes various local government areas including Cardinia Shire. “Biosphere reserves are sites recognised under the United Nations Educational, Scientific and Cultural Organisation’s (UNESCO’s) Man and the Biosphere (MAB) Program” (https://www.biosphere.org.au/). The Western Port Ramsar wetland is considered a core component as it is legally protected under the EPBC Act. Areas such as the subject precinct are deemed transition areas where UNESCO promotes the incorporation of sustainable development principles such as those adopted in the MSA program.

The subject precinct being part of the MSA program has had likely impacts from urban development in the Urban Growth Corridors on the Western Port Ramsar wetland assessed previously. Any changes to land use in the precinct that are not covered by the assessments made in the MSA Program Report (DPCD 2009) may require additional referral and assessment under the EPBC Act. Such deviations that adversely impact on the ecological character of the downstream Western Port Ramsar wetland may be considered a high risk to that ecological character. Threats that may trigger this increased risk include:

- Increases in contamination and sedimentation loads entering the Western Port Ramsar wetland via surface water flows or through the regional aquifer that may directly poison waterfowl or their habitat; and
- Interruption of freshwater flows from the regional aquifer entering the Western Port Ramsar wetland that may alter the microphytobenthos extent, abundance and diversity that the waterfowl feed upon within the mud and sand flats of the Ramsar site.

4.4.5 Identified Development Constraints

The precinct includes two sections of Conservation Area 36. This Conservation Area is unable to be developed and will be retained, enhanced and managed for Growling Grass Frog habitat. Planning of developments within the precinct should aim to integrate with the Conservation area in a manner that will not degrade the habitat values, such as introducing weeds, pest animals, contaminants and major alterations to the hydrology. Activities that may adversely alter or effect the Conservation Area may require a Works in Conservation Area permit from the Department of Environment, Land, Water and Planning (DELWP). If in doubt, consultation with DELWP is recommended.

Development within the precinct should also take into consideration any effects that development may cause downstream on the Western Port Ramsar wetland. Increased sediment or contaminant loads should not increase above current baseline conditions. This may require some developments to store and treat stormwater on site and have appropriate controls for contaminant spills or leaks. Any activities that may have a likely significant impact above limits of acceptable change, and above described impacts in the Program Report on the Western Port Ramsar wetland may require Referral to the Commonwealth Department of Agriculture, Water and the Environment to determine if the activity requires assessment under the EPBC Act.

Removal of the limited areas of native vegetation and scattered native trees will be subject to approvals under the Planning Scheme. The removal of native vegetation will require financial developer contributions. The amount of contribution will be developed as part of the Planning Scheme approvals for native vegetation removal.

4.5 Contamination Assessment

For this desktop assessment, the identification of potentially contaminated sites involved the review of the precinct’s land use history and ownership, EPA Victoria registers / databases, DELWP environmental databases and other databases where historical pollution may have been recorded within and immediately surrounding the precinct in a 1 km radius. The information reviewed were largely based on the data retrieved by data-provider Lotsearch, with a copy of the reviewed information provided in **Appendix B**.

To the extent practicable, supplementary reviews via internet searches and queries in publicly available databases such as Victoria Unearthed Online (https://mapshare.vic.gov.au/VictoriaUnearthed/) has been completed to cross-check for currency. It is noted that given the size and high-level reviews undertaken, localised contamination and contaminating activities may not have been able to be identified through this assessment.

Key findings of the review for potentially contaminating activities or contaminated sites that may adversely impact the developability of the precinct are summarised in this section.

4.5.1 Current Certificates of Title and Site Uses

Current certificates of title were retrieved for the 48 parcels listed within the precinct. Copies of the titles and title plans are provided in **Appendix C**. Land uses that could be interpreted from these titles are depicted on **Figure A4**.

4.5.2 Council Planning Permits

Cardinia Shire Council completed a historical planning permit search on 30 June 2020 for this project, the findings of which are summarised in **Table 4-9** below. Cardinia Shire Council notes that due to recent IT changes to the permit systems, it is possible that not all available planning permit information has been identified for all properties within the precinct.

Based on a review of retrieved permit descriptors, the following key findings are:

- Development permits for the BP Service Station at 94 Princes Freeway were approved and completed.
- Several farm sheds have been built as part of more recent applications and this is consistent with the rest of the titles and site history information reviewed.
- Some development of land was identified for public roads.
- Minor building demolition works (former dwellings and outbuildings) were identified in a current public road parcel.

Table 4-9 Cardinia Shire Council retrieved historical planning permit summary (30 June 2020)

Permit No.*	Listed Address	Status	Reason for Permit	Decision Date
T980262	20 Handford Ln	Application Complete	Subdivision	19-Jun-98
T060643	20 Handford Ln	Withdrawn	Two lot boundary re-alignment	10-Oct-06
T060665	20 Handford Ln	Application Complete	Two (2) lot subdivision	24-Jul-08
T060528	20 Handford Ln	Application Complete	Use and development of land for a Freeway Service Centre and access to a public acqusition overlay and removal of vegetation	15-Jun-11
T060528	20 Handford Ln	Application Complete	Amended Plans (Condition 1 of T060528).	15-Jul-11
T100872	20 Handford Ln	Application Complete	For internally illuminated business identification signage	13-Apr-11
T010929	Handford Ln	Application Complete	Outbuilding (including to store semi-trailer)	5-Mar-02
T150832	310 Officer South Rd	Application Complete	Buildings and works for an outbuilding (shed) extension exceeding 100 square metres and within 100m of a dwelling not in common ownership.	10-Feb-16
T080697	310 Officer South Rd	Application Complete	Works to construct a swimming pool	24-Nov-08
T050418	310 Officer South Rd	Application Complete	Shed	18-Jul-05
T040732	310 Officer South Rd	Application Complete	Dwelling & outbuilding	7-Sep-04

Permit No.*	Listed Address	Status	Reason for Permit	Decision Date
T030131	330 Officer South Rd	Application Complete	two lot subdivision	3-Jul-03
T040732	330 Officer South Rd	Application Complete	dwelling	7-Sep-04
T040706	330 Officer South Rd	Application Complete	re-subdivison	27-Jan-05
T040707	330 Officer South Rd	Application Complete	two lot subdivison	27-Jan-05
T180042	410 Officer South Rd	Withdrawn	Development of the land for a 30 metre monopole, outdoor equipment cabinet and ancillary equipment	6-Apr-18
T100016	Officer South Rd	Application Complete	Vegetation Removal	31-Mar-10
T060464	90 Handford Ln	Application Complete	To remove the Reserve status for the land shown as Reserve No.1 on the attached PS549439S	20-Sep-06
T130454	Stephens Rd	Withdrawn	Two lot subdivision	3-Oct-13
T050514	122 Stephens Rd	Application Complete	Farm shed storage of machinery & stock feeds	9-Aug-05
T020164	122 Stephens Rd	Application Complete	Dwelling & Outbuilding	13-May-02
T070178	130 Stephens Rd	Withdrawn	Earth works	12-Sep-07
T020532	155 Stephens Rd	Application Complete	Outbuilding (Garage)	26-Sep-02
T040089	135 Stephens Rd	Application Complete	Shed & Horse Arena	3-Jun-04
T980024	125 Stephens Rd	Application Complete	Outbuilding	19-Jan-98
T180217	185 Officer South Rd	Application Complete	Removal of Native Vegetation	16-Aug-18
T080056	185 Officer South Rd	Withdrawn	Temporary Relocatable Billboards	13-Feb-08
Section 29 A Building Approval	185 Officer South Rd	Application Complete	Section 29A demolition of dwelling and out-buildigns	21-May-19
T960013	425 Officer South Rd	Application Complete	Riding Arena	25-Mar-96
T94/314	425 Officer South Rd	Withdrawn	Outbuilding and tennis court	30-Jun-10
T020591	425 Officer South Rd	Application Complete	Tourist accommodation	31-Oct-02
T030281	425 Officer South Rd	Application Complete	Tourist accommodation, conference centre and recreation facilities	26-Jul-04
T030282	425 Officer South Rd	Withdrawn	Bed and breakfast extension & Leisure & recreation facility (tennis court) (change of use)	29-Jun-04
T030281 - 1	425 Officer South Rd	Withdrawn	Tourist accommodation, conference centre and recreation facilities	25-Oct-16

Permit No.*	Listed Address	Status	Reason for Permit	Decision Date
T050026	425 Officer South Rd	Application Complete	2 Farm sheds	14-Feb-05
T100457	320 Officer South Rd	Application Complete	Development of the land for the purpose of an outbuilding	23-Sep-10
T140497	320 Officer South Rd	Application Complete	Earthworks associated with the development of the land for a swimming pool	30-Oct-14
T160574	320 Officer South Rd	Application Complete	Buildings and works associated with a Section 2 Use (dwelling on a lot less than 40ha).	17-Oct-16
SC0001/17	320 Officer South Rd	Closed	Secondary Consent	13-Jan-17
T090832	190 Officer South Rd	Application Complete	Use and development of the land for the purpose of a utility installation (pumping station)	24-Feb-10
T090832a - 1	190 Officer South Rd	Application Complete	Use and development of the land for the purpose of a utility installation (pumping station)	8-Sep-11
T110078	190 Officer South Rd	Application Complete	Floodlit sky sign	7-Jun-11
T190559	Officer South Rd	Application Complete	Development of land for utility installation upgrades, vegetation removal and associated road widening-works	12-Feb-20
T1200400	3809	Application Complete	The subdivision of land into two lots	11-Jan-13
T180618	3809	Issued (tribunal)	Subdivision of land for future drainage reserve and creation of carriageway easement	12-Mar-19
T130296	94 Princes Freeway	Withdrawn	The development of the land for the purpose of an automated weighbridge system in accordance with the existing Freeway Service Centre generally in accordance with the approved plan/s	12-Aug-13
T180052 - PC1	Freeway Service Centre West Bound, 94 Princes Freeway	Plans to Comply Issued	Use and development of the land for a telecommunications facility (installation of 35 metre monopole, outdoor equipment cabinet and ancillary equipment)	Nil retrieved
T180052	Freeway Service Centre West Bound, 94 Princes Freeway	Application Complete	Use and development of the land for a telecommunications facility (installation of 35 metre monopole, outdoor equipment cabinet and ancillary equipment)	28-May-18

Note: * Not all parcels within the precinct had permits listed within Cardinia Shire Council systems at the time of the search, and hence not all parcels are listed within the summary table above.

4.5.3 Historical Businesses

Based on the review findings, three key areas (Areas A, B and C) have been identified in proximity to the precinct where multiple businesses have been listed that could be associated with a potentially polluting activity and legacy contamination issues. These areas are located within a 1 km buffer as follows:

- Area A: Located directly west in Clyde North.
- Area B: Located approximately 500 m north / north-west of the precinct in Officer and proximal to Flanagan Avenue and Station Street.
- Area C: Located approximately 900 m north in Officer.

The listed notable businesses and their details are summarised in **Table 4-10** below.

Table 4-10 Historical businesses in proximity to the precinct

Area	Business Activity	Listing Date	Premise & Distance to Precinct	Comments
A	Veterinary Surgeons & Hospitals.	1991	3 m west: Riches, W., Grice Rd., Berwick 3806	Localised contamination may have occurred. However, it is not very likely that this activity may have caused significant contamination that may adversely impact the developability of the precinct.
B	Carpenters	1950	513 m north-west: Bergen Constructions. Lot 3. Rix Rd., Officer. 3809	Localised contamination may have occurred. However, it is not very likely to adversely impact on the developability of the precinct due to the distance and activity types listed.
	Builders / Building Contractors	1991		
C	Orchardists & Fruit-growers	1950	919 m north: Apted, A., Station Rd. Officer	Localised contamination from chemicals such as pesticides, heavy metals and petroleum hydrocarbons is likely to have occurred on some level. However, these kinds of contamination sources are not very likely to adversely impact on the developability of the precinct due to the significant distance and activity types listed.
	Motor Hire Services	1960	919 m north: McNeilage, C. J., Station Rd., Officer	
	Wood Merchants	1991	919 m north: Eames. P. Station St., Officer 3809	
	Fuel Merchants – Wholesale & Retail			
	Fuel Merchants – Coal, Coke and/or wood			
	Welders	1991	919 m north: E B Welding. Lot 18 Station St., Officer 3809	
	Motor and Panel Beaters &/or Spray Painters			
	Earth Moving Equipment (incl. service and repair)			
	Motor Body Builders			
	Motor Body Repairers			
	Sheet Metal Workers			
	Steel Fabricators			

Area	Business Activity	Listing Date	Premise & Distance to Precinct	Comments
	Truck and/or Bus Repairs			

In a review of other environmental and/or EPA Victoria databases for this desktop assessment, specific mention of these premises (such as incidents, complaints or clean up notices) activities were not able to be identified.

4.5.4 Historical Aerial Imagery and Maps

Aerial photography from years between 1974 and 2020 and historical maps between 1925 and 2009 were reviewed for any indication of activity in the precinct, such as former buildings, landmarks, businesses, areas of disturbed land or clearing that could indicate potentially contaminating activity. Key observations are provided in **Table 4-11**.

Table 4-11 Summary of historical aerial imagery and map review (1925-2020)

Year	Document Type	Comments / Observations
1925	Historical map*	A 'sand pit' is mapped in the far northwest of the precinct, approximately 900 m from the precinct boundary. Orchards are marked south of the current Princes Freeway (not yet built) location adjacent to the northern boundary of the precinct.
1936	Historical map*	No significant changes were observed to have occurred in the listed uses since those within the 1925 map. It is noted the '100' elevation contour is mapped through the centre of the precinct. It is inferred this is in feet, which converts to approximately 30 m elevation and would therefore be consistent with current mapped surface elevations ranging up to 40 m at the highest point.
1968	Aerial imagery	Consistent with the land uses listed in the historical maps of 1925 and 1936, the precinct consists of cleared agricultural lands, with some farmhouses along Cardinia Creek and Scrub Gum Creek. Officer South Road is the main road through the centre of the precinct and appeared to be unsealed. Parts of Cardinia Creek and Scrub Gum Creek appear to have been modified to create dams.
1974	Aerial imagery	No significant changes were observed between the 1968 and 1974 aerial imagery provided, with the exception of the development of a rectangular track along the current Patterson Road by the current Jesmond Dene Stud (indoor lodging).
1978	Historical map*	A caravan park, primary school and public hall are noted north of the precinct.
1979	Historical map*	Railway line marked located to the north of the precinct. No other significant changes were observed.
1985	Aerial imagery	Precinct remains largely unchanged in the years from ~1974 leading up to 1985 – with the exception of a large racetrack and adjacent sheds / buildings added on the present-day northern precinct boundary, with adjacent paddocks (likely for horse training).
1986	Historical map*	Proposed Princes Freeway alignment added, in addition to Stephens Road, Handford Lane and Leckey Road. Recreation Reserve added east of Public Hall in Officer, and Sanctuary for Native Game marked west of Cardinia Creek.
1991	Aerial imagery	Minimal changes since 1985 to the precinct. Old Princes Freeway under construction north of the Site boundary.
1998	Historical map*	Native Game reserve removed; Old Princes Highway marked.
2004	Aerial imagery	

Year	Document Type	Comments / Observations
2006	Aerial imagery	Precinct remains largely agricultural. Gas pipeline easement appears to have been added running from east to west through the precinct. Old Princes Freeway to the north appeared complete.
2009	Historical map*	Princes Freeway built; residential suburbs added in Beaconsfield northwest of Site. No other notable additional buildings, roads or features otherwise were added within the precinct.
2009	Aerial imagery	New Princes Freeway added, that forms the boundary of the precinct to the north currently. Several properties adjacent to Princes Freeway's main service station were cleared.
2013	Aerial imagery	Service stations along Princes Freeway under construction. Majority of the precinct still largely agricultural.
2014	Aerial imagery	Service stations along Princes Freeway have been built. No significant changes were observed to have occurred to the wider site.
2019	Aerial imagery	Between 2014 and 2019, several urban residential developments were constructed in areas adjacent to the precinct (at Officer and Clyde North). A large residential hub was added to the east of the precinct.
2020	Aerial imagery	The precinct is in its current layout. Service stations are still present, with adjacent land areas undergoing further progressive development. Much of the precinct appears to be vacant agricultural lots still.

Note: *No legend or detailed roads were provided with the maps. As such, a best guess has been made when interpreting symbols and locations relative to features presented in the historical aerial imagery for commentary on the comparison of key changes.

4.5.5 Heritage Databases

Commonwealth, National and Victorian Heritage

The database retrieval by Lotsearch did not identify the existence of any Commonwealth, National Heritage or Victorian heritage sites were able to be identified within and immediately surrounding the precinct in a 1 km radius. It is noted that there are two existing Heritage Overlays, which are on a local council database.

Aboriginal Cultural Heritage

There are 19 registered areas or sites of Aboriginal cultural heritage or significance, as specified in Division 3 – Part 2 of the Victorian Aboriginal Heritage Regulations (2018) within the precinct boundary. In addition, there are another 47 registered sites within a 1 km buffer of the precinct boundary. The cultural heritage sites that have been identified are generally concentrated along Cardinia Creek, which forms the western boundary of the Officer South Precinct. No potentially contaminating activities could be gleaned from these sites.

4.5.6 Environment Protection Authority Victoria Databases

A review of various EPA Victoria databases for sites which may be undertaking potentially contaminating activities was completed for the precinct and within a 1 km radius of the study area. The data reviewed were those retrieved by Lotsearch (data provided in **Appendix B**) and subsequently cross-checked against Victoria Unearthed Online Database for currency (available at https://mapshare.vic.gov.au/VictoriaUnearthed/).

EPA Licensed Activities

The data review did not identify any current EPA licensed activities within the precinct; however, there is one current EPA licensed activity registered for a business approximately 930 north of the precinct located at 4A Hickson Road, Officer. The business is listed as “OUTLOOK INC (Vic), Officer”, which is a branch of Outlook Environmental, which undertakes recycling operations and operates recycled goods shops. There are no former licensed activities or EPA works approvals registered within the precinct, or within a 1 km buffer.

Prescribed Waste Facilities

Three prescribed waste facilities have been identified within the precinct:

- S&K Services located at 12 Swallowtail Avenue, Clyde North VIC 3978 – located ~380 m west of the precinct.
- Subasic Mersudina, 23 Sandy Road, Officer VIC 3809 – located ~550m north-east of the precinct.
- Khan, Shandar Ali (Clyde North), Clyde North VIC 3978 – located ~970 m west of the precinct.

Given the distance, these properties do not pose a significant contamination risk to the precinct.

Priority Sites Register and Pollution Abatement Notices

The EPA Victoria database retrieval by Lotsearch did not identify the existence of any current EPA Priority Sites or Pollution Abatement Notices (PAN) registered within and immediately surrounding the precinct in a 1 km radius. Subsequent additional checks by Aurecon on publicly listed registers also did not identify additional sites in the same study extent.

A former pollution abatement notice (90007445) exists for a property at 10 Hicks Road, Officer (located approximately 911 m north of the precinct) for a company called HY GAIN FEED Pty. Ltd., dated 8 May 2017. HY GAIN Feed Pty Ltd is listed as an equine feed and supplement company that manufactures their own products in ‘equine only’ feed mills at various locations in Australia, which includes the address listed at 10 Hickson Road, Officer. No further information regarding the pollution notice (90007445) and what it was related to was available.

Environmental Audits and Groundwater Restricted Use Zones

An EPA Victoria environmental audit site (CARMS No. 74407-1) is registered approximately 120 m north-east of the precinct at 101 Wells Street, Frankston dated with a completion date of 8 February 2018. There are no EPA Groundwater Restricted Use Zones within the precinct or within a 1 km radius.

A review of reports relating to CARMS No. 74407-1 identified the following basis for the environmental audit requirement:

- SEW operates the Officer-Pakenham Class A recycled water scheme using recycled water sourced from its Pakenham Recycled Water Treatment Plant, which is located approximately 4 km south of Pakenham. The scheme provides Class A recycled water to approximately 3,700 dwellings (as of February 2018).
- The objective of this audit was to establish whether the dual pipeline scheme operated by SEW in the Officer-Pakenham area is functioning in a manner that protects human health and operates without an unacceptable risk of harm to the environment.
- The audit determined that the implementation of the dual pipe recycled water scheme by SEW does not pose a significant risk of harm to the environment, which includes human and local ecological health.
- The Auditor (Stephen Jenkins, EnviroRisk) made several recommendations that related to ongoing improvement of monitoring, review, training and community engagement in order to maintain the integrity of the recycled water scheme. None of the recommendations related to specific elevated chemical concentration that may represent a significant risk to the community or environment.
- The next independent audit of the recycled water scheme is due in 2021.

Based on the above, it is considered that this environmental audit did not reveal significant contamination issues that may pose a risk to the current study area (i.e. the Officer South Employment Precinct).

The updated Environment Audit Overlay was viewed on 19 May 2022 using the Victoria Unearthed online GIS viewer. No additional sites have been added that are within or in proximity to the precinct area.

4.5.7 Per- and Polyfluoroalkyl Substances Investigation Databases

There are currently no listed PFAS site investigations, Defence PFAS or Regional Contamination Investigation Programs, Airservices Australia PFAS investigations, or management programs registered within and immediately surrounding the precinct in a 1 km radius.

4.5.8 Liquid Fuel Facilities and Cathodic Protection Systems

One active BP-operated service station is within the precinct at 94 Princes Freeway and another BP-operated service station is located immediately north of the precinct at 65 Princes Freeway (~120 m to the north-west).

Based on aerial imagery, these two facilities were developed in approximately 2013 (based on aerial imagery), with a building permit completion date of 2018. There is no public record of any incidents or complaints at either site.

Given that these services stations are less than 10 years old, it is likely that both have been built with fuel infrastructure that meets modern environmental and engineering standards, with adequate monitoring systems. BP as part of their obligations under the *Environment Protection Act* 2017 and operating license are obliged to carry out regular checks, report product losses and clean up any incidents relating to spills and subsequent contamination. However, in general, the nature of service stations lends to it being a potential source of relatively higher levels of contamination.

Furthermore, a search for cathodic protection systems registered within the precinct, typically indicative of the presence of fuel storage systems, did not identify other properties with such systems. A copy of this search is provided in **Appendix B**.

4.5.9 Site Inspection

A site inspection was completed on 16 June 2020 by an experienced Aurecon Environmental Scientist. Properties that were visited were chosen based on features of interest identified by desktop information (e.g. groundwater bores), and where Aurecon staff were given express permission to access. Kerbside observations were also made from public roads and utility access tracks where possible. No strong indication of noise or odour issues were identified within the precinct as part of these high-level site inspections. It is noted that quantitative noise and odour assessments were not within the scope of this assessment.

Details of the properties, parcels and main observations made are summarised in **Table 4-12** and are shown in **Figure A2**.

Table 4-12 Contamination site inspection details (16 June 2020)

Lots Visited	Parcel SPI	Comment
425 Officer South Road	1\TP215018	Property visited; one bore found. No other bores present on site.
Lot 1 Officer South Road	1\TP370056	Property visited; Cardinia Creek water quality parameters opportunistically measured.
345 Officer South Road	1\TP128503	Property visited, no accessible bores were able to be found.
235 Lecky Road	1\PS602663	Property visited; no bores found.

Lots Visited	Parcel SPI	Comment
Lot 2 Officer South Road	2\LP126079	Property visited; one bore found.
185 Officer South Road	20\PP3363	Kerbside inspection – two bores observed in paddock. Did not enter property. No notable observations could be made.
290 / 300 Officer South Road	2\PS705115	Kerbside inspection – one bore marked by windmill and water tank observed in paddock. Did not enter property. No notable observations could be made.
Lot 2 Stephens Road	4\PS446665	Kerbside inspection – viewed from the Southern Boundary from the utility access track. Did not enter property. No notable observations could be made.
90 Handford Lane, Officer South	1\PS446665	Kerbside Inspection - viewed from the Southern Boundary from the utility access track. Did not enter property.
200 Officer South Road	1\PS644697	Door knocked - no answer. Did not enter property.

The site inspection identified 17 features of interest, which are summarised with photographs in **Table 4-13**.

Table 4-13 Contamination site inspection features of interest (16 June 2020)

Feature, description and address	Photograph
Un-named utility track off corner of Stephens & Lecky Road, Officer South. **E1 and E2**: Illegally dumped rubbish (bagged domestic rubbish, furniture, white goods, gas cyclinders).	 

Feature, description and address	Photograph
E2, E3 and E4: Weed infestation (blackberries),	 

4.5.10 Potential for Contamination

The preliminary findings of this desktop study did not identify substantial or significantly high-risk areas for potentially contaminated land and groundwater, with the exception of inferences made for 94 Princes Freeway (current BP Truck Stop Service Station); however, it is noted that agricultural practices still have the potential to contaminate land at generally lower levels. Given the size of this precinct and level of assessment completed, it is possible that not all contamination issues have been identified at this stage and that sites identified as low risk may be re-classified as medium risk PCL sites. However, as the intent of this investigation was to identify significant development implications, this level of assessment is considered to be adequate. **Figure A12** identifies areas of potentially contaminated land qualitatively ranked in accordance with PPN30 and are categorised by the limited findings of this assessment only (i.e. these sites may contain more contamination than readily identifiable by this high-level desktop).

Based on the findings of this assessment, it can be inferred that the following types of localised low-level contamination may be encountered on a precinct-wide scale during further development of the precinct:

- Fill soils of unknown quality and origin and likely to be predominantly situated around existing building footprints and less in areas used for pasture.
- Stockpiles of spoil generated from standard agricultural activities on private properties.

- Sporadic areas of illegal dumping along overgrown areas adjacent to public roadways. During the site inspection undertaken by Aurecon, evidence of illegally disposed white goods, domestic waste, furniture and gas cylinders was noted.
- Isolated areas of farm wastes on the surface or within the subsurface at undetermined depths sourced from burial of deceased livestock and spreading / manuring with animal excrement as part of common agricultural practices.
- Isolated areas of agricultural chemical use in the shallow soil profile.

Due to the nature of existing infrastructure and activities at the BP Truck Stop Service Station (i.e. underground and above ground fuel storage and refuelling activities), there is a higher potential for contaminated land. It is recommended that future sensitive uses not be proposed at or immediately adjacent this particular property.

4.5.11 Ministerial Direction No. 1 and No. 19

There are two documents relating to potentially contaminated land to be considered by a planning authority when submitting a planning scheme amendment (PSA): *Ministerial Direction No. 1 (MD1) Potentially Contaminated Land* (Victorian Government 2001) and Ministerial Direction No. 19 (MD19) Ministerial Direction on the preparation and content of amendments that may significantly impact the environment, amenity and human health (Victorian Government 2018).

MD1 states that in preparing an amendment which would have the effect of allowing (whether or not subject to the grant of a permit) potentially contaminated land to be used for a sensitive use, agriculture or public open space, a Planning Authority must satisfy itself that the environmental conditions of that land are or will be suitable for that use. This could consist of staged environmental assessments and / or a requirement to complete an environmental audit (Certificate or Statement to be issued).

In the case of the requirement for an environmental audit, MD1 provides for an exemption from the need to comply with the Direction. Such an exemption may be appropriate where potentially contaminated land is already used for a sensitive use, agriculture or open space or where the prior industry use of the land was benign and unlikely to result in any contamination. However, the planning authority should consult with the EPA before requesting an exemption.

MD19 requires the Planning Authority to seek the early advice of EPA when preparing planning scheme reviews and amendments that could significantly impact on the environment, amenity and human health due to potential contamination. MD19 requires the Planning Authority to give the Minister for Planning the following information when applying for authorisation to prepare an Amendment under sections 8A or 8B of the P&E Act, or preparing an Amendment under section 9 of the P&E Act:

- The written views of EPA, including any supporting information and reports; and
- A written explanation of how the proposed Amendment addresses any issues or matters raised by EPA.

It is noted that the VPA has sought preliminary view from the EPA in preparation of this report.

How the above guidance applies to the precinct will largely depend on the information provided under MD1 and where the proposed future sensitive land uses are relative to the identified potentially contaminated land sites (indicated on **Figure A12**). An indication of where MD1 directives may apply and change over these potentially contaminated land sites is shown on **Figure A13** and **Figure A14**.

Based on the identified PCL sites within the precinct, the following are recommended:

- **Pertaining to MD1 and the Potential Contaminated Land General Practice Note requirements**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to more sensitive uses, then it is likely that an environmental audit and environmental audit overlay would be required to ensure that the contamination status of the property do not pose a risk to human health and the environment for the identified future sensitive land uses. It is noted that if the less sensitive uses such as retail, industry or open space were proposed for the Service Station, then a preliminary site assessment from a suitably qualified environmental professional should be required at the planning permit stage.

- For low risk sites, general duties under the *Planning and Environment Act* 1987 apply. As an added due diligence measure, an exploratory[1] intrusive assessment (any combination of soil, groundwater, surface water or air, to be determined on a site-specific basis) could be undertaken based on or to further inform area-specific or lot-specific development plans and to assist with construction soil management. It is noted that PFAS and asbestos in particular have the potential for significant implications to human health and ecological receptors, project schedules and budgets, but the presence of which are not always accurately informed by a high-level desktop review such as this assessment. Further assessment should consider detailed assessment for these contaminants on a site-specific basis.
- Given the high-level nature of this desktop review, it is considered that there is insufficient detail to confirm whether contamination may or may not exist at any of the sites reviewed. For land where there was insufficient detail to confirm or rule out the presence of contamination and where sensitive land uses (in accordance with General Practice Note) are proposed, it is recommended that a Preliminary Site Investigation (PSI) should be undertaken to the standard established under the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) (the 'ASC NEPM').
- Following on from the further assessment to confirm whether contamination may exist, all sites where sensitive land uses are proposed at sites that are deemed to have a 'Medium' potential for contamination should be subject to further assessment including an intrusive soil investigation and to make a conclusion as to whether an environmental audit is required. Any soil investigation should also determine if groundwater needs to be assessed.
- A matrix defining levels of assessment for various development scenarios is provided in PPN30 and should be referenced once the next steps for the precinct have been identified.

- **Pertaining to MD19 requirements**
  - The BP Service Station at 94 Princes Freeway meets the definition of 'potentially contaminated land' as defined in MD1 and the requirements of the EP Act may be applicable. If the petrol station required a PSA and changed to different zoning but not necessarily a 'more sensitive' zoning, then MD19 requirements for consultation with the EPA would be triggered. The EPA should be notified of the nature and intention of the future project for general approval of works and further advice. If no further requirements from EPA were provided, then the general process is to continue the proposed redevelopment in accordance with MD1 and PPN30 guidance.
  - Based on the review findings, other lots within the precinct do not meet the definition of 'potentially contaminated land' as defined in MD1 and hence requirements of MD19 do not apply.

4.5.12 Planning Practice Note 30

Planning Practice Note 30 (PPN30) was issued in July 2021 and pertains to land use planning and potentially contaminated land, in particular, how to identify potentially contaminated land, determining the appropriate level of assessment for contaminated land, determining the appropriate provisions in planning scheme amendments, and determining the appropriate conditions on planning permits.

PPN30 relies upon the definitions of contaminated land and potentially contaminated land as set out in *Ministerial Direction No. 1 – Potentially Contaminated Land* and Clause 73.01 General Terms of the *Victoria Planning Provisions* and provides a non-exhaustive list of land uses with high and medium potential for contamination. Within this list the following high potential for contamination land uses may have occurred within the precinct area which have not been identified by the desktop assessment:

- Mass animal burial on agricultural sites

[1] An exploratory intrusive investigation is a limited investigation for which the aim is to:
- Reduce uncertainty;
- Update the initial conceptual site model; and
- Provide information to support any future detailed investigation.

- Fertiliser storage
- Fill sites
- Stock dipping sites

Should evidence of these land practices be identified then pending potential future land use of the area, the appropriate Preliminary Risk Screening Assessment (PRSA) should be undertaken as per Table 3 in PPN30.

4.5.13 Environment Protection Act 2017

Revisions made to the Environment Protection Act (EP Act) set out to define contaminated land, what notifiable contamination is and subsequent duties for its management. The definition for contaminated land is consistent with that set out in PPN30, MD1, and MD19. Under the EP Act, a person in management or control of land must notify the Authority if the land has been contaminated by notifiable contamination as soon as practicable after the person becomes aware of the contamination.

In the instance that notifiable contamination is identified within the parcels of land subject to development, either through investigations triggered by a PRSA or happenstance, lodgement of the following information must be provided to the Environment Protection Authority:

- the location of the land;
- the activity resulting, or suspected as resulting, in the contamination;
- the nature and extent of the contamination;
- the nature of the risk of harm to human health and the environment from the contamination; and
- any other prescribed information.

4.5.14 Identified Development Constraints

In general, the majority of land within this precinct has not been heavily industrialised and hence many opportunities to redevelop the land within the precinct for various sensitive (e.g. residential, schools) and less sensitive uses (e.g. commercial and industrial) are available.

One site was identified to have the highest potential for contaminated land, which is the BP Truck Stop Service Station at 94 Princes Freeway. It is recommended that future sensitive uses not be proposed at or immediately adjacent this particular property given that the nature of its infrastructure and activities (i.e. underground and above ground fuel storage and refuelling activities) would typically create a high potential for contaminated land (in accordance with the Potentially Contaminated Land General Practice Note (DSE 2005)). Moving forward for the precinct, it is likely that the following further assessments may be required and will depend on the redevelopment scenarios to be applied, as follows:

- **Scenario 1: Redevelopment of land to more sensitive land uses at identified low to high potential for contaminated land sites (Figure A13)**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to more sensitive uses, then it is likely that an environmental audit and an environmental audit overlay would be required to ensure that the contamination status of the land (and related environmental media) do not pose a risk to human health and the environment for the identified future sensitive land uses. It is not yet known whether land surrounding the BP site may be contaminated by site-derived sources/activities; hence, further assessment is required to inform on this potential risk.
  - Where current low PCL agricultural and reserve land are proposed to be developed into sensitive land uses (e.g. residential, child-care centres, pre-schools and elementary schools) then general duties under Section 12(2)(b) and Section 60(1)(a)(iii) of the *Planning and Environment Act* 1987 apply, which involves the Planning Authority being satisfied the site is not contaminated. It is suggested that an exploratory intrusive soil and groundwater assessment could be undertaken to confirm the status of the areas contamination risk.

- **Scenario 2: Redevelopment of land to less sensitive land uses at identified low to high potential for contaminated land sites (Figure A14)**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to less sensitive land uses (such as commercial / industrial), then it is recommended to undertake further intrusive assessment of subsurface conditions to obtain an understanding of how impacted the site is during the due diligence period and prior to acquisition and redevelopment and whether or not an environmental audit may be required. It is not yet known whether land surrounding the BP site may be contaminated by site-derived sources/activities; hence, further assessment is required to inform on this potential risk.
  - Where current low PCL agricultural land and reserve land is proposed to be developed into less sensitive uses (e.g. commercial, industrial) then general duties under Section 12(2)(b) and Section 60(1)(a)(iii) of the *Planning and Environment Act* 1987 apply, which involves the Planning Authority being satisfied the site is not contaminated. It is suggested that an exploratory intrusive soil and groundwater assessment be undertaken to confirm the inferred contamination risk and support waste classification at the location.

To support future waste classification at the precinct and confirm background concentrations and low inferred risk of contamination, an exploratory soil and groundwater intrusive assessment could be undertaken. This investigation is considered optional and should be conducted to further inform area-specific or lot-specific development plans and assist with construction soil management which is likely to be required. It is noted that PFAS and asbestos in particular have the potential for significant implications to human health and ecological receptors, project schedules and budgets, but the presence of which are not always accurately informed by a high-level desktop review such as this assessment. Future investigations should consider detailed assessment for these contaminants on a site-specific basis.

In general, if optional intrusive assessments are undertaken, they should involve a soil sampling and analysis program as a minimum and consideration should be made for further groundwater sampling and analysis program where groundwater may be encountered as part of future works particularly where groundwater may be a source of contaminant migration and / or vapour intrusion risks in the vicinity of the development.

5 Conclusions and Recommendations

Based on the findings of this assessment, the following conclusions and recommendations can be made for each discipline.

5.1 Geotechnical

Soft Soils / Settlement

Areas of identified lacustrine-paludal deposits should be assumed to have low shear strength and are likely to undergo primary and secondary consolidation under relatively low loading. Localised soft areas within the alluvial deposits are likely to exist throughout the site, which may also pose bearing or settlement issues. Alluvial deposits are generally anticipated to be suitable for light weight structures without ground improvement. These soils will result in higher construction and maintenance cost for foundations and pavements. The extent of soft and compressible soils cannot be confirmed without further intrusive investigations.

Sodic / Dispersive Soils / Erosion / Trafficability

Most soils across the site are mapped as sodosols, which are expected to be dispersive based on visual identifiers onsite. The risk of erosion along Cardinia Creek is evident by previous activities taken to control it, and this must be further managed. A buffer zone of approximately 20 m along Cardinia Creek is recommended to avoid future structural development without improvement to the management strategies for erosion of the creek bank. It is anticipated that most of the site will become difficult to traffic during in wet periods, boggy ground is predicted in wet periods.

Given the large extent of these soils, this is overall considered to pose a risk for development. Potential management strategies for civil works include may construction of access tracks, use of tracked equipment, careful management of compaction requirements, higher compactive effort, chemical amelioration, and raising the ground level.

Acid Sulfate Soils

Areas with the highest probability of containing acid sulfate soils are likely to also be soft soils with high water tables, it is advised to avoid disruption of these soils where possible. A map of PASS risks is provided as **Figure A7**.

Precinct-wide Issues

All soils hold the risk of trench collapse, good earthworks practice will control this risk. All upper soils are anticipated to provide low strength for basement wall retention support (anchors, soil nails) therefore multi-level basement construction is not recommended based on the desktop assessment. Multi-level basement construction is likely to have high construction costs.

Recommended Further Testing

Based on the findings of the desktop review and site inspection observations, the following further geotechnical investigations have been identified for the next phase of precinct planning:

- Systematic progression of test pits or boreholes across the entire precinct to establish the material properties of the upper 1.5 to 3 metres of soil. The density of testing will typically be limited by available resources and funds for the overall planning process; however, for planning purposes, a density of 0.1 to 0.2 locations per hectare (200 to 400 m spacing) is acceptable for an initial impact assessment (Handbook of Geotechnical Investigation and Design Tables 2014). Aurecon recommends for the purpose of high-level classification of the site to determine if the risk of dispersive soils or ASS are

present then a lesser test density could be adopted. As a guide a spacing of 600 m would provide sufficient data Aurecon to ascertain the level of risk posed to development and the types of development which would not be suitable.

- Strength testing of the upper soil strata. Dynamic Cone Penetrometer, Standard Penetrometer, Shear Vane and Pocket Penetrometer testing are considered the most cost-effective methods.
- Laboratory testing soils for:
  - Dispersive soil behaviour (Exchangeable Sodium Percentage, Emerson Crumb)
  - Acid sulfate soils (field testing, SPOCAS, Chromium Suite)
  - Salinity (EC)
- Investigations should be conducted throughout the precinct as development progresses, however acid sulfate soil testing could be targeted to medium and high-risk areas as identified within **Figure A7**.
- Should the presence of dispersive soils or ASS/PASS be found through further testing it is recommended that appropriate controls be put in the PSP and Urban Growth Zone to manage this issue. Additional testing may be required by developers or restrictions placed onto potential developments.

5.2 Hydrological / Hydrogeological

Topography and Drainage

The precinct is relatively flat, falling from the north-western corner to the south-eastern corner. The land surface gradients are typically very low across the precinct, with surface elevation differences at points located 1 km or more from streams ranging between 0.5 m and 1 m. As low-lying land water sits in this local environment and during rain events it experiences sheet flows. Stream and drain beds are generally incised by up to 2.5 m bgl, in the northern section of the precinct, increasing in depth as the precinct progresses south, particularly along Cardinia Creek.

The precinct contains several surface water bodies to which overland flows drains and include: Cardinia Creek, Lower Gum Scrub Creek, several unnamed drains through the precinct, and several farm dams across the precinct (**Figure A8**).

The two major waterways of Cardinia Creek and Lower Gum Scrub Creek both support biodiversity attributes and natural habitats for fauna and consequently their riparian corridors are 100m wide either side of each waterway.

Several drainage assets to be provided for the precinct have been identified for the precinct, and are shown within existing Melbourne Water Drainage Scheme Plans (i.e. Cardinia Industrial DS 1510 and Officer DS 1315). The Officer South Drain is expected to support a series of treatment ponds down the east side of Officer South Road as part of its treatment train to Cardinia Creek. However due to the precinct's flat nature these drainage assets could be located up to 200m east of this road and options to split the catchment, given its large volume of flow may be possible. The width of this corridor for the Officer South Drain is expected to be between 50-80m in accordance with Melbourne Water's *Waterway corridors – Guidelines for greenfield development areas within the Port Phillip and Westernport Region* (MW 2013).

Flood Risk

Land within the precinct is subject two overlays that address the land's flooding risks.

The FO which applies to both Cardinia Creek, Lower Gum Scrub Creek and their surrounds (up to 100 m on either side) identifies these waterways as major flood paths which have the highest likelihood of flood risk or hazard and/or frequency of being affected by flood waters.

The second overlay is the LSIO, which identifies land used for flood storage, or flood fringe areas, that are affected by the 1 in 100-year flood. The LSIO that applies to the precinct runs along Officer South Road and

includes the Officer South Drain, as this provides an overland flow path for flood waters within and through the precinct (**Figure A8**).

Aquifer and Supply

The Pakenham employment corridor lies on the coastal plains of Western Port Bay where the soil profiles consist of clay rich sediments to 10 m deep or more. This thick clay sediment, which is underlain by Silurian bedrock forms a low permeability fractured rock 'aquifer' in which lateral groundwater flows, across the Western Port plains.

The precinct is located within the Koo Wee Rup WSPA (**Figure A9**), declared in response to significant groundwater use and declining water levels. The purpose of the WSPA is to protect groundwater supply for future users, by maintaining appropriate groundwater levels. Within the Koo Wee Rup WSPA allocations of groundwater are in excess of the Permissible Consumptive Volume (PCV), which means that future applications for groundwater extraction are unlikely, potentially affecting local food and agricultural production.

Groundwater Depths, Salinity and Quality

The precinct features a shallow water table with groundwater sitting or perched on the clay sediment which directly interacts with existing drainage lines.

Previous assessments of depth to water table (SKM 2005) indicate a likely depth range of 1-3m can be expected across this portion of the Pakenham growth corridor, particularly in the northern section of the precinct where the land is very flat. Groundwater depths generally increase across the precinct to between 3 - 5m in the southern area as the soil structure transitions to sandier material, typical of converging drainage lines across the plains, as they descend into the Western Port Bay coastal environment. Data collected as part of the site inspection for groundwater depth was limited due to access restrictions, inaccessibility due to overgrown vegetation and disuse, limiting landmark locations. However, the data that was obtained confirmed that the groundwater depth varied between approximately 4 m and 6 m with readings at 4.75 m and less than 6 m spread across the precinct apart from surface water bodies.

Regional groundwater salinity has been reported at a concentration range of 3,500-7,000 mg/L across the precinct. Data collected as part of the site inspection for groundwater salinity indicates low levels within Cardinia Creek at less than 400 mg/L at the precinct's western boundary. However, within the precinct salinity varies from 5,257 mg/L in the northern section of the precinct to 1,276 mg/L in the southern section, consistent with increasing groundwater levels and the transition in soil permeability. Planning and building controls for management of drainage and groundwater adopted for the Officer Precinct should be extended to the Officer South Employment Precinct. These salinity levels require salinity management controls as this water should not be used on soils with restricted drainage, and salt tolerance of vegetation should be considered. For the extremely high salinity water its use should be confined to emergency situations for salt tolerant crops on permeable soils only.

Summary

In summary, the hydrology of the precinct that features two significant waterways, a major overland flow path and additional water treatment assets related to water management within the locality, affords opportunities to integrate water into the precincts future urban structure in a manner that will facilitate amenity, connectivity and liveability for its future occupants. The conversion of rural land to urban provides an opportunity to rehabilitate the land and assist the natural water balance to support sustainable development. This approach to water management should be incorporated into the drainage strategy for the precinct.

As part of the precinct's development planning IWM should be incorporated to address the current constraints that exist within the precinct's hydrology and hydrogeological context. Some IWM opportunities that may be explored within the precinct consist of:

- Stormwater and rainwater harvesting as an alternative water source for greening local parks, sporting reserves and private open space, or for wash-down in retail and/or commercial areas;

- Flood management, including green/blue corridors, that maintain water in place, reduce salinity and support natural groundwater recharge, base flows and the Koo Wee Rup WSPA;
- Reduction of discharges into Cardinia Creek, Lower Gum Scrub Creek and Western Port Bay;
- Provision of recycled water to residential areas through a third pipe scheme including the ability to extend the scheme to provide recycled water for commercial and industrial uses, where customer/user demand exists;
- Recycled water use for drought proofing critical open space or ecological corridors including support for increased canopy cover, urban forest and buffer zones; and
- Clyde-to-Pakenham Regional Sewerage Treatment Plant, supporting *'water for work'*, including agriculture (food bowl) and manufacturing uses within employment areas.

Stormwater harvesting is an excellent system of achieving pollutant reduction targets and contributes significantly to achieving a *Water Sensitive City* when supplementing water supply. Proposed stormwater infrastructure for the precinct should be positioned to be co-located within areas of planned local parks or open space to enable stormwater harvesting capabilities. Stormwater capture and its use for irrigation within the precinct along with stormwater capture integration with infrastructure for water supply should also be explored as part of the future drainage strategy for the precinct.

The precincts linear drainage system that runs from its north- western boundary to its south- eastern boundary also provides opportunities to co-locate vegetation/open space with drainage assets to facilitate co-located corridors that further support ecological and biodiversity values, provide flood management, improve groundwater salinity, and create urban forest connections. Ongoing assessment and monitoring of groundwater levels and salinity within the precinct is required to ensure water quality does not have future implications for downstream water supply or ecosystems.

If opportunities arise, co-location of future drainage assets within the existing transmission easement at the southern portion of the precinct and within the riparian corridors (100 m) adjoining both Cardinia Creek and Lower Gum Scrub Creek, has the potential to result in a reduction in land take and could be explored as part of future drainage planning works. Where drainage assets and other infrastructure (i.e. pump stations, storage tanks etc.) can be co-located on already encumbered land, net developable area within the precinct is maintained for urban development.

The provision of recycled water through the established third pipe scheme for residential areas, managed by South East Water (SEW), has the capacity to be extended through the precinct to include industrial and employment areas where manufacturing customer bases are likely to exist. Provision for these opportunities to use additional water sources should be considered as part of the overall IWM strategies for the Officer South Employment precinct.

Recommended Further Work

Based on the findings of the desktop assessment, the following further testing are recommended:

- Undertaking a basic groundwater monitoring program which includes installations of bores to:
  - Confirm water table depths across areas of interest or in a grid-style pattern;
  - Groundwater quality parameters such as salinity, temperature, dissolved oxygen, electrical conductivity, pH and redox potential;
- Further assessments and monitoring of water levels and salinity on downstream ecosystems is required to ensure water quality is maintained at current levels as part of the precinct's future development.
- Sea level rise should be factored into the future detailed drainage report and flood modelling in accordance with the VPPs.

5.3 Ecology

The precinct includes two sections of Conservation Area 36. This Conservation Area is unable to be developed and will be retained, enhanced and managed for Growling Grass Frog habitat. Activities that may

adversely alter or effect the Conservation Area may require a Works in Conservation Area permit from the DELWP. If in doubt, consultation with DELWP is recommended.

Due to the identified Ramsar wetlands located downstream of the precinct, any activities that may have a likely significant impact above limits of acceptable change, and above described impacts in the Program Report on the Western Port Ramsar wetland may require Referral to the Commonwealth Department of Agriculture, Water and the Environment to determine if the activity requires assessment under the EPBC Act.

Removal of the limited areas of native vegetation and scattered native trees will be subject to approvals under the Planning Scheme.

It is anticipated that all scattered trees outside conservation areas will be removed and habitat compensation will be paid. If scattered trees are retained here is a possibility for developers to apply for a dispensation from habitat compensation fees, but otherwise, all scattered trees are considered lost.

Recommendations

Based on the understanding of the ecological values within and surrounding the precinct, the following key interrelated items of interest should be considered in tandem with geotechnical, hydrological, hydrogeological and contamination issues:

- Planning of developments within the precinct should aim to integrate with the Conservation area in a manner that will not degrade the habitat values, such as introducing weeds, pest animals, contaminants and major alterations to the hydrology.
- Development within the precinct should also take into consideration any effects that development may cause downstream on the Western Port Ramsar wetland. Increased sediment or contaminant loads should not increase above current baseline conditions. This may require some developments to store and treat stormwater on site and have appropriate controls for contaminant spills or leaks.
- Removal of native vegetation will be subject to approvals under the Planning Scheme and will likely require financial developer contributions that will be developed as part of the Planning Scheme approvals for the removal.

5.4 Contamination

The preliminary findings of this desktop study did not identify substantial or significantly high-risk areas for potentially contaminated land and groundwater, with the exception of inferences made for 94 Princes Freeway (current BP Truck Stop Service Station); however, it is noted that agricultural practices still have the potential to contaminate land at generally lower levels. Given the size of this precinct and level of assessment completed, it is possible that not all contamination issues have been identified at this stage and that sites identified as low risk may be re-classified as medium risk PCL sites. However, as the intent of this investigation was to identify significant development implications, this level of assessment is considered to be adequate. **Figure A12** identifies areas of potentially contaminated land qualitatively ranked in accordance with PPN30 and are categorised by the limited findings of this assessment only (i.e. these sites may contain more contamination than readily identifiable by this high-level desktop).

Based on the findings of this assessment, it can be inferred that the following types of localised low-level contamination may be encountered on a precinct-wide scale during further development of the precinct:

- Fill soils of unknown quality and origin and likely to be predominantly situated around existing building footprints and less in areas used for pasture.
- Stockpiles of spoil generated from standard agricultural activities on private properties.
- Sporadic areas of illegal dumping along overgrown areas adjacent to public roadways. During the site inspection undertaken by Aurecon, evidence of illegally disposed white goods, domestic waste, furniture and gas cylinders was noted.
- Isolated areas of farm wastes on the surface or within the subsurface at undetermined depths sourced from burial of deceased livestock and spreading / manuring with animal excrement as part of common agricultural practices.

- Isolated areas of agricultural chemical use in the shallow soil profile.

Due to the nature of existing infrastructure and activities at the BP Truck Stop Service Station (i.e. underground and above ground fuel storage and refuelling activities), there is a higher potential for contaminated land. It is recommended that future sensitive uses not be proposed at or immediately adjacent this particular property. It is this property that is likely to trigger the requirements of MD1, MD19, PPN30, and the EP Act. With respect to MD1, PPN30 and MD19 requirements, the following are highlighted:

- **Pertaining to MD1 and the Potential Contaminated Land PPN30 requirements**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to more sensitive uses, then it is likely that an environmental audit and environmental audit overlay would be required to ensure that the contamination status of the property do not pose a risk to human health and the environment for the identified future sensitive land uses. It is noted that if the less sensitive uses such as retail, industry or open space were proposed for the Service Station, then a preliminary site assessment from a suitably qualified environmental professional should be required at the planning permit stage.
  - For low risk sites, general duties under the *Planning and Environment Act* 1987 apply. As an added due diligence measure, it is suggested that an exploratory intrusive assessment (any combination of soil, groundwater, surface water or air, to be determined on a site-specific basis) should be undertaken based on or to further inform area-specific or lot-specific development plans and to inform on construction soil management. It is noted that PFAS and asbestos in particular have the potential for significant implications to human health and ecological receptors, project schedules and budgets, but the presence of which are not always accurately informed by a high-level desktop review such as this assessment. Further assessment should consider detailed assessment for these contaminants on a site-specific basis.
  - Given the high-level nature of this desktop review, it is considered that there is insufficient detail to confirm whether contamination may or may not exist at any of the sites reviewed. For land where there was insufficient detail to confirm or rule out the presence of contamination and where sensitive land uses (in accordance with PPN30) are proposed, it is recommended that a Preliminary Site Investigation (PSI) should be undertaken to the standard established under the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) (the 'ASC NEPM').
  - Following on from the further assessment to confirm whether contamination may exist, all sites where sensitive land uses are proposed at sites that are deemed to have a 'Medium' potential for contamination should be subject to further assessment including an intrusive soil investigation and to make a conclusion as to whether an environmental audit is required. Any soil investigation should also determine if groundwater needs to be assessed.
  - A matrix defining levels of assessment for various development scenarios is provided in PPN30 and should be referenced once the next steps for the precinct have been identified.
- **Pertaining to MD19 requirements**
  - The BP Service Station at 94 Princes Freeway meets the definition of 'potentially contaminated land' as defined in MD1 and the requirements of the EP Act and subordinate regulations are applicable. If the petrol station required a PSA and changed to different zoning but not necessarily a 'more sensitive' zoning, then MD19 requirements for consultation with the EPA would be triggered. The EPA should be notified of the nature and intention of the future project for general approval of works and further advice. If no further requirements from EPA were provided, then the general process is to continue the proposed redevelopment in accordance with MD1 and PPN30.
  - Based on the review findings, other lots within the precinct do not meet the definition of 'potentially contaminated land' as defined in MD1 and hence requirements of MD19 do not apply.

Recommendations

Moving forward for the precinct, it is likely that the following further assessments may be required and will depend on the redevelopment scenarios to be applied, as follows:

- **Scenario 1: Redevelopment of land to more sensitive land uses at identified low to high potential for contaminated land sites (Figure A13)**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to more sensitive uses, then it is likely that an environmental audit and an environmental audit overlay would be required to ensure that the contamination status of the land (and related environmental media) do not pose a risk to human health and the environment for the identified future sensitive land uses. It is not yet known whether land surrounding the BP site may be contaminated by site-derived sources/activities; hence, further assessment is required to inform on this potential risk.
  - Where current low PCL agricultural and reserve land are proposed to be developed into sensitive land uses (e.g. residential, child-care centres, pre-schools and elementary schools) then general duties under Section 12(2)(b) and Section 60(1)(a)(iii) of the *Planning and Environment Act* 1987 apply, which involves the Planning Authority being satisfied the site is not contaminated. It is suggested that an exploratory intrusive soil and groundwater assessment could be undertaken to confirm the status of the areas contamination risk and assist with future soil management.
- **Scenario 2: Redevelopment of land to less sensitive land uses at identified low to high potential for contaminated land sites (Figure A14)**
  - If the BP Service Station at 94 Princes Freeway were to be redeveloped to less sensitive land uses (such as commercial / industrial), then it is recommended to undertake further intrusive assessment of subsurface conditions to obtain an understanding of how impacted the site is during the due diligence period and prior to acquisition and redevelopment and whether or not an environmental audit may be required. It is not yet known whether land surrounding the BP site may be contaminated by site-derived sources/activities; hence, further assessment is required to inform on this potential risk.
  - Where current low PCL agricultural land and reserve land is proposed to be developed into less sensitive uses (e.g. commercial, industrial) then general duties under Section 12(2)(b) and Section 60(1)(a)(iii) of the *Planning and Environment Act* 1987 apply, which involves the Planning Authority being satisfied the site is not contaminated. It is suggested that an exploratory intrusive soil and groundwater assessment could be undertaken to confirm the status of the areas contamination risk and assist with future soil management.

As an added due diligence measure, an exploratory intrusive assessment could be undertaken at any site within the precinct based on or to further inform area-specific or lot-specific development plans and to assist construction soil management. It is noted that PFAS and asbestos in particular have the potential for significant implications to human health and ecological receptors, project schedules and budgets, but the presence of which are not always accurately informed by a high-level desktop review such as this assessment. Further assessment should consider detailed assessment for these contaminants on a site-specific basis.

In general, optional further intrusive assessments should involve a soil sampling and analysis program as a minimum and consideration should be made for further groundwater sampling and analysis program where groundwater may be encountered as part of future works, and where groundwater may be a source of contaminant migration and / or vapour intrusion risks in the vicinity of the development.

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Wildlife Act 1975. No. 8699/1975, Version incorporating amendments as at 1 March 2017.

7 Limitations

The information presented in this report provides an **initial understanding** of the environmental variables assessed as supported by a) the findings of this desktop review; b) available / retrievable public and Council information at the time of this report; and c) limited site inspection observations for a select number of parcels (i.e. sites with potentially higher risk or uncertainties). The information presented herein are considered indicative until further assessments can be undertaken in future phases of works for the precinct to ground truth the desktop information.

A detailed review of contamination status and general quality of elements of the environment within and adjacent to the project site such as soil, surface water, groundwater, subsurface gas, indoor/outdoor air, landfill leachate and/or gas (if existing), health risks posed to human and ecological receptors on- and off-site, and any off-site properties / receiving environment was outside this project's current scope of works. Further environmental contamination and quality assessments are required to be completed as part of future planning processes to inform on the current status and its related impacts at individual lots or on a more localised basis.

Likewise, the detailed nature and extent of geotechnical variables have not been able to be determined based on this high-level desktop review, and further intrusive assessment works to quantify the geotechnical variables and identified conastraints on a localised level are recommended.

Aurecon notes that in some instances, access to some areas within the project study area was restricted by the agreed proposed site inspection scope in conjunction with physical obstructions such as fencing and / or third-party property access limitations.

Where the presented information indicates that the existing environmental conditions may adversely impact on the planning developments, then further investigation and assessment of soil conditions should be considered by the VPA, noting that conclusions drawn from additional investigations and assessment may differ from the initial appraisal of conditions presented in this report. It is recommended that care is especially taken by the VPA in the application of any costs of contingent liabilities derived from using the findings, inferences, conclusions and/or recommendations within this preliminary report.

Appendix A Figures

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Legend

- Employment Precinct
- VPA Parcels
- Locality
- Watercourses
- Roads

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 29/06/2020 Version: 1

A3 scale: 1:20,000

0 0.5 1 Km

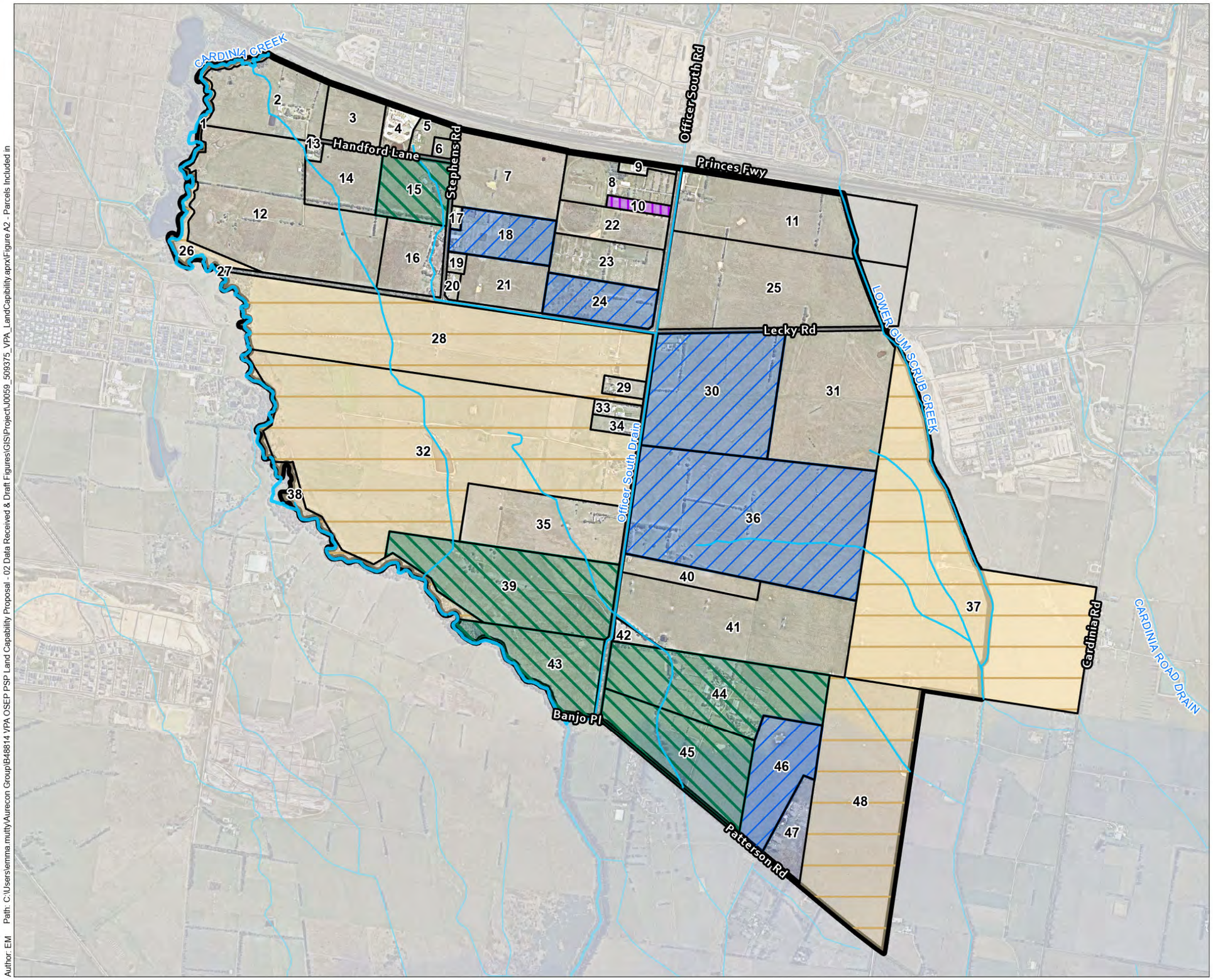
Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A1: Site Locality

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A1 - Site Locality



Legend

- Employment Precinct
- VPA Parcels
- Watercourses
- Roads
- High priority sites accessed for geotechnical isnpections (+Desktop study)
- High priority sites accessed for hydrogeological isnpections (+Desktop study)
- Properties with geotechnical and/ or hydrogeological features that was not accessed due to access restrictions
- No site contact detailed provided. Door-knock unanswered. Did not enter property

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 2/07/2020 Version: 1

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A2 - Parcels Included in

A3 scale: 1:20,000

0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A2: Parcels Included in Desktop Study and Site Inspections

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Legend

- Employment Precinct
- VPA Parcels
- Roads
- Watercourses
- PUBLIC ACQUISITION OVERLAY 1-3
- INCORPORATED PLAN OVERLAY - SCHEDULE 2-3
- DEVELOPMENT CONTRIBUTIONS PLAN OVERLAY - SCHEDULE 2-4, 13, 15.
- INFRASTRUCTURE CONTRIBUTIONS OVERLAY - SCHEDULE 1-2
- SPECIFIC CONTROLS OVERLAY - SCHEDULE 1
- LAND SUBJECT TO INUNDATION OVERLAY
- HERITAGE OVERLAY (HO90, 91, 92, 209)
- ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 3, 6, 7
- FLOODWAY OVERLAY
- URBAN GROWTH ZONE
- PUBLIC CONSERVATION AND RESOURCE ZONE

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 2/07/2020 Version: 2

A3 scale: 1:20,000

0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A3: Planning Zones and Overlays

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A3 - Planning Zones and

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Legend

- Employment Precinct
- VPA Parcels
- Roads

Current Land Use

- Agricultural
- Commercial
- Reserve (public / private mixed)

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 2/07/2020 Version: 2

A3 scale: 1:20,000

0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A4: Current Land Uses within the Precinct

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A4 - Current Land Uses within

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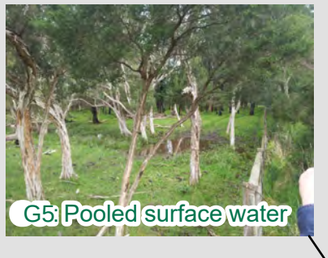
Legend

- Geotech Points
- Employment Precinct
- VPA Parcels

Soft Soil Risk
- High
- Medium

Geology 25K Map
- Qra - Alluvial
- Qrm - Lacustrine-paludal deposit


G5: Pooled surface water


G3: Boggy Ground


G9: Boggy Ground


G14: Erosion - Dam Banks


G4: Pooled surface water


G1: Boggy Ground


G13: Boggy Ground


G15: Reeds - Waterlogged


G18 - 2: Basalt Beaching


G20 - 3: Erosion


G18 - 1: Erosion


G17 - 1: Reeds - Waterlogged


G18 - 4: Erosion


G18 - 5: Erosion


G19 - 1: Swampy Ground


G19 - 3: Swampy Ground


G17 - 4: Reeds - Waterlogged

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 6/07/2020 Version: 2

A3 scale: 1:25,000

0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A5: Soft Soils / Settlement Constraints

aurecon

Legend

- Geotech Points
- Employment Precinct
- VPA Parcels

Dispersive Soil Erosion Risk

- High
- Medium
- Low

VIC Soil Type

- Brown Chromosols
- Grey Dermosols
- Grey Kurosols
- Grey Sodosols
- Brown Sodosols

Number	SP#		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 6/07/2020 Version: 2

A3 scale: 1:20,000

0 0.5 1 Km

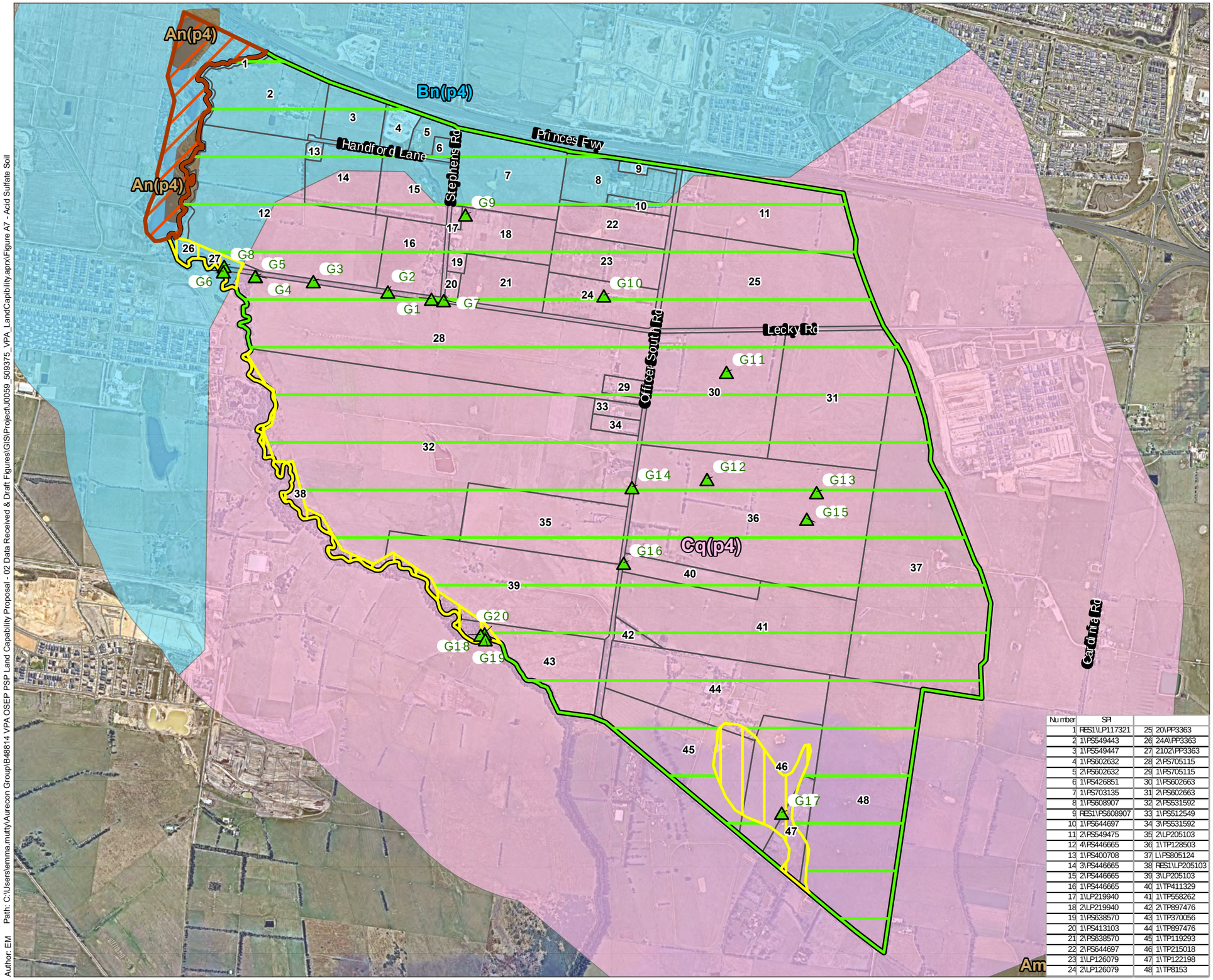
Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A6: Sodic/ Dispersive Soils and Erosion Constraints

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A6 - Sodic or Dispersive Soils



Number	SPI		
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2	1\PS549443	26	24A\PP3363
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4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
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22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

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Legend

- Geotech Points
- Employment Precinct
- VPA Parcels

NatASS (Aus Soils Classification)
Probability of occurrence of Acid Sulfate Soils

- A - High (>70%)
- B - Low (6-70%)
- C - Extremely Low (1-5%)

Acid Sulfate Soil Risk

- High
- Medium
- Low

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 6/07/2020 Version: 2

A3 scale: 1:20,000

0 0.5 1 Km

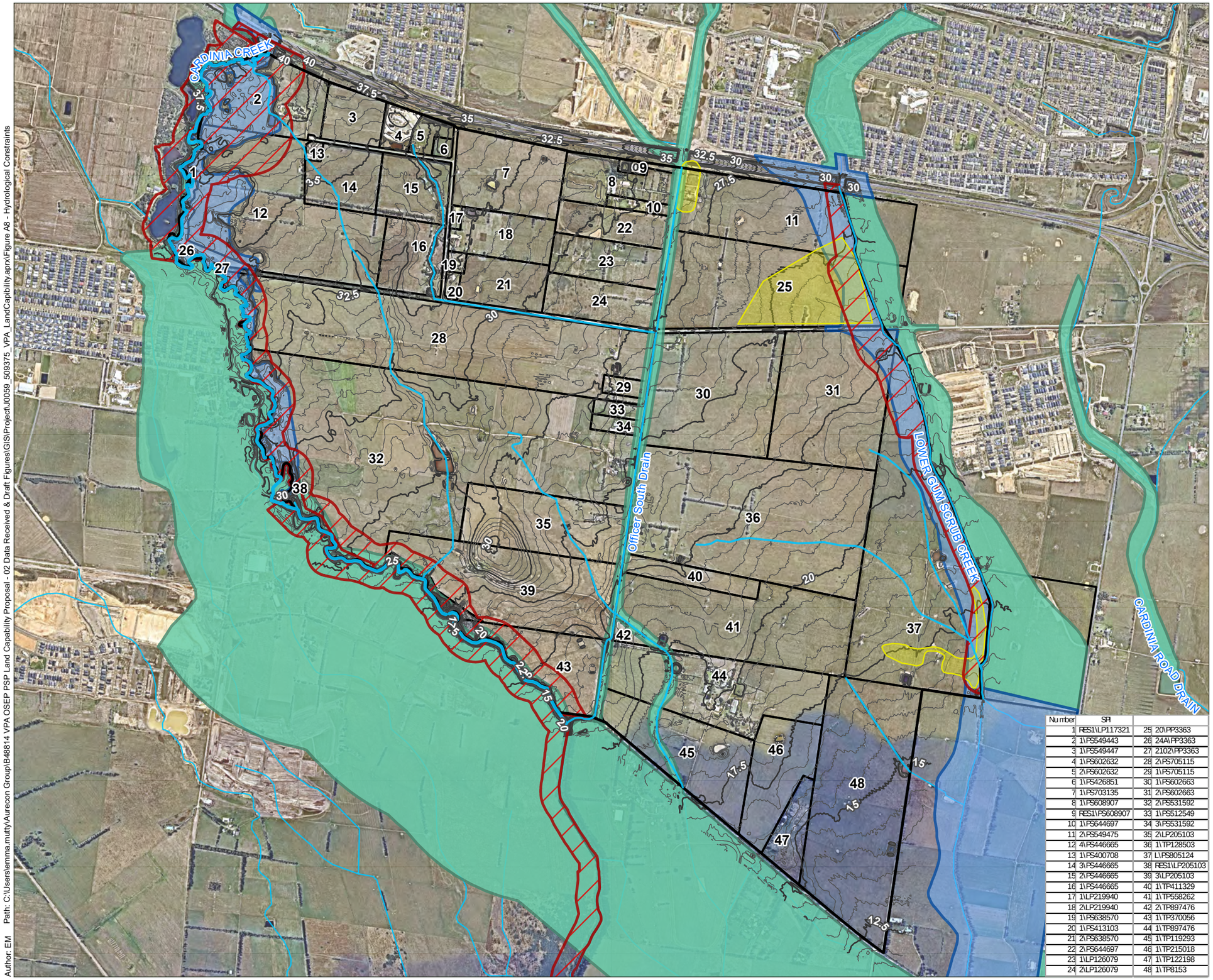
Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A7: Acid Sulfate Soil Constraints

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A7 - Acid Sulfate Soil



Number	SPI		
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3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

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Legend

- Watercourses
- Roads

Contours (0.5m)

- Contour
- Index Contour
- Employment Precinct
- Parcels
- FLOODWAY OVERLAY
- LAND SUBJECT TO INUNDATION OVERLAY
- Indicative Drainage Assets (MW DS)

Conservation Area 36

- South-East Growth Corridor

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 6/07/2020 Version: 2

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A8 - Hydrological Constraints

A3 scale: 1:20,000

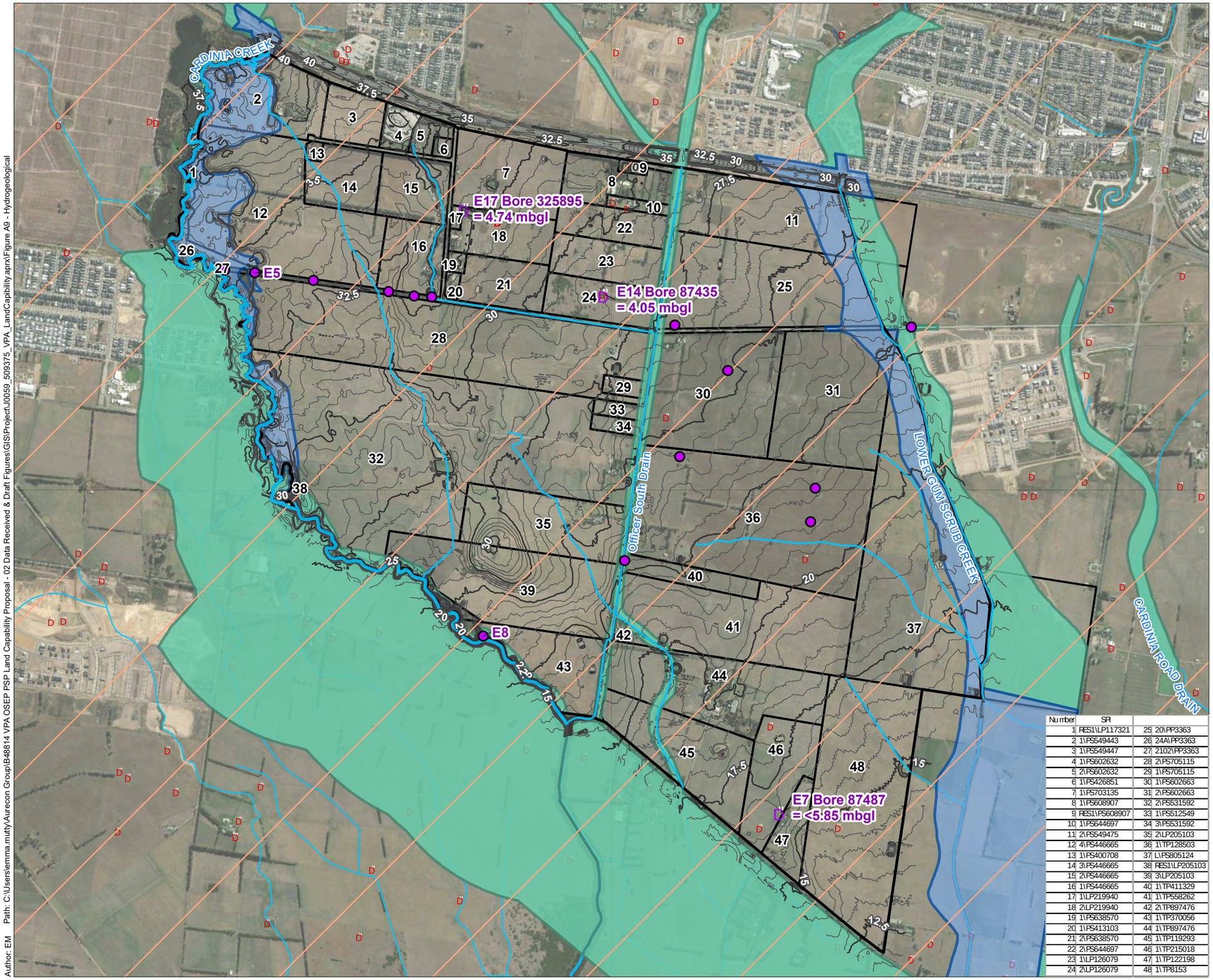
0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A8: Hydrological Constraints



Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Legend

- Roads
- Watercourses

Contours (0.5m)

- Contour
- Index Contour
- Employment Precinct
- Parcels
- Koo Wee Rup Water Supply Protection Area (covers entire precinct)

Plan Overlays (Lotsearch)

- FLOODWAY OVERLAY
- LAND SUBJECT TO INUNDATION OVERLAY
- Boreholes (DEPI WMIS) (Lotsearch)

Site Inspection

- GW Bore
- Other

Notes:

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020

Date: 6/07/2020 Version: 2

A3 scale: 1:20,000

0 0.5 1 Km

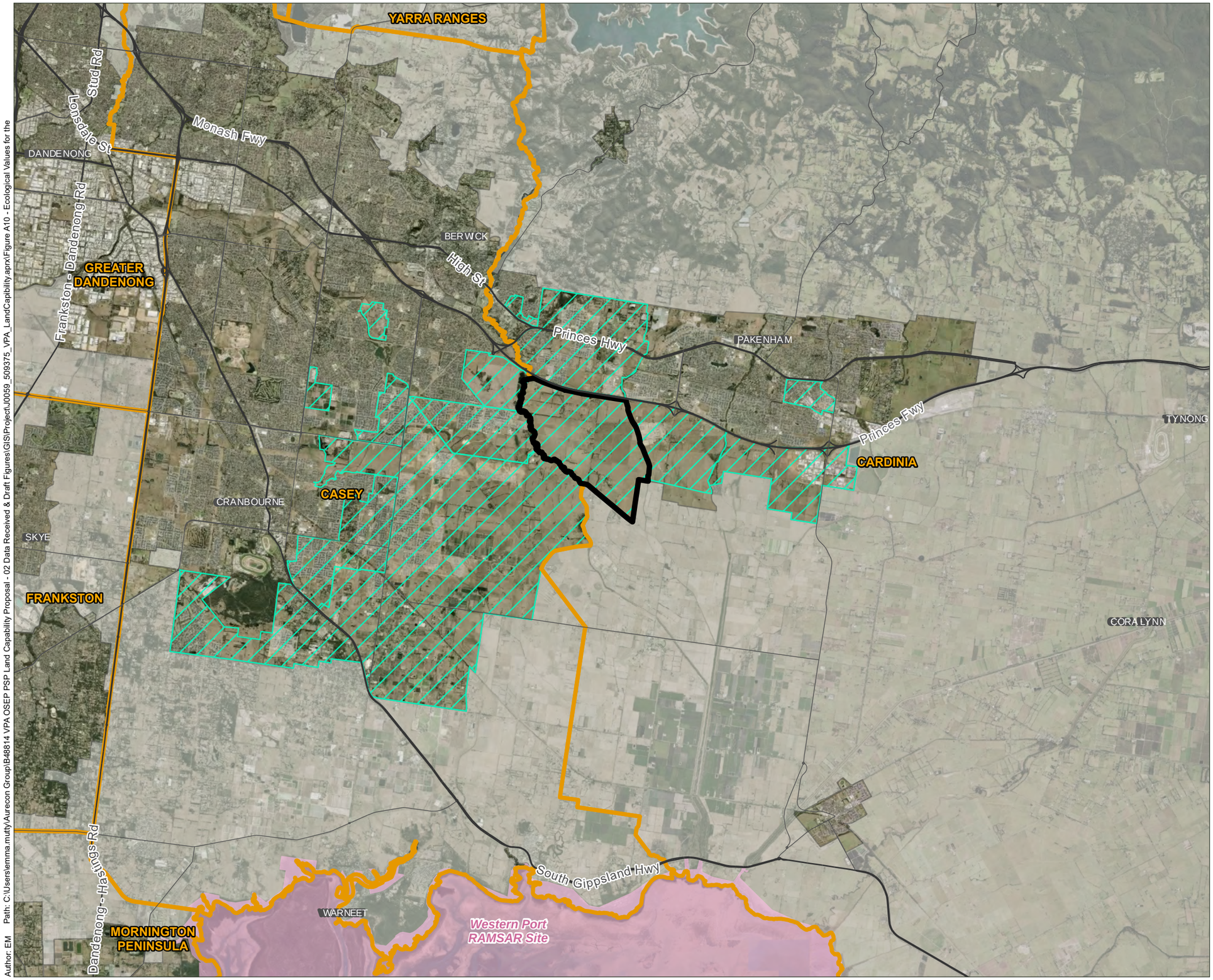
Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A9: Hydrogeological Constraints

Author: EM Path: C:\Users\emma.mutty\Aurecon Group\B48814 VPA OSEP PSP Land Capability Proposal - 02 Data Received & Draft Figures\GIS\Project\J0059_509375_VPA_LandCapibility.aprx\Figure A9 - Hydrogeological



Legend

- Employment Precinct
- Melbourne Strategic Assessment Extent
- Outside Urban Growth Boundary
- RAMSAR Wetlands
- LGA

Notes:

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

Date: 6/07/2020 Version: 2

A3 scale: 1:125,000

0 2.5 5 Km

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VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A10: Ecological Values for the Broader Area

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Legend

- Watercourses
- Employment Precinct
- VPA Parcels
- VBA FAUNA - Growling Grass Frog
- Scattered Tree (Environment Mitigation point dataset)

Conservation Areas in the Biodiversity Conservation Strategy

- South-Eastern Growth Corridor: Growling Grass Frog Corridors

Areas of Strategic Importance for Growling Grass Frog habitat

- Area of Strategic Importance - Buffer around waterbodies
- Area of Strategic Importance - Existing retained waterbody
- Area of Strategic Importance - Indicative new wetland location
- Area of Strategic Importance - Instream pool
- Other terrestrial habitat
- Terrestrial habitat buffer to ASI and waterway

Habitat Compensation Areas

- Growling Grass Frog and Southern Brown Bandicoot habitat area
- Native vegetation area and Southern Brown Bandicoot habitat area
- Southern Brown Bandicoot habitat area

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

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A3 scale: 1:20,000

0 0.5 1 Km

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VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A11: Ecological Values for the Precinct

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Legend

- Employment Precinct
- Parcels
- Roads

Potential for Contaminated Land

- High
- Low

Princes Fwy
Handford Lane
Stephens Rd
Lecky Rd
Officer South Rd
Cardinia Rd

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

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0 0.5 1 Km

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Figure A12: Potentially Contaminated Land Sites

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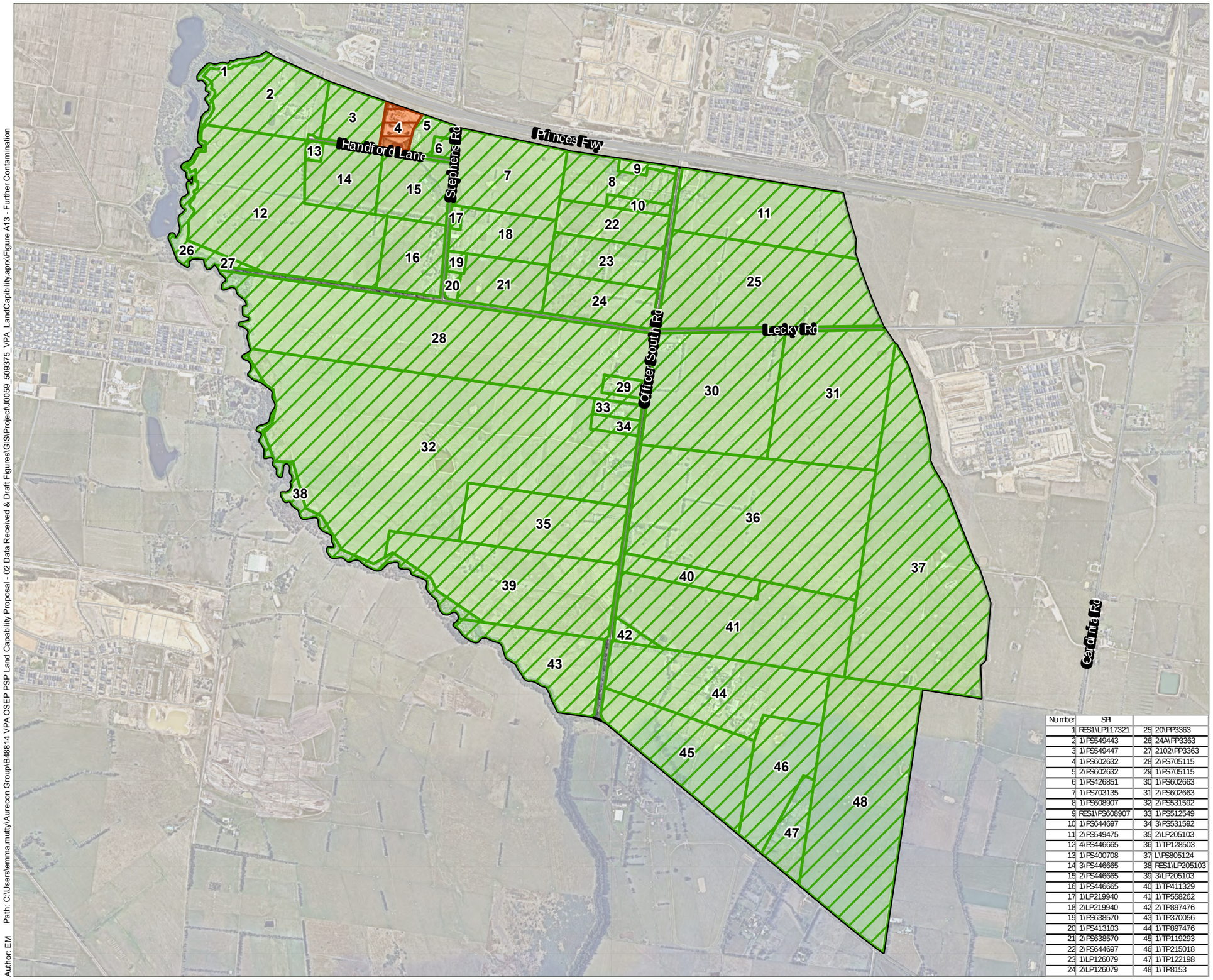

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
17	1\LP219940	41	1\TP558262
18	2\LP219940	42	2\TP897476
19	1\PS638570	43	1\TP370056
20	1\PS413103	44	1\TP897476
21	2\PS638570	45	1\TP119293
22	2\PS644697	46	1\TP215018
23	1\LP126079	47	1\TP122198
24	2\LP126079	48	1\TP8153

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Legend

- Employment Precinct
- Parcels
- Roads

Sensitive Development Scenario

- A = Require an environmental audit
- C = General duty under S12(2)(b) and S60(1)(a)(iii) of the Planning and Environment Act 1987

Notes:

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, VPA 2020, Lotsearch 2020, DELWP 2020, Nearmap 2020

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0 0.5 1 Km

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VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A13: Further Contamination Assessment Requirements (Sensitive Development Scenarios)

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Princes Fwy
Handford Lane
Stephens Rd
Lecky Rd
Officer South Rd
Cardinia Rd

Legend

- Employment Precinct
- Parcels
- Roads

Less Sensitive Development Scenario

- B = Require environmental assessment to determine requirement for Audit. *May also require further consultation with EPA Victoria
- C = General duty under S12(2)(b) and S60(1)(a)(iii) of the Planning and Environment Act 1987

Number	SPI		
1	RES1\LP117321	25	20\PP3363
2	1\PS549443	26	24A\PP3363
3	1\PS549447	27	2102\PP3363
4	1\PS602632	28	2\PS705115
5	2\PS602632	29	1\PS705115
6	1\PS426851	30	1\PS602663
7	1\PS703135	31	2\PS602663
8	1\PS608907	32	2\PS531592
9	RES1\PS608907	33	1\PS512549
10	1\PS644697	34	3\PS531592
11	2\PS549475	35	2\LP205103
12	4\PS446665	36	1\TP128503
13	1\PS400708	37	L\PS805124
14	3\PS446665	38	RES1\LP205103
15	2\PS446665	39	3\LP205103
16	1\PS446665	40	1\TP411329
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A3 scale: 1:20,000

0 0.5 1 Km

Job No: 509375

Coordinate System: GDA2020 MGA Zone 55

VPA Officer South Employment Precinct Structure Plan Land Capability Assessment

Figure A14: Further Contamination Assessment Requirements (Less Sensitive Development Scenarios)