WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Situational Analysis Report

Avalon Corridor IWMP

City of Greater Geelong

28 September 2023

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ACKNOWLEDGEMENT OF COUNTRY

Water Technology proudly acknowledges the Wadawurrung People as the traditional owners and custodians of the waterways and lands on which this project is based. We pay our respects to their Elders past, present and emerging.

We recognise the connection of the Traditional Owners to Country and the value of their contribution to managing the land and water and acknowledge their ongoing contribution to improved and connected management of our waterways and floodplains. We embrace the spirit of reconciliation, working towards equity for Traditional Owners.

Open landscapes within the Avalon Corridor with longer range views to Wurdi Youang / the You Yangs (Image courtesy of D Jones: Wadawurrung Traditional Owners Aboriginal Corporation, 2021)

ABBREVIATIONS

AAA	-	Avalon Airport Australia Pty Ltd
ACS	-	Avalon Corridor Strategy
AEP	-	Annual Exceedance Probability
ARR	-	Australian Rainfall and Runoff
BW	-	Barwon Water
CCMA	-	Corangamite Catchment Management Authority
CGSWS	-	Central and Gippsland Sustainable Water Strategy
CMA	-	Catchment Management Authority
CoGG	-	City of Greater Geelong
CWS	-	Corangamite Waterway Strategy
DCP	-	Development Contribution Plan
DDO	-	Design and Development Overlay
DEECA	-	Department of Energy Environment and Climate Action
DELWP	-	Department of Environment, Land and Water Planning
DPO	-	Development Plan Overlay
DSS	-	Development Services Scheme
EAO	-	Environmental Audit Overlay
EPA	-	Environmental Protection Authority
EPBC	-	Environment Protection and Biodiversity Conservation
ERS	-	Environment Reference Standard
ESO	-	Environmental Significance Overlay
EVC	-	Ecological Vegetation Class
FI	-	Fraction Imperviousness
FMP	-	Flood Management Plan
GAEP	-	Greater Avalon Employment Precinct
GP	-	Gross Pollutants
GREP	-	Geelong Ring Road Employment Precinct
HWS	-	Healthy Waterways Strategy
ICS	-	Index of Stream Condition
IWM	-	Integrated Water Management
IWMP	-	Integrated Water Management Plan
LCA	-	Land Capability Assessment
LGA	-	Local Government Area
LISO	-	Land Subject to Inundation Overlay
MNES	-	Matters of National Environmental Significance
MUSIC	-	Model for Urban Stormwater Improvement Conceptualisation

MWC	-	Melbourne Water Corporation
NASF	-	National Airport Safety Framework
NWP	-	Northern Water Plant
NWGGA	-	North Western Geelong Growth Area
PPF	-	Planning Policy Framework
PSP	-	Precinct Structure Plan
RAP	-	Registered Aboriginal Party
SDS	-	Strategic Directions Statement
TN	-	Total Nitrogen
TP	-	Total Phosphorus
TSS	-	Total Suspended Solids
VGED	-	Victorian Grassland Earless Dragon
VICSES	-	Victorian State Emergency Services
VPA	-	Victorian Planning Authority
WMP	-	Waterway Management Plan
WRP	-	Water Reclamation Plant
WSBA	-	Water Supply by Agreement
WSUD	-	Water Sensitive Urban Design
WTOAC	-	Wadawurrung Traditional Owners Aboriginal Corporation
WTP	-	Western Treatment Plant
WWTP	-	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The Avalon Corridor Strategy (ACS) is a strategic land use framework developed in collaboration between the City of Greater Geelong, Wyndham City Council, and the former Victorian Department of Environment, Land, Water and Planning (DELWP) (CoGG and WCC, 2022). The Avalon Corridor covers an area of approximately 30,000 hectares and is located east of the township of Lara, between Melbourne and Geelong. The Greater Avalon Employment Precinct (GAEP) is a significant part of the ACS. The GAEP will be a State significant employment precinct centred around Avalon Airport. The current study focuses on the land within the City of Greater Geelong Local Government Area (LGA) and aims to develop an Integrated Water Management Plan (IWMP) for this area. The IWM assessment will inform the preparation of a Precinct Structure Plan (PSP) for the GAEP by the Victorian Planning Authority (VPA). The Avalon Corridor IWMP will:

- **examine options for servicing** the future GAEP and nearby agricultural properties. The options will have a particular focus on secure and sustainable alternate water supplies.
- **study options for managing potential stormwater runoff impacts** from industrial and commercial development on sensitive ecosystems, such as the adjacent Port Phillip Bay (Western Shoreline) Ramsar wetland site.
- **review opportunities to enhance environmental and cultural values** associated with local waterways and landscapes while investigating the delivery of cultural flows as the Wadawurrung Traditional Owners Aboriginal Corporation deem appropriate.
- **align with to relevant State Government frameworks and policies** related to Integrated Water Management (IWM) including the Barwon Strategic Direction Statement.

This interim report presents the outcomes of the situational analysis phase of the Avalon Corridor Integrated Water Management Plan (IWMP). It is aimed to identify key information on the existing drainage and servicing situation as well as high level opportunities and constraints influencing the IWMP. Situational analysis was informed by a background review of existing data, reports, policies and strategies and a series of discussions with key stakeholders.

A range of national, state and local policies and strategies related to IWM were reviewed. All policies and strategies encourage IWM and support, the use of alternative water sources to address climate change and population growth related challenges, and the return water to environment and cultural flows.

A review of existing background reports and stakeholder interviews revealed that there are limited existing infrastructure servicing the area. There is no Barwon Water owned sewer or recycled water infrastructure servicing area at present. There is limited potable water supply infrastructure and council owned drainage network servicing the area. This indicates significant upgrades/extensions to existing drainage, water supply and sewer infrastructure is needed for servicing the proposed development in the study area.

Additionally, a range of potential issues and constraints ranging from topography, soils, environment, cultural and heritage, flooding and drainage, climate change, groundwater, land ownership and land governance around Avalon Airport were considered. The combined effect of key issues and constraints is represented in Figure 7-1.

Three of the major constraints identified within the situational analysis were:

- Significant presence of environmental and cultural heritage values within the area
  - There are nationally and internationally significant wetlands, threatened ecological communities and species, migratory species present in the area
  - Majority of the area is currently identified as an area of cultural sensitivity

- Existing and future flooding and climate change impacts
  - A significant portion of the study area is subject to flooding due to low-lying flat terrain.
  - A significant portion of the land is predicted to be impacted by coastal erosion vulnerability and some loss of land due to coastal inundation under climate change predictions.
- Uncertainty
  - Currently there is lack of information of the development type and characteristics. This information is critical in planning future infrastructure.
  - Current lack of information on proposed expansion of Avalon Airport. Avalon airport is an integral part of the GAEP. It is understood the airport is not subject to the PSP process as it is has its own master planning process, but closely coordinating the development within the airport and other areas of GAEP is desired., Furthermore, understanding of the airport drainage and water infrastructure is critical for development of this IWMP.
  - Complexities around developing a consistent service strategy with multiple agencies.

It is evident that further investigations are needed to better understand the impact of above issues and constraints on overall GAEP development and subsequently Avalon Corridor IWMP development. The following investigations are recommended:

- Environmental Impact Assessment (VPA has commissioned an assessment for the GAEP as part of the PSP process)
- Cultural Values Assessment (VPA has completed an assessment for the GAEP as part of the PSP process)
- Drainage and Flooding Assessment
- Climate Change Impact Assessment
- Obtain information on Avalon Airport Development
- Derive GAEP development characteristics

Additionally, continued collaboration between key stakeholders is needed to derive a consistent drainage and water service strategy for the GAEP. Discussion between key stakeholder such as Melbourne Water, Barwon Water, Corangamite CMA, City of Greater Geelong on collaborative opportunities to manage drainage, flooding, stormwater/wastewater treatment and reuse is recommended. Furthermore, there are several investigations that are either being developed in parallel to this IWMP such as GAEP PSP background investigations, Avalon Airport Master Plan, Barwon Water's water and sewer strategy, or strategies that are proposed to be developed in future (including for example the stormwater management plan) that will need to be considered when preparing this IWMP. However, it is understood that due to timing of these complementary studies alongside other constraints, relevant information may not be incorporated to the IWMP. Meaning that the IWMP may need to be revisited at the point new relevant information becomes available.

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1 INTRODUCTION

The Avalon Corridor Strategy (ACS) is a strategic land use framework developed in collaboration between the City of Greater Geelong (the City), Wyndham City Council, and the former Victorian Department of Environment, Land, Water and Planning (DELWP) (CoGG and WCC, 2022) (Figure 1-1). The strategy provides strategic guidance for future development within the precinct and covers a range of key considerations including environment, cultural heritage, movement, and access, flooding and drainage, and economics and employment.

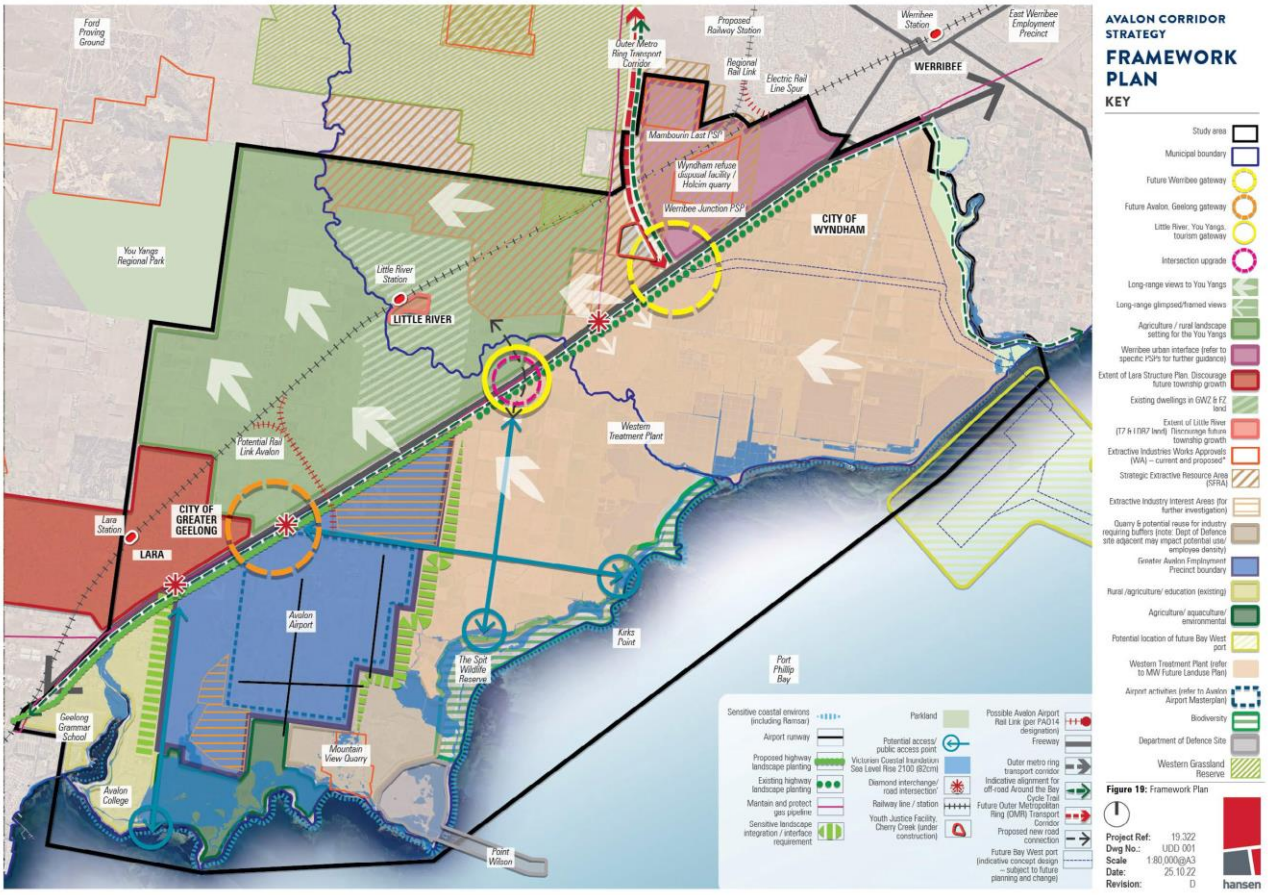

Figure 1-1 Avalon Corridor Strategy Framework (CoGG and WCC, 2022)

The Avalon Corridor covers an area of approximately 30,000 hectares and is located east of the township of Lara, between Melbourne and Geelong. Whilst the Avalon Corridor Strategy covers a broad area, the Integrated Water Management Plan (IWMP) will focus on the area located within the City of Greater Geelong municipality encompassing the Greater Avalon Employment Precinct (GAEP). The IWMP will:

- **examine options for servicing** the future GAEP and nearby agricultural properties. The options will have a particular focus on secure and sustainable alternate water supplies.
- **study options for managing potential stormwater runoff impacts** from industrial and commercial development on sensitive ecosystems, such as the adjacent Port Phillip Bay (Western Shoreline) Ramsar wetland site.
- **review opportunities to enhance environmental and cultural values** associated with local waterways and landscapes while investigating the delivery of cultural flows as the Wadawurrung Traditional Owners Aboriginal Corporation deem appropriate.

- **align with to relevant State Government frameworks and policies** related to Integrated Water Management (IWM) including the Barwon Strategic Direction Statement.

> *The IWM assessment will inform the preparation of a Precinct Structure Plan (PSP) for the GAEP by the VPA.*

The Avalon Corridor IWMP is aimed to be prepared through a collaborated approach. The overall methodology to be adopted is shown in Figure 1-2 . This draft situational analysis report presents the outcomes of the first phase of the investigation which is aimed to identify key information on existing drainage and servicing situation as well as high level opportunities and constraints influencing the IWM Plan.

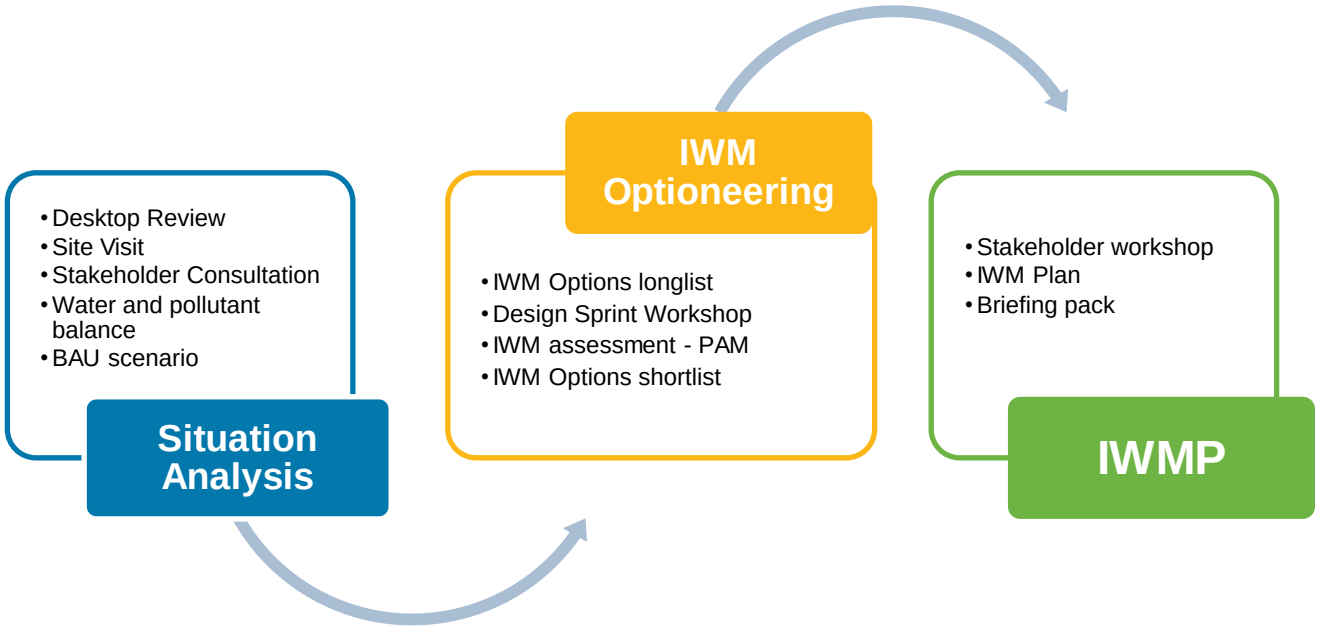

Figure 1-2 Methodology Overview

2 METHODOLOGY

The draft situational analysis report was prepared based on a desktop review and initial round of stakeholder consultation. The desktop review included a rapid assessment of relevant polices and strategies, previous relevant research undertaken for Council and other stakeholders, publicly available data on range of influential factors such environment and climate change (refer to Appendix A for list of data sources adopted for desktop review).

The desktop assessment was strengthened by initial consultation with key stakeholders including the City, Barwon Water, Victorian Planning Authority (VPA), Department of Energy, Environment and Climate Action (DEECA), Melbourne Water and Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC).

3 STUDY AREA

The study area is within the land of the Wadawurrung people. The boundary of the IWM Plan is the part of the ACS that falls within the City of Greater Geelong (Figure 3-1) excluding the existing Lara residential development (township area). The area covered by the IWMP including the GAEP, Avalon Airport itself, part of Western Treatment Plant (WTP) and a number of adjacent rural properties.

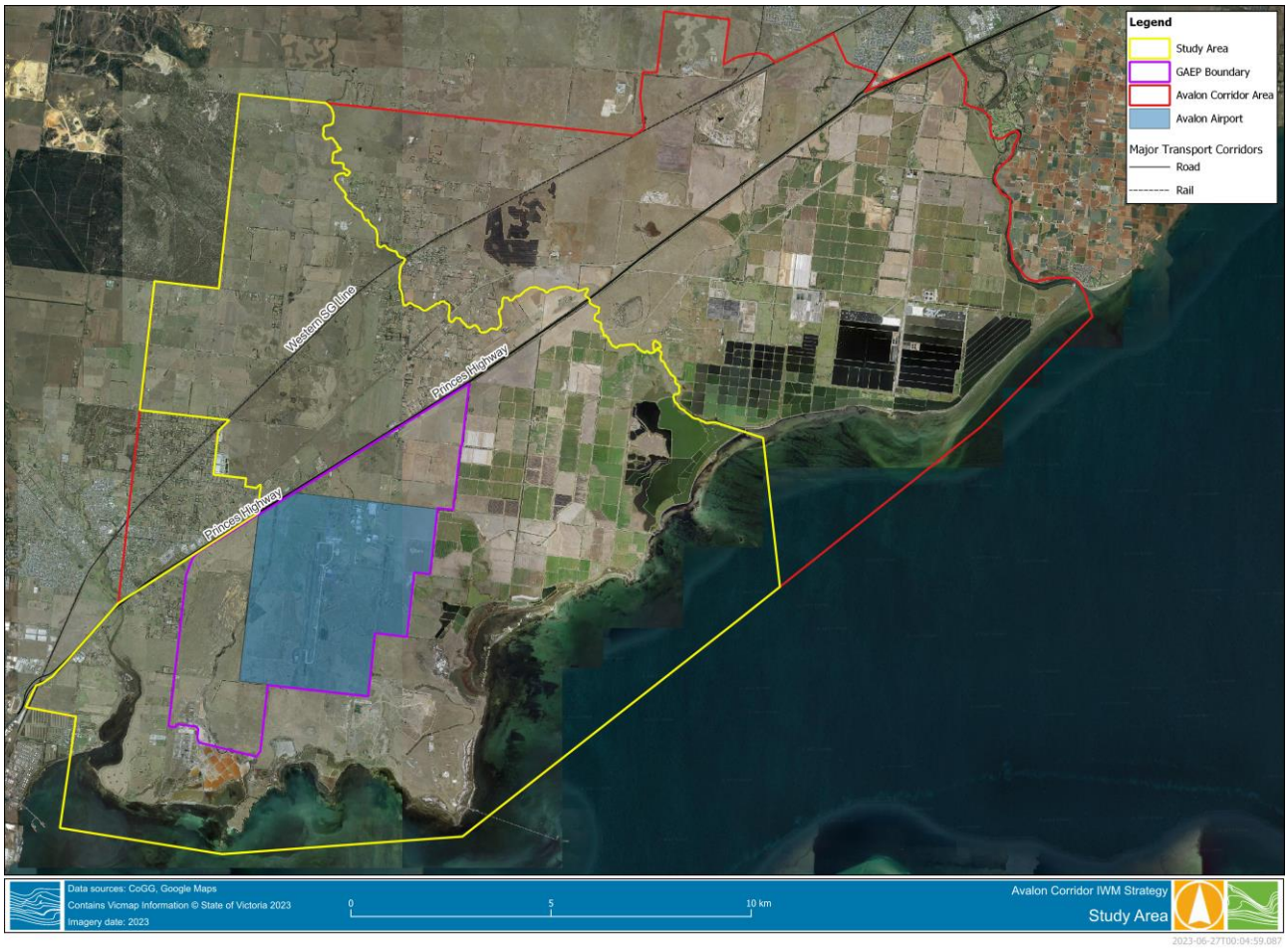

Figure 3-1 Study Area

3.1 Administration Boundaries

The study area encompasses several administrative boundaries (Figure 3-2). WTOAC is the Registered Aboriginal Party (RAP) of the study area. In terms of water cycle management context, the area is managed by two Catchment Management Authorities (CMAs), namely Corangamite CMA and Melbourne Water Corporation. Water and Sewerage services are managed by Barwon Water while Southern Rural Water is responsible for groundwater management and rural take and use licences within the area.

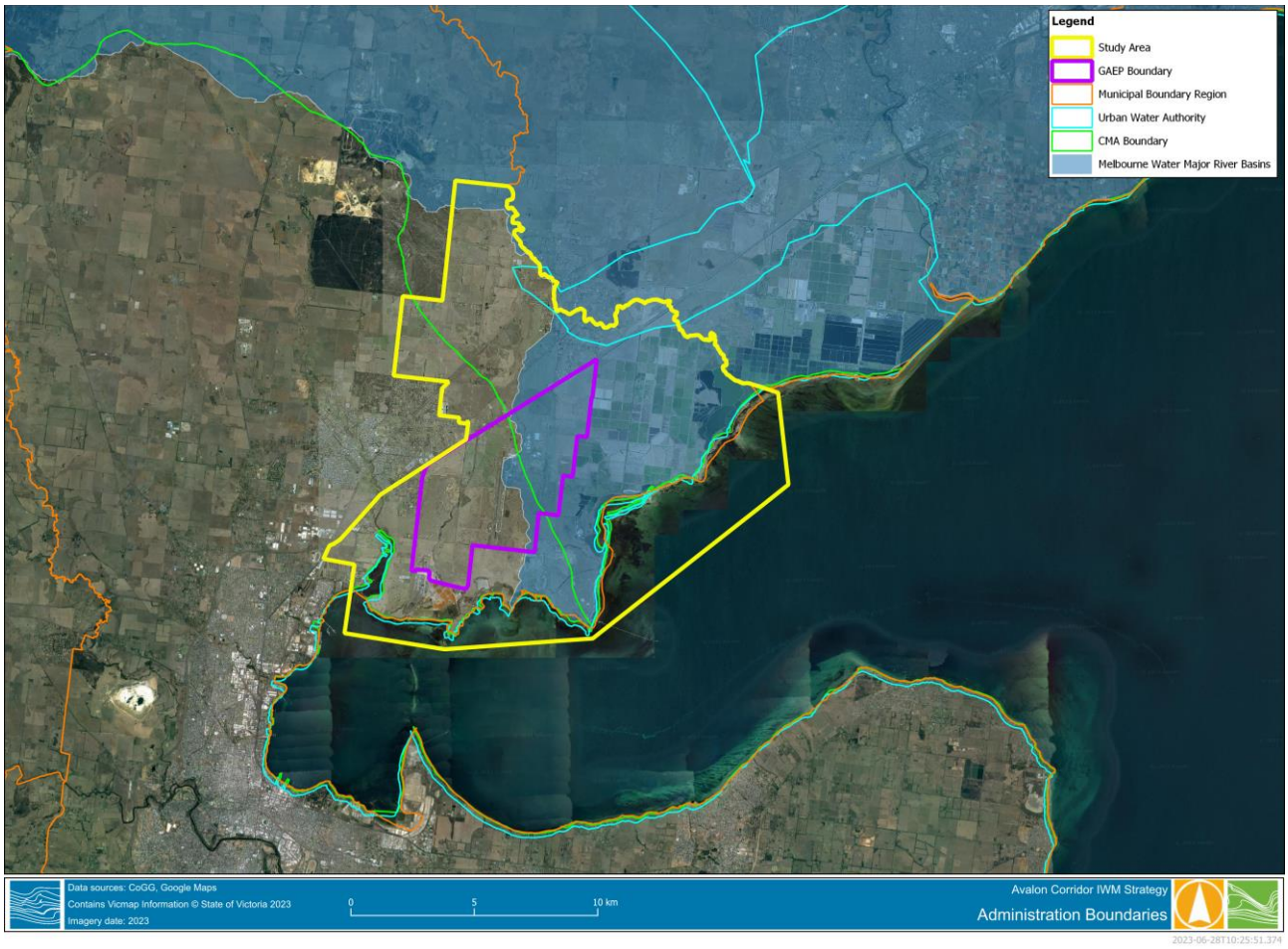

Figure 3-2 Administration boundaries

3.1.1 Stakeholders

Key stakeholder identified during the project inception include:

- City of Greater Geelong (project owner)
- Victorian Planning Authority (VPA) (funding partner)
- Department of Energy, Environment and Climate Action (DEECA) (funding partner)
- Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC)
- Barwon Water (BW) (funding partner)
- Melbourne Water Corporation (MWC)
- Corangamite Catchment Management Authority (CCMA)
- Parks Victoria
- Department of Defence (Point Wilson Pier)
- Commonwealth (Land owner)
- Avalon Airport including sub-tenants (i.e. Recharge Industries, Cotton On, Hanwha Defence, etc.)

3.2 Existing Landuse, Planning Zones and Overlays

A significant proportion of the land in the study area is currently being used as pasture/grassland, agricultural or sewage (WTP), and airport services land use (Figure 3-3). Additionally, the coastline is covered by conservation area and protected landscape. Some scattered pockets of residential and industrial (quarries, manufacturing and industrial) land use are also present within the area. It should be noted that that the farmland within the WTP is known to have contaminated soils, resulting from legacy land/grass filtration (a historical method of wastewater treatment). The contaminant levels are likely to impact on the type of future landuse to be adopted in the GAEP.

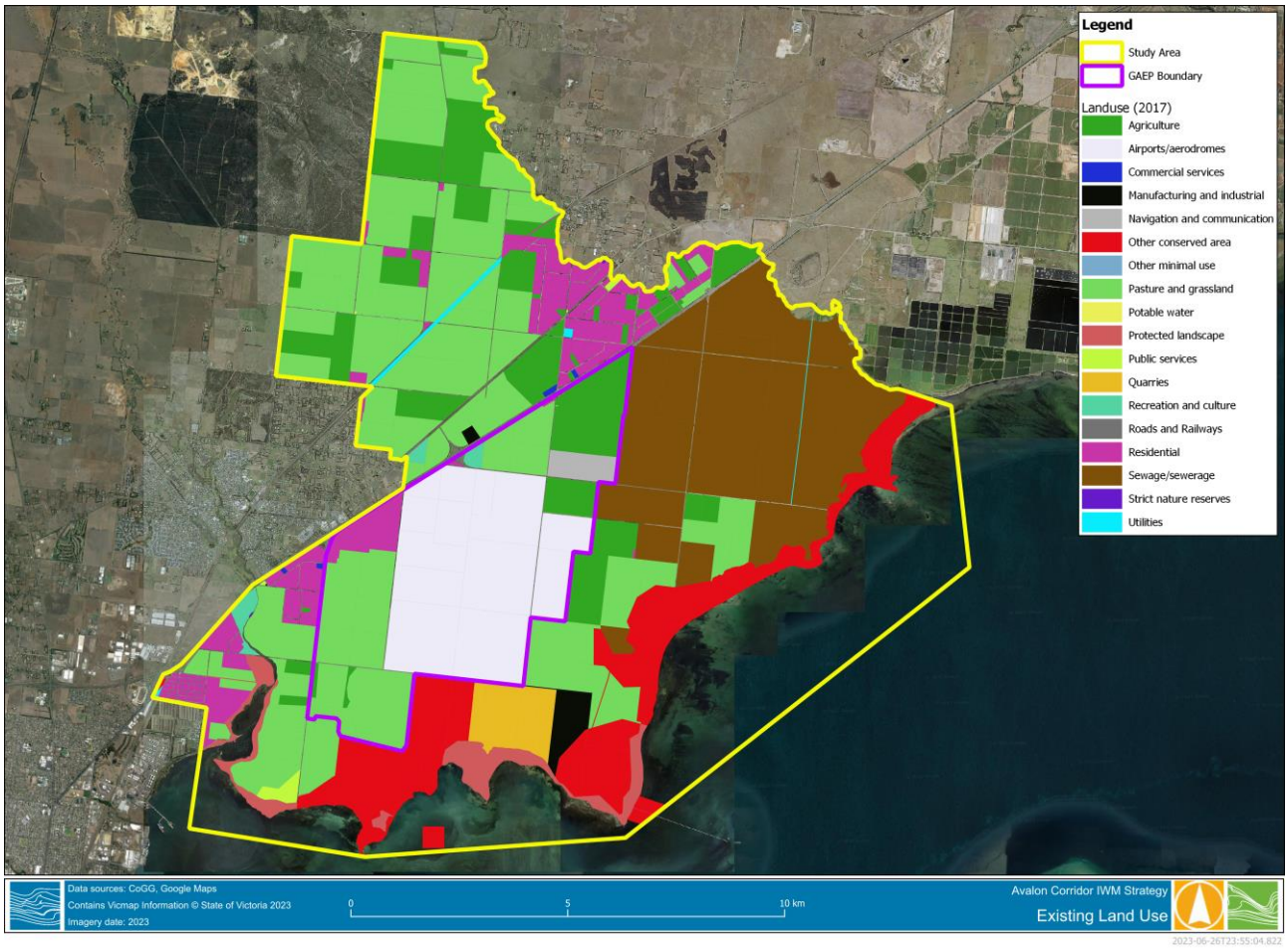

Figure 3-3 Existing Landuse

Similarly, the majority extent of the existing planning zones comprised of farming, public use (WTP), special use, conservation area and industrial (Figure 3-4). There are several planning overlays in the area (Figure 3-5 - Figure 3-7) with the most prominent overlays being the Environmental Significance Overlay (ESO), Land Subject to Inundation Overlay (LSIO), Design and Development Overlay (DDO),Development Plan Overlay (DPO) and Environmental Audit Overlay (EAO).

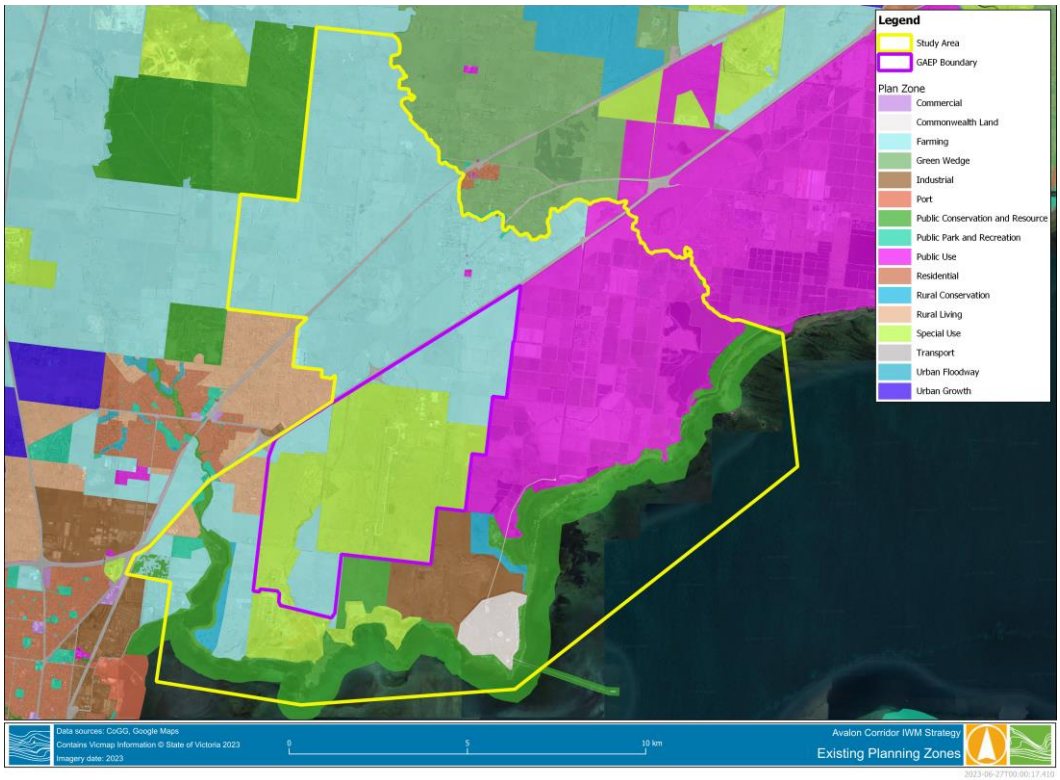

Figure 3-4 Planning Zones

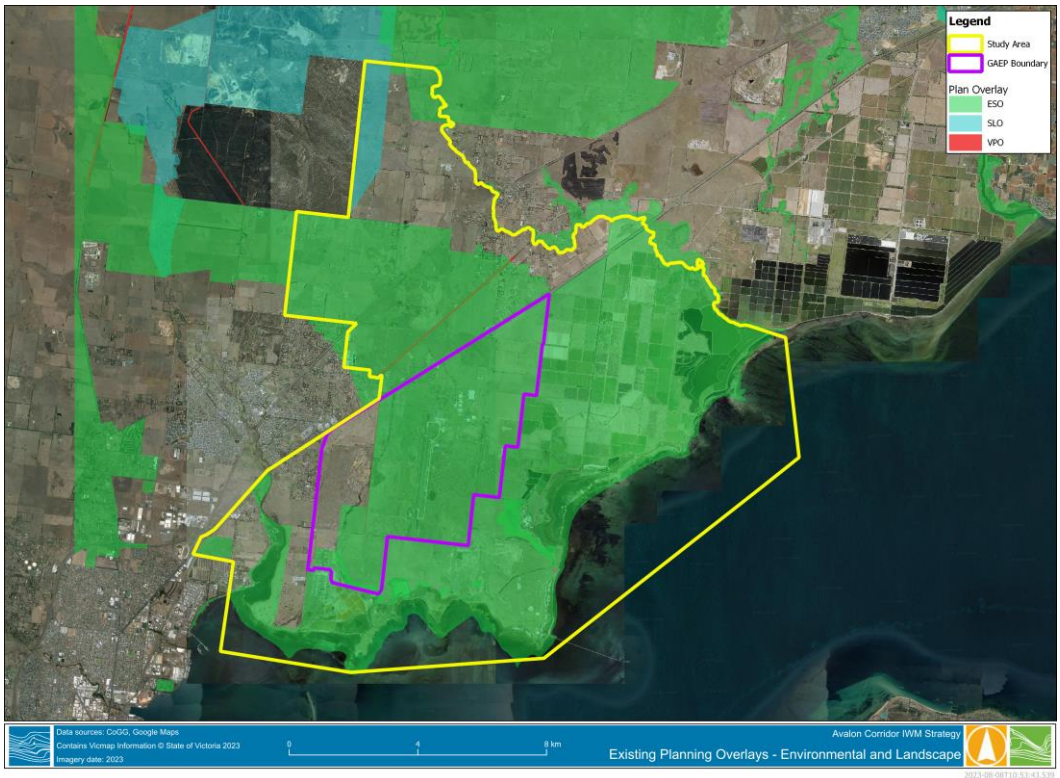

Figure 3-5 Existing Planning Overlays – Environmental and Landscape

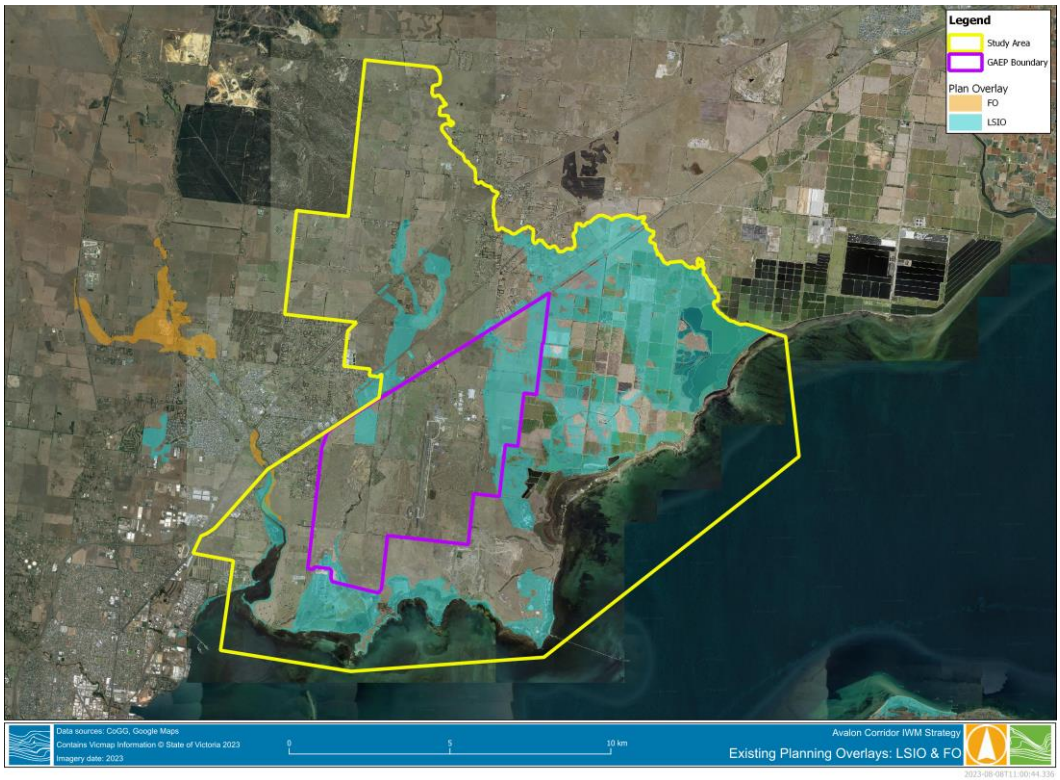

Figure 3-6 Existing Planning Overlays – LSIO and FO

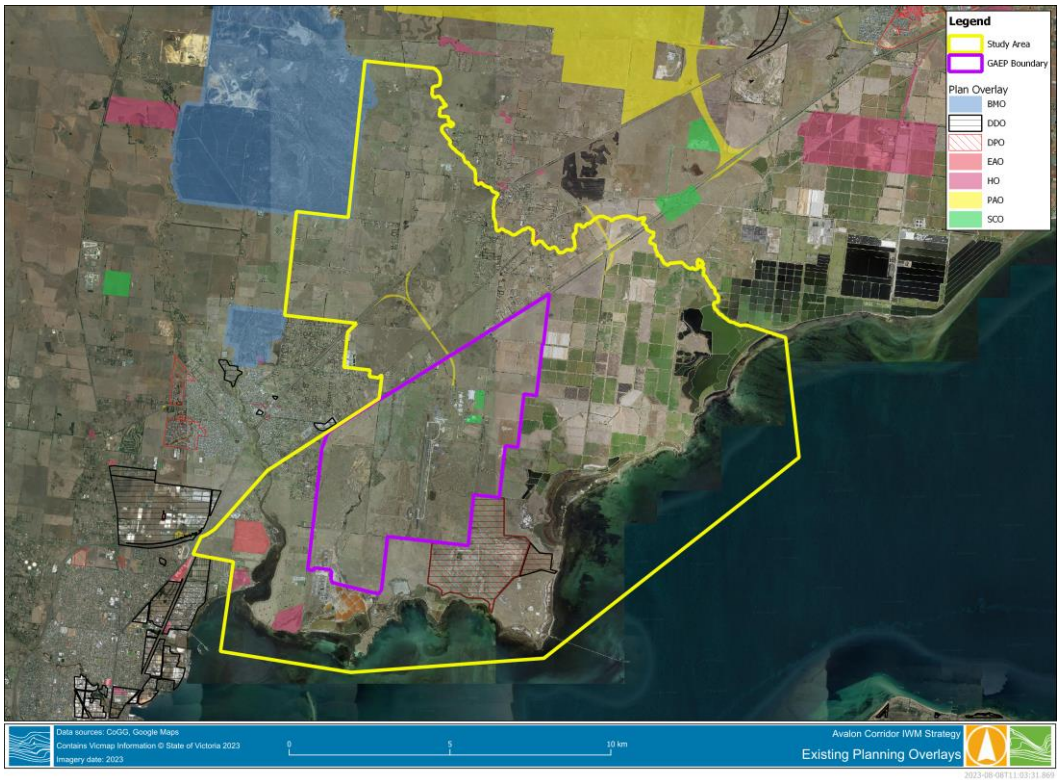

Figure 3-7 Existing Planning Overlays

3.3 Proposed Development

ACS Vision
The Avalon Corridor will continue to provide a green break between Geelong (regional Victoria) and Werribee (metropolitan Melbourne), while protecting areas of recognised environmental, landscape, heritage, and cultural value.
It will limit residential growth while supporting the expanded operations of Avalon Airport as Victoria's second international airport and fostering new land use, development and employment opportunities on airport land and immediate surrounds (as appropriate).
It will protect operations of the Western Treatment Plant to ensure it can continue to provide low-cost sewage treatment, recycled water for irrigation and support broader biodiversity values in the region.

The ACS Framework Plan (Figure 1-1) guides future detailed land use and development in the Avalon Corridor up to 2050 (CoGG and WCC, 2022). The key guiding principles which underpin the Framework Plan include:

1. Maintain and reinforce a green break between Geelong (regional Victoria) and Werribee (metropolitan Melbourne).

2. Protect green wedge and rural landscapes, as well as cultural and environmental features of identified value.

3. Protect ongoing and future operations of the Western Treatment Plant.

4. Protect ongoing and future expanded functional operations of Avalon Airport as per Avalon Airport, Master Plan.

5. Focus appropriate commercial and industrial development within and surrounding Avalon Airport, as per the Framework Plan.

6. Create economic development and employment opportunities in the northern part of Geelong.

7. Highlight the ongoing importance of the economic and transport connections between Werribee and Geelong.

8. Protect and enhance traffic movement on major roads (current and proposed) and rail corridors.

9. Avoid residential development within the Avalon Corridor.

10. Protect areas of acknowledged environmental value including coastline and Ramsar wetlands and grasslands.

11. Protect Wadawurrung cultural values and areas of known cultural heritage significance, as well as post-contact heritage sites (in addition to undertaking further investigations as part of specific land use change and development proposals).

Major development is expected within the GAEP area of the study area. Sensitive landscape integration/interface requirements are proposed along eastern and western edges of the GAEP where it interfaces with the Western Treatment Plant (WTP) and existing rural/agriculture and education in the vicinity of Limeburner's Bay. Other development areas include extractive industry in the area of existing quarry site (Mountain View Quarry) and north of Princess Highway. Additionally, some agriculture/aquaculture operations exist to the south of GAEP. The remainder of the study area is generally preserving the existing landuses such as the agriculture/rural landscape upstream of Princess Highway, WTP land, existing rural/agriculture and education in the vicinity of Limeburner's Bay, biodiversity and sensitive coastal areas (including Ramsar).

4 POLICY AND STRATEGIES RELATED TO IWM

A summary of relevant local, state and federal policy, regulation, guidelines and strategies relating to IWM is summarised in this section.

4.1 VPA PSP Guidelines

VPA PSP Guidelines 2.0 (2021) provides a consistent framework for preparing PSPs, guaranteeing quality outcomes while also being flexible, responsive and supportive of innovation by setting aspirational goals for our future communities. With relevance to the IWM context, it aims to improve outcomes for the whole of water cycle by referencing regional IWM plans to resolve development-related water balance challenges. The guidelines articulate general planning principles and set performance targets. Two of the performance targets apply directly to IWM context and are set to provide a high-quality public realm by ensuring:

- T14: All streets containing canopy trees should use stormwater to service their watering needs
    - There is opportunity to consider other alternative passive irrigation options such as use of recycled water where demonstrated by a comprehensive analysis such as a local IWM plan.
        - *It is important to note that the use of recycled water for passive irrigation would need to be supported by an appropriate sewerage strategy. For instance, if recycled water is available for the area.*
- T17: IWM solutions should meaningfully contribute towards the actions and targets from the relevant Catchment scale Public Realm and Water Plans and any relevant water-related strategies, plan or guidelines (including the Healthy Waterways Strategy 2018-2028)

4.2 Victorian IWM Framework

Five metropolitan and ten regional IWM Forums have been established under the Victorian IWM framework across the state to identify, prioritise and oversee the implementation of collaborative water opportunities. The Avalon Corridor IWM Plan is one of the nineteen priority opportunities identified within the Strategic Directions Statement (SDS) of the Barwon Region IWM forum (DELWP, 2022a).

This Avalon Corridor IWM Plan is aimed to respond to objectives of the draft Avalon Corridor Strategy by considering options for servicing the future Greater Avalon Employment Precinct and nearby agricultural properties, with a particular focus on secure, sustainable and diverse water supplies. It will also consider options for managing potential impacts of industrial and commercial development on sensitive ecosystems, such as the adjacent Port Phillip Bay (western shoreline) and Bellarine Peninsula Ramsar wetland site, as well as opportunities to enhance local waterways and landscapes. The Avalon Corridor IWM plan has as opportunity to make an impact towards the seven strategic IWM outcomes of:

- safe, secure and affordable supplies in a changing future
- effective and affordable wastewater systems
- manage flood risks
- healthy and valued waterways and waterbodies
- healthy and valued landscapes
- Traditional Owner and community values reflected in place-based planning
- jobs, economic opportunity and innovation

4.3 Central and Gippsland Sustainable Water Strategy

The Central and Gippsland Sustainable Water Strategy (CGSWS) (DELWP, 2022b) sets out policy directions and outline actions for securing the region's long-term water supplies to protect the jobs, farms, ecosystems, communities, and Traditional Owners that rely on them. The strategy identifies various policies and actions to:

- Support people and businesses and schools to continue to use water efficiently
- Plan for how we could double our water supplies over the next 50 years by using more manufactured water – desalination water, recycled water and treated stormwater for a range of uses
- Improve how we share the benefits of our limited resources, without compromising existing water entitlements
- Restore water justice to Traditional Owners, including by returning water to Traditional Owners
- Support farmers adapt and expand in a drying climate by using water more efficiently and through greater use of recycled water and treated stormwater
- Return water to the environment in major rivers in the next 10 years and deliver environmental works and complementary measures
- Commence planning for preferred future urban water supply options so new water supplies are ready when they are needed.

The strategy supports transitioning to greater reliance on manufacturing water (desalination water, recycled water and treated rainwater and stormwater) to supply water needs instead of river water ahead of pressures such as population growth and climate change. The strategy proposes to use IWM to drive investment and collaboration which could deliver up to 43 GL/year recycled water, treated rainwater and stormwater for non-potable uses. It also supports investigations onto large scale supply networks both in metropolitan Melbourne as well as the regional Victoria. Of particular interest to the Barwon region, the SWS reports on a large-scale network connecting schemes in the Moorabool Valley, Surf Coast Hinterland, South Balliang and on the Bellarine Peninsula which could supply up to 4 GL for various urban demands and up to 40 GL for agribusinesses by 2070, while managing the impact of urban stormwater on sensitive environments.

The Strategy is the first of its kind to be developed through a genuine partnership with Traditional Owners. A Cultural Benefits Framework was developed by the Traditional Owner Partnership, which will be applied when implementing relevant actions and policies to

- Return water to Traditional Owners
- Removing barries to water accesses
- Strengthening the role of Traditional Owners in water resources planning and management

Of particular interest to the Barwon region, the strategy will support exploration of opportunities to return water to Wadawurrung in Durdidwarrrah Wetland, the Moorabool Yulluk (Moorabool River) and Parwan (Barwon River).

4.4 Barwon Water Urban Water Strategy

Barwon Water's 2022 Urban Water Strategy "Water for our Future" (Barwon Water, 2022), provides a visionary, 50 year outlook for Barwon Water region and identifies a range of actions that will be taken to secure high quality, affordable water for all its service areas. Through this strategy, Barwon Water will deliver actions to progressively invest in more manufactured water such as fit-for-purpose recycled water, stormwater and desalinated water, embrace integrated water management opportunities and facilitate smarter water use. For instance, Barwon Water has an ambitious goal of 100% productive use of recycled water (Barwon Water, 2022). With an estimate of 40 GL/year recycled water available for beneficial use in the Barwon region by

2070, there is a significant opportunity to achieve positive outcomes for the regional economy and provide for environmental and cultural needs. Of particular actions related to IWM context in the Greater Geelong area, Barwon Water will investigate the feasibility of a large-scale alternative water grid to distribute recycled water and stormwater for beneficial uses. Additionally, Barwon Water will work collaboratively with other stakeholders such as local governments, CMA and Traditional Owners to deliver localised IWM opportunities and support waterway health by undertaking river rehabilitation works.

4.5 City of Greater Geelong

4.5.1 Stormwater Service Strategy

The City of Greater Geelong Stormwater Service Strategy 2020 – 30 (CoGG, 2020a) aims to lead the adaptation and integration of stormwater services to support the City's growth, health and liveability through four main goals that are supported by 15 objectives:

- Goal 1: Foster healthy and resilient communities
  - Reduce the impacts of dangerous stormwater flooding
  - Support urban greening through integrated water management
  - Reduce demand on drinking water through alternative water sources
    - A target of supplying 20% of water demand by alternative water sources by 2030
  - Integrate stormwater systems to enhance the use of community spaces
  - Minimise flood disruption to transport corridors
- Goal 2: Support innovative and sustainable growth
  - Implement catchment wide practices that guide growth
  - Implement stormwater solutions that are financially sustainable
  - Develop partnerships to plan and deliver stormwater solutions
- Goal 3: Enhance the natural and built environments
  - Protect the health of receiving waterways, maximising their value and amenity
  - Conserve biodiversity corridors
  - Protect cultural values along waterways
  - Implement stormwater systems that can adapt to future needs
- Goal 4: Create positive community experiences
  - Engage with community on stormwater services
  - Enable communities to better prepare for, and recover from, damaging stormwater events
  - Establish funding streams which are transparent and equitable

The strategy subdivides the local government area into 25 catchment management units (Figure 4-1) The Avalon Corridor sits within the three catchment management units, namely, Little River, Avalon and Hovells Creek with the majority of the study area falling within the Avalon management unit. A summary of catchment prioritisation and key actions are listed in Table 4-1.

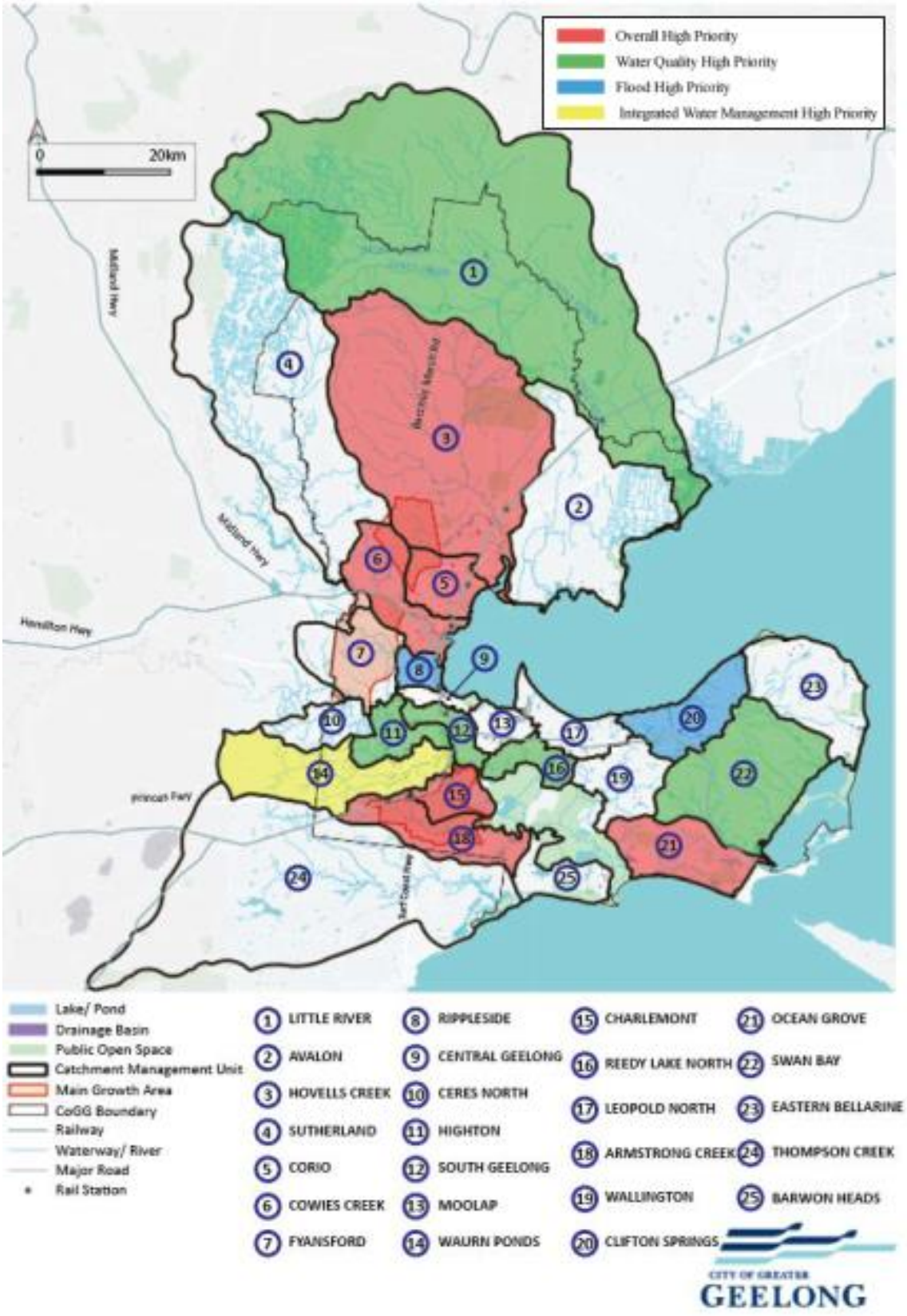

Figure 4-1 CoGG Catchment Management Units (CoGG, 2020a)

Table 4-1 CoGG Catchment Management Unity Summary for the Study Area

Management Unit	Priority	Summary
Little River	Low	The City will focus on the management of water quality in this Management Unit. The City's knowledge of waterway risks is limited and investigation and engagement with Melbourne Water is required to understand actual risk. Catchment Management Strategy is expected to be developed by 2025.
Avalon	Low	No priority actions identified. Catchment will be monitored for changes. Catchment Management Strategy is expected to be developed by 2030.
Hovells Creek	High	The City has assigned a high priority for the management of ***water quality***. The City's knowledge of waterways is currently limited, and investigation/partnership with CCMA is required to understand and monitor actual risk. There is a high priority for ***flood management*** to manage existing risk and the impacts of future development. Following the 2018 Flood Study, flooding risks are now better understood, so solutions can be developed over the coming years which account for current service shortfalls and future catchment changes. Opportunities for IWM have been identified and will be explored as part of solutions for Waterways, Flooding or improvement in urban amenity. Catchment Management Strategy was expected to be developed by 2021.

4.5.2 IWM Strategy (Draft)

The City of Greater Geelong draft IWM Strategy (Wave Consulting Australia, 2023) had introduced a new set of IWM targets for the LGA and a model to prioritise IWM projects that will contribute to a set of IWM targets. The new set of IWM targets were a refinement of the IWM related targets identified in the stormwater strategy (CoGG, 2020a). The new IWM targets for the LGA consists of:

- No net increase in annual average damages from a 2020 baseline, by 2030
- 10,000 passively irrigated watered trees delivered by 2030
- 30% of Council water use is sourced from alternative water sources (stormwater harvesting and recycled water) by 2030
- All IWM projects to partner with Wadawurrung Traditional Owners Corporation from 2023 to 2030
- An increase in 10 ha native vegetation by IWM projects by 2030
- 100 ML/year of stormwater infiltrated through IWM projects to support contribution to regional cultural flow targets by 2030.
- All IWM projects in high profile precincts will be prioritised

The strategy also recommends two additional 'next generation' IWM targets to be considered by the City:

- "Increase permeability" – a permeable city would retain most of the rainfall and stormwater in a location and support increased urban greening, reduced flooding, reduced potable water use, improved waterway health, reduced urban heat risks, and support a move towards cultural flows.
- "Create a water positive Greater Geelong" by reducing stormwater and wastewater discharges and decreasing potable and recycled water imports.

4.5.3 Environmental Strategy

The City of Greater Geelong Environment Strategy 2020 – 30 (CoGG, 2020b) aims to deliver on Council's sustainability commitments, embed environmental considerations in Council's decision-making and communicate the importance of the environment to the region's future. The strategy is implemented by achieving five key goals and associated directions (Figure 4-1): Goal 5 of the strategy focus on the IWM and sets out several directions to support IWM within the municipality with collaboration with other stakeholders such as Barwon Water, CCMA, Barwon Coast

GOAL 1	BECOME A ZERO-EMISSION, CLIMATE-READY CITY AND REGION
Principle 1.1	Increase energy efficiency and renewable energy production.
Principle 1.2	Switch to renewable electricity and cleaner fuels.
Principle 1.3	Reduce non-energy emissions and increase carbon storage.
Principle 1.4	Increase awareness and understanding of climate change impacts.
Principle 1.5	Build climate change adaptation into decision-making.
Principle 1.6	Increase collaborative climate change responses.
GOAL 2	CREATE GREENER COMMUNITY SPACES
Principle 2.1	Increase amenity of community spaces and reduce urban heat risk.
Principle 2.2	Increase adoption of nature-based, green-blue infrastructure solutions.
Principle 2.3	Connect people to nature.
GOAL 3	CONTRIBUTE TO A CIRCULAR ECONOMY BY REDUCING WASTE
Principle 3.1	Avoid creating waste.
Principle 3.2	Recover more resources.
Principle 3.3	Protect the environment from waste impacts.
GOAL 4	PROTECT, ENHANCE AND RESTORE OUR REGION'S BIODIVERSITY
Principle 4.1	Collaborate with the Wadawurrung Traditional Owners to connect culture and biodiversity.
Principle 4.2	Protect and enhance indigenous biodiversity.
Principle 4.3	Restore biodiversity in modified urban landscapes.
Principle 4.4	Adaptive management approach to biodiversity conservation.
Principle 4.5	Build community knowledge, engagement and partnerships.
GOAL 5	ACHIEVE BETTER INTEGRATED WATER MANAGEMENT THROUGH PLANNING AND DESIGN
Principle 5.1	Support sustainable water use.
Principle 5.2	Sustainable management of drainage and stormwater asset networks.
Principle 5.3	Create ecologically healthy, accessible urban waterways.

Figure 4-2 Environmental Strategy Goals and Associated Principles (CoGG, 2020b)

PRINCIPLES		DIRECTIONS
5.1	Support sustainable water use.	a. Act as a sustainable water user. b. Implement best practice stormwater harvesting schemes. c. Reduce demand on drinking water supplies by using alternative water supplies. d. Reduce potable water usage in all new multi-unit, commercial and mixed-use developments. e. Reduce potable water usage in existing and future City-owned assets.
5.2	Sustainable management of drainage and stormwater asset networks.	a. Use adaptation programs to reduce stormwater flooding impacts on people, infrastructure, places and the environment. b. Support urban greening by applying integrated water management practices. c. Integrate stormwater reuse into natural and built environments to create multi-functional community spaces. d. Develop partnerships with governments, water corporations, key agencies, organisations and our community, to plan and deliver sustainable water management outcomes.
5.3	Create ecologically healthy, accessible urban waterways.	a. Partner with Barwon Water, Barwon Coast, the CCMA and our community to improve linkages, biodiversity values and the ecological health of our waterways. b. Improve understanding of the values and threats to urban waterways. c. Improve our capacity to achieve the best possible social, environmental and economic outcomes from urban waterways. d. Secure dedicated resources to achieve best practice in urban waterway management. e. Develop infrastructure to treat or divert waste water before it is discharged into natural waterways.

Figure 4-3 Principles and Directions to achieve IWM (CoGG, 2020b)

4.5.4 Flood Management Strategy

This City's Flood Management Plan (FMP) 2020-25 (plan) (CoGG, 2020c) was prepared in collaboration with the Corangamite CCMA, MWC, Victorian State Emergency Services and Regional Roads Victoria and establishes a 5 year program for improved floodplain management within the municipality of Greater Geelong, contributing to the delivery of key objectives of the Stormwater Service Strategy. The Plan assembles river, coastal and stormwater flooding knowledge from relevant agencies to advise of flooding issues, opportunities for improvement and actions to address. The study area falls within Little River, Avalon and Lara/Hovells Creek catchment management units. Flood risk snapshots of three management units and key short-term and long-term priorities for each unit is summarised in Table 4-2.

Table 4-2 Floor Risk Snapshot (CoGG, 2020c)

<table>
<tr><th>c</th><th>Little River</th><th>Avalon</th><th>Hovells Creek</th></tr>
<tr><td>Flood Risk Drivers</td><td>This area is subject to riverine flooding and rural overland flooding along the waterway of the Little River along with coastal inundation from storm surge at the outlet of the catchment with Port Philip Bay.</td><td>Catchment Flooding, Coastal Storm Surge, Sea Level Rise</td><td>Riverine, Stormwater, Coastal Storm Surge and Sea Level Rise</td></tr>
<tr><td>Historic Flooding</td><td>No detailed flooding information is available for this location. The Victorian Flood Database does have historical flooding extents and some levels available for this location.</td><td>The Avalon catchment was impacted by significant flooding during events which occurred in 1983 and 1973. These events resulted in significant damage to public and private infrastructure including flooding of the Princes Highway.</td><td>The Hovells Creek Lara has been subject to flooding from both riverine and stormwater flooding in the past 30-50 years. The two most significant events occurring in 1983 and 1973. These events resulted in significant damage to public and private infrastructure including several homes which became inundated above floor.</td></tr>
<tr><td>Available Information</td><td>Limited available flooding information exists at this location; Existing available mapping is based on the Flood Data Transfer Project undertaken by DNRE in 2000. The study considered significant flooding of this are which was experience in the 70’s and 80s.</td><td>■ Flood Data Transfer Project
■ Hovells Creek and Avalon Road Flood Study (2020)
■ Bellarine Peninsula – Corio Bay Local Coastal Hazard Study (2015)</td><td>■ Hovels Creek Floodplain Management Study 2013
■ Hovells Creek Flooding Report – 1988 Event
■ Hovells Creek flood Mapping Extension Project (WBM, 2002)
■ Lara Flood Study Report 2002 (WBM)
■ North East Lara Flood Study Report 2002 (WBM)\
■ Report on Lara 1973 Event
■ Development Based Assessments: Grand Lakes, Manzeene Village, Heales Road Industrial Estate.</td></tr>
<tr><td>Damages</td><td>No detailed damages assessment has been completed within this area.</td><td><table><tr><th>Study</th><th>Risk</th><th>Properties affected by 1% AEP</th></tr><tr><td>Lara Flood Study (Avalon Catchment Only)</td><td>Floors</td><td>21</td></tr></table></td><td><table><tr><th>Study</th><th>Risk</th><th>Properties affected by 1% AEP</th></tr><tr><td rowspan="2">Lara West</td><td>Above Floor</td><td>23</td></tr><tr><td>Properties</td><td>477</td></tr><tr><td rowspan="2">Lara Flood Study Report</td><td>Above Floor (riverine, stormwater)</td><td>44, 47</td></tr><tr><td>Properties (riverine, stormwater)</td><td>3924</td></tr></table></td></tr>
<tr><td>Mitigation</td><td>No recommended mitigation options are currently available</td><td>No recommended mitigation options are currently available in this location</td><td>Lara has several Existing Flood Mitigation measures in place along Hovells Creek and a number proposed by the new Lara Flood Study.</td></tr>
<tr><td>Building and Planning Controls</td><td>The mapped 1% AEP flood extent is covered by a LSIO downstream of the Little River township to the Bay.</td><td>Land Subject to Inundation Overlay (Planning Scheme), Flood Prone Land Designation. The extent of the flood prone land designation does exceed the coverage of the flood related zones and overlays in this location.
A future amendment to introduce a LSIO referencing coastal inundation (storm surge and sea level rise) is currently being considered.</td><td>Several existing planning and building controls exist within the Lara Area. A significant portion of the area is covered by a flood prone land designation with this area also subject to Land Subject to Building Overlay, Special Building Overlay and Urban Floodway Zone planning controls</td></tr>
<tr><td>Growth and Development</td><td>Limited low-density residential development within the lower Little River area</td><td>Development within the Avalon Catchment is being driven by the expansion and use of the Avalon Airport and the associated industrial land use for freight industries. Development within the remainder of the catchment is being driven by lower density residential subdivisions
Investigations are also underway as to the appropriate use of the decommissioned salt works within the Avalon catchment foreshore.</td><td>The township of Lara and surrounding areas have seen a significant growth in population over the past 30 years with the opening of large estates within the Lara West Precinct, Manzeene Village, and Grand Lakes. The Northern Growth Area is partially located within the Hovells Creek catchment and covers an area of 5331 hectares and is expected to accommodate an estimated population in excess of 110,000 people. Appropriate planning and design of proposed stormwater and flood mitigation infrastructure will be crucial to managing the existing flooding risk within the downstream catchment (Lara).</td></tr>
</table>

c	Little River	Avalon	Hovells Creek
Critical Infrastructure	Princes Highway, Geelong Bacchus Marsh Road	Avalon Airport, Princes Highway, Geelong-Melbourne Railway	Princes Highway, Bacchus Marsh Road, Geelong Melbourne Railway, Lara Flood Levees (St Laurance and Hovells Creek)(private levee 515 Forest Rd North), Serendip Dam, Wooloomanata Dam, Geelong Ring Road, Grand Lakes Wetlands and Retarding Basin, Lara Lake, Lara Flood Protection Pumping System, Flood Gates (Windermere Rd, Flinders Rd, Investigator Dr, Rennie St), Rennie Street Flood Warning, Flinders and Rennie Street Stream and Rain Gauges Floodways (Flinders Av, Windermere Rd, Peak School Rd, Stoney Creek Rd, Plains Rd, Stoney Creek Road).
Flood Mapping and Mitigation Priority	Low	Low	High
Estimated Delivery of Flood Mapping	10 years +	10 years +	1 -3 years
Short Term (1-5 years) Priorities	■ Information Improvement ■ Education and Awareness	■ Information Improvement ■ Education and Awareness ■ Update Planning and Building Controls (Lara Flood Study) ■ Mitigation Prioritisation ■ Coastal Adaptation Planning	■ Flood Mitigation Works Prioritisation ■ Review of Special Charge Scheme Option ■ Planning and Building Control Update ■ Education and Awareness ■ Dam Safety Assessment (Woolamanta and Serendip) ■ Growth Area Planning (Northern Growth Area)- Integrated Water ■ Update Levee Management Plan
Long Term (5 year +) Priorities	■ Update Planning and Building Controls	■ Update Planning and Building Controls	■ Update Planning and Building Controls ■ Infrastructure Upgrade to accommodate Northern Growth Area Development

4.6 CCMA Strategies

4.6.1 Floodplain Management Strategy

The vision of the Corangamite Regional Floodplain Management Strategy 2018–2028 (CCMA, 2018) is to protect floodplains of the Corangamite region for their ecological and cultural values and communities, businesses and government agencies are aware of their food risks and are actively taking measures to manage these risks. This vision is achieved through seven key objectives:

- Assess flood risk and share information
- Build a flood-resilient community
- Reduce existing flood risks
- Avoid future flood risks
- Manage residual flood risks
- Protect and restore floodplains for their ecological values
- Project and restore the cultural values of floodplains

The strategy summarises the priority flood risks in each LGA and corresponding priority management actions. There are several riverine and coastal flood risk areas present with the City (Figure 4-4). The study area is identified as a priority coastal flood risk area and is located within the 1% AEP riverine flood extent. An adaptation pathways plan is proposed to be developed as part of the Coastal Hazard Assessment and recommendations implemented from this adaptation pathways plan. Additionally, the strategy recommends implementing recommendations from the Lara food and drainage study (Hovells Creek Flood Study).

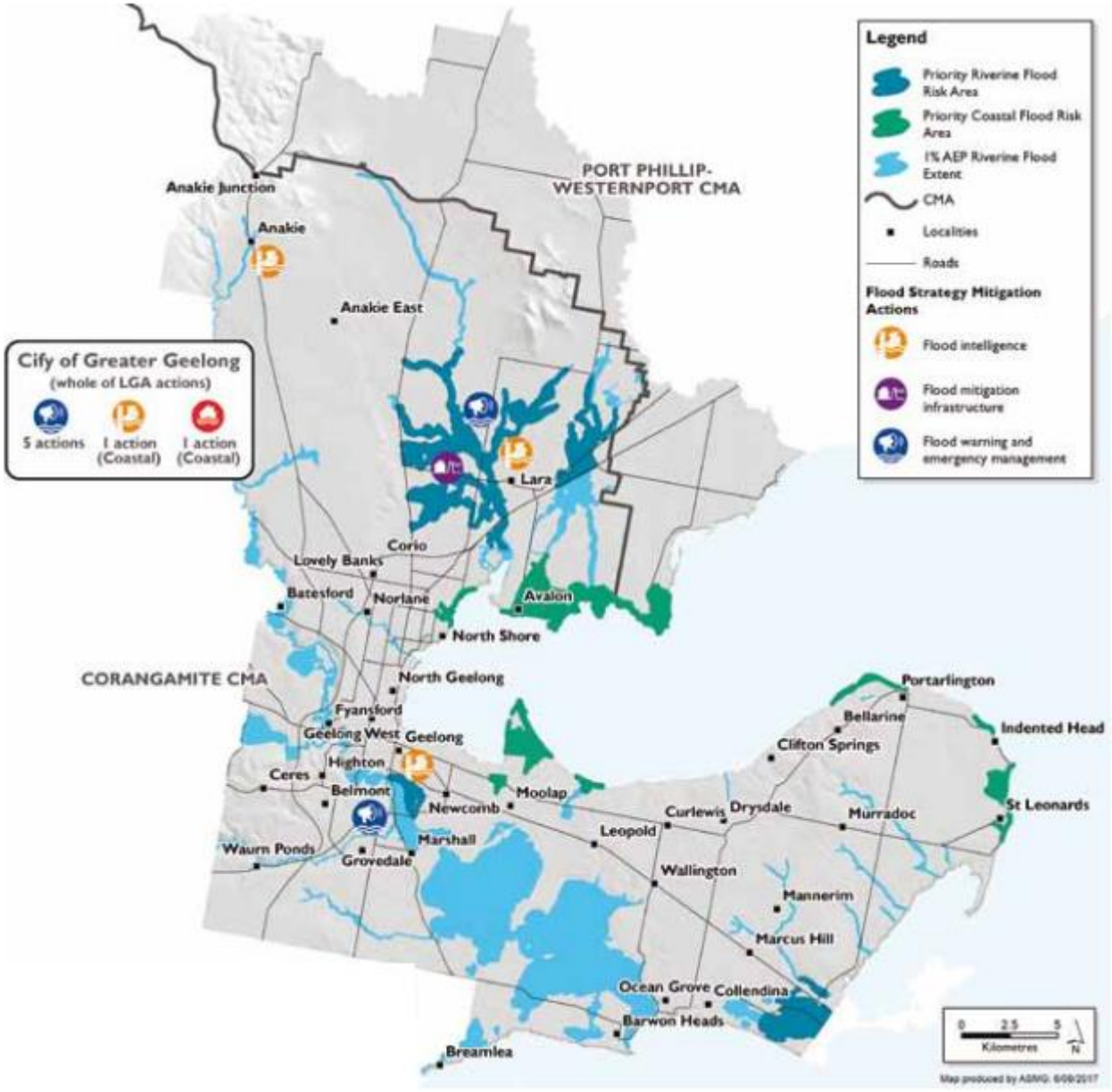

Figure 4-4 Priority Flood Risk Areas of City of Greater Geelong (CCMA, 2018)

The CCMA floodplain development guidelines (CCMA, 2022) helps the community to avoid future flood risks by ensuring development across the region responds appropriately and consistently to the flood hazard. The CCMA provides specialist flood advice and assessment of development, based on the following assessment objectives for development in flood prone areas:

- Objective 1 – Site safety
  - Development must not be located where the depth and flow of floodwaters is hazardous
- Objective 2 – Site access
  - Development must not be located where the depth and flow of floodwaters along the access to or from the property is hazardous
- Objective 3 – Flood Damage

- Development must be designed to minimise the potential damage to property due to flooding
  - Any commercial and industrial buildings required a minimum of 0.3 m freeboard from the 1% AEP flood level.
- Objective 4 – Flood Flow
  - Works or structures must not adversely affect floodwater flow paths or the physical form of a waterway
- Objective 5 – Flood storage
  - Works or structures must not reduce floodwater storage capacity
- Objective 6 – Floodplain and waterway conditions
  - Development must ensure the protection of floodplains and the maintenance or improvement of waterway condition including vegetation and physical form
- Objective 7 – Water quality
  - Development must maintain or improve the quality of stormwater and catchment run-off in rural and urban areas

The City of Greater Geelong contains 21 named waterways, including a mix of creeks and river systems. These waterways form an important natural drainage network, with a combined length of about 1,350 km. Designated waterways must be protected, vegetated and maintained into the future (CCMA, 2022). To ensure their long-term protection, where waterways flow through or alongside large developments, the CCMA preference is for a reserve to be created along the waterway and buffer and for that reserve to be vested in Council (CCMA, 2022). The Planning Policy Framework (PPF) Clause 14.02-1S aims to retain natural drainage corridors with vegetated buffer zones at least 30 metres wide along each side of a waterway.

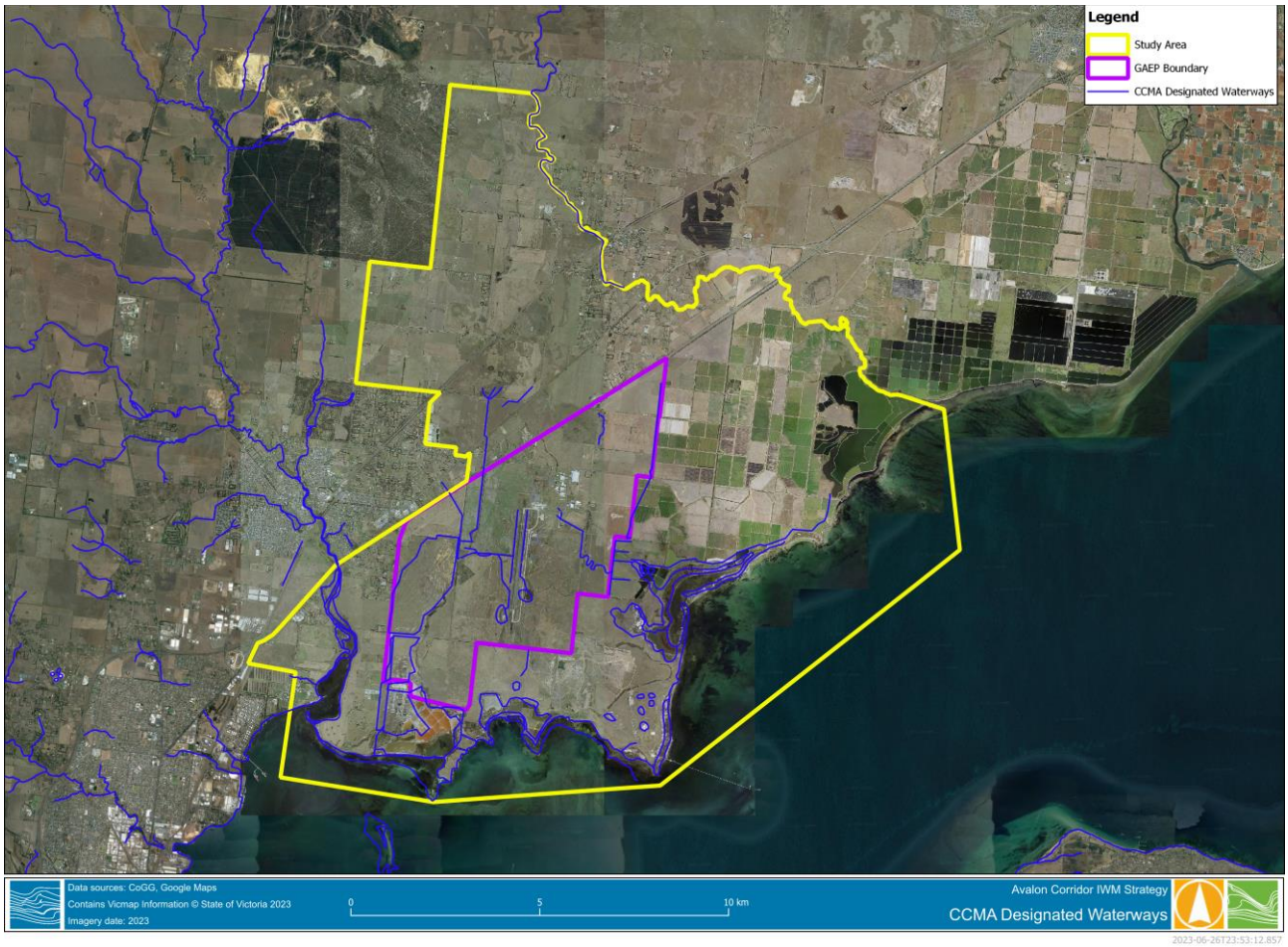

Figure 4-5 CCMA Designated Waterways

A Waterway Management Plan (WMP) will be required as part of the development. The WMP applies to the entire reserve and guides revegetation and provides a plan for ongoing maintenance of the reserve. Waterway Management Plans must include a plan detailing landscaping and a maintenance schedule. The landscape plan should include at a minimum the planting zones, plant types and densities, cross sections of planting and details of inlets, outlets and other features. The maintenance schedule should include establishment actions, a maintenance plan including inspection details, the short-, medium- and long-term actions and identify the responsible parties. Waterway planting should make use of indigenous species consistent with the prevailing Ecological Vegetation Class (EVC). The protection of human life must be prioritised in bushfire affected areas in accordance with Clause 13.02-1S of the PPF. This does not justify ignoring or nullifying other policy considerations such as the requirement to provide 30m vegetated buffers along waterways under Clause 14.02-1S. If conflict arises, the development layout will need to respond appropriately to both requirements and ensure that any dwellings or new lots are appropriately located to reflect the risk associated with the vegetated waterway.

4.6.2 Waterway Strategy

The Corangamite Waterway Strategy (CWS) 2014 – 2022 (CCMA, 2014) focuses on the management, maintenance and improvement of all waterways within the region, recognising the importance of waterways as a connection between catchments, aquifers, streamside vegetation, estuaries and the marine environment,

at the same time acknowledging the strong influence land use and catchment condition have in this context. Key goals and long-term resource targets from the waterways strategy are shown in Figure 4-6.

Regional Goals	Long-term Resource Condition Targets
Maintain or improve waterway condition where it supports high social values.	1. High value social attributes of waterways are maintained.
Secure and manage waterways that provide significant economic benefits to the region.	2. Waterways within special water supply catchments are managed to provide quality water for urban water supplies. 3. Waterways that support licensed diversions for irrigated agriculture are managed to maintain or improve the quality and viability of the resource.
Maintain the viability of populations of threatened native fish species.	4. Known populations and habitat of Australian mudfish are maintained or improved[25]. 5. The condition of sites where Yarra pygmy perch currently occur show no further decline[26]. 6. The probability that important dwarf galaxias populations become self-sustaining is increased[27]. 7. The probability that important Australian grayling populations become self-sustaining is increased[28].
Maintain or improve the resilience of other threatened waterway dependent species.	8. Known habitat and breeding sites for populations of threatened wetland dependent bird species are secured from further environmental degradation. 9. All extant populations of the Corangamite water skink are maintained in systems of reserves and/or areas managed specifically for their conservation[29]. 10. Populations of growling grass frog are secured, particularly those occurring in known breeding habitats[30]. 11. All extant populations of Otway crayfish are secured.
Manage water for the environment to improve waterway condition.	12. Environmental water entitlements for priority waterways are managed to maximise environmental outcomes.
Maintain or improve waterways with formally recognised significance.	13. The ecological character of Ramsar wetlands is maintained or improved. 14. The condition of values of nationally important wetlands are maintained or improved. 15. The listed values of heritage rivers are maintained or improved.
Maintain the extent and condition of other significant wetlands (by type).	16. The condition of freshwater marshes and meadows supporting the seasonal herbaceous wetlands ecological community[31] are maintained or improved.
Maintain waterways in near natural condition.	17. All environmental values of near natural rivers and estuaries are maintained.

Figure 4-6 Corangamite Waterways Strategy Goals and Targets (CCMA, 2014)

The study area falls within the Hovells landscape zone. Hovells Creek and Limeburners Lagoon are two high priority waterway assets within the zone. The western end of the ACS encompasses the Limeburners Lagoon. Therefore, key values, threats and associated targets for the Limeburners Lagoon are summarised below.

Key values of the Limeburnes Lagoon are identified as:

- Formally recognised significance
  - East Asian – Australasian Flyway site
  - Ramsar site
  - Nationally Important Wetland
- Environmental

- Important bird habitat (Double-banded Plovers)
- Significant birds
  - The following birds, listed as endangered under the List of Threatened Vertebrate Fauna in Victoria, have been recorded at Limeburners Lagoon:
    - Fairy Tern (*Sternula nereis nereis*)
    - Little Egret (*Egretta garzetta nigripes*)
  - The following birds, listed as vulnerable under the List of Threatened Vertebrate Fauna in Victoria, have been recorded at Limeburners Bay:
    - Eastern Great Egret (*Ardea modesta*)
    - Royal Spoonbill (*Platalea regia*)
- Significant EVCs – Mangrove Shrubland (140) - vulnerable

- Social
  - Picnics and barbeques
  - Tracks
  - Motor boating
  - Non-motor boating

Key threats to Limeburner's Lagoon values were identified as:

- Invasive fauna (Terrestrial) – Foxes directly prey on bird species and rabbits damage habitat
- Increase in low flow magnitude - Index of Stream Condition (ISC) results for Hovells Creek upstream of the estuary indicate that summer flows and seasonality of the creek have been altered, but it is unknown if this occurred prior or subsequent to the Ramsar Site listing.
- Degraded water quality: No specific information about the threat to ecological character from stormwater was available. However, the increasing development and corresponding stormwater discharges are a threat to this area.
- Disturbance of acid-sulphate soils – Adjacent land has the potential to contain coastal acid sulphate soils or inland waterway is at high risk from acid sulphate soils
- Recreation: Disturbance of waterbirds and other wildlife by people is becoming an increasing problem where urban areas have spread to the edge of wetlands.

Due to its values Limeburner Lagoon meet the following regional goals of the CWS:

- Goal S1: maintain or improve waterway condition where it supports high social values
- Goal ENV2: maintain or improve the resilience of other threatened waterway dependant species
- Goal ENV4: maintain or improve waterway with formally recognized significance

The corresponding long-term resource condition targets for the Limeburner's Lagoon are:

- High value social attributes of waterways are maintained
- Known habitat and breeding sites for populations of threatened wetland dependent bird species are secured from further environmental degradation.

- The ecological character of Ramsar wetlands is maintained or improved.
- The condition of values of nationally important wetlands are maintained or improved.

Additionally, a separate set of management outcome targets are also set to Limeburner's Lagoon:

- The estuarine vegetation has improved from moderate to good condition
- No measurable outcome target is able to be set for the water quality threat over the eight-year implementation period
- Invasive fauna species (terrestrial) are contained (they are present but have no significant impacts)
- Invasive riparian flora (ground layer) threat has reduced from high to moderate
- Wetlands are connected to the estuary but less than natural

4.7 MW Strategies

4.7.1 Healthy Waterways Strategy

The Healthy Waterways Strategy (HWS) 2018-28 (Melbourne Water, 2018) sets a long-term vision for managing the health of rivers, wetlands and estuaries in the Port Phillip and Westernport region, in order to protect and improve their value to the community. The HWS brings together scientific and stakeholder knowledge in a single, comprehensive framework for the region's five major catchments: Werribee, Maribyrnong, Yarra, Dandenong and Westernport. For each catchment, it outlines a vision, goals, long-term targets (10- 50 years) and ten-year performance objectives. These objectives and targets are aligned and prioritised to contribute to the best waterway outcomes for effort and investment across the region.

There are several performance objectives sets for rivers, wetlands and estuaries within the 69 subcatchments spread across the five major river basins. The study areas falls within Little River Lower subcatchment Figure 4-7. While this subcatchments is not currently identified as a stormwater priority area which is subject to higher stormwater harvesting and infiltration targets to protect streams/rivers from urbanisation, there are several performance objectives related to maintaining and or improving water regimes to support values of wetlands and estuaries.

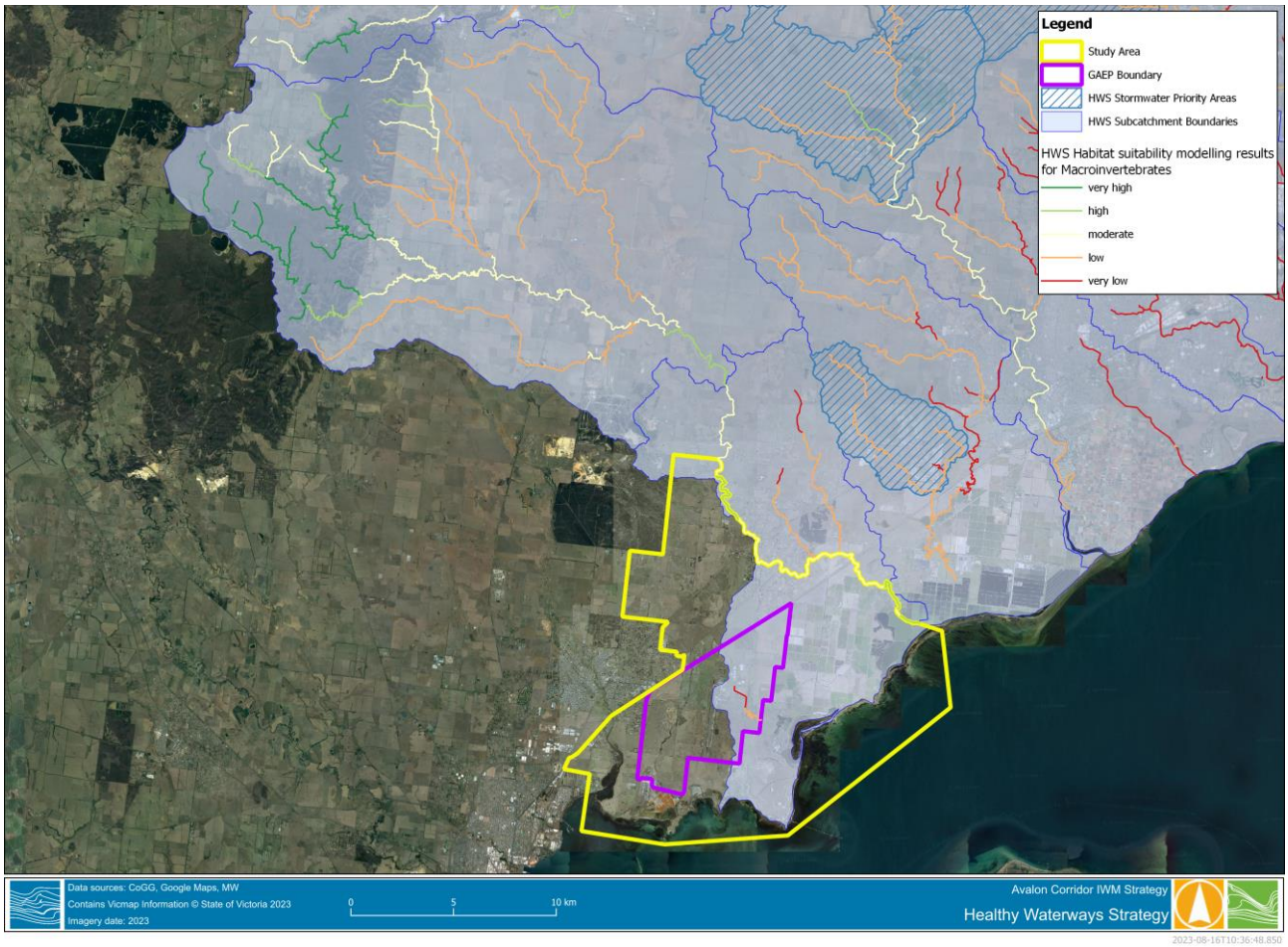

Figure 4-7 Healthy Waterways Subcatchments

Table 4-3 HWS Performance Objectives of Little River Lower Subcatchment (Melbourne Water, 2018)

Waterbody	Performance Object Category	10-year Performance Objectives
All Rivers	Vegetation	▪ Establish a continuous riparian vegetated buffer (25 km, 99 ha) along priority reaches. ▪ By 2028, maintain existing vegetation (2 km, 10 ha) annually, along priority reaches.
	Community	▪ Increase access (about 2 km of path) by improving and extending path network to and along river around Little River (Worrin-yaloke) township and to coastal wetlands. ▪ Support participation in Landcare and other rural programs that improve waterway habitats and build capacity of land owners. Increase support for community/environment groups as population increases.

Waterbody	Performance Object Category	10-year Performance Objectives
	Water for the environment	▪ Maintain critical flow components in refuge reaches in Little River (Worrin-yaloke) to protect instream environmental values and platypus (perridak). ▪ Identify and implement opportunities to reduce the key threat of summer low flow stress by addressing causal factors such as water for domestic and stock use, climate change, diversions or urbanisation.
	Habitat	▪ Increase instream connectivity provide fish (kuwiyn) passage along the Little River (Worrin-yaloke) from the mouth to Geelong-Bacchus Marsh Rd, by removing five fish barriers in the lower reaches.
All Wetlands	Stormwater	▪ Ensure appropriate stormwater planning controls are in place in key wetlands.
	Habitat	▪ Conserve priority species and communities through habitat protection, research and monitoring.
	Water for the environment	▪ Reduce threats from invasive flora and fauna.
	Water for the environment	▪ Maintain or improve wetland water regime to support values.
	Vegetation	▪ Protect, maintain, or improve wetland vegetation to support habitat values. ▪ Improve wetland buffer along wetland perimeters.
WTP ponds (wetlands)	Habitat	▪ Undertake monitoring to ensure that site stays within the limits of acceptable change as identified in the Ramsar Management Plan and in accordance with new requirements for monitoring, evaluation and reporting at Ramsar sites. ▪ Identify and assess management options for addressing risk to coastal habitat from sea level rise and increasing coastal storm surge. ▪ Identify opportunities for habitat creation and migration with the adjacent to Ramsar to mitigate habitat loss due to climate change risks. ▪ Reduce invasive flora threat to low focussing on salt tolerant weeds in saltmarsh communities. ▪ Reduce invasive fauna threat (cats and foxes) to low focussing on orange-bellied parrot, shorebird and nesting bird habitats.
	Water for the environment	▪ Continue to implement water regime management to meet ecological objectives in artificial habitats within the Ramsar site.

Waterbody	Performance Object Category	10-year Performance Objectives
The Spit Nature Conservation Reserve Wetlands	Habitat	▪ Undertake monitoring to ensure that site stays within the limits of acceptable change as identified in the Ramsar Management Plan and in accordance with new requirements for monitoring, evaluation and reporting at Ramsar sites. ▪ Identify and assess management options for addressing risk to coastal habitat from sea level rise and increasing coastal storm surge. ▪ Identify opportunities for habitat creation and migration with the adjacent to Ramsar to mitigate habitat loss due to climate change risks. ▪ Reduce invasive flora threat to low focussing on salt tolerant weeds in saltmarsh communities. ▪ Reduce invasive fauna threat (cats and foxes) to low focussing on orange-bellied parrot, shorebird and nesting bird habitats.
	Vegetation	▪ Increase wetland buffer to 50 per cent of the wetland perimeter.
All Estuaries	Vegetation	▪ Protect, maintain, or improve estuarine vegetation to improve conditions and support values.
	Habitat	▪ Protect estuary roosting sites from excessive disturbance from humans, vehicles, dogs, foxes and cats. ▪ Improve longitudinal connectivity and tidal exchange in estuaries.
	Water for the environment	▪ Increase the environmental water reserve volume in regulated systems. ▪ Maintain or improve flow regimes in unregulated systems.
	Community	▪ Maintain, support or enhance opportunities for access, recreation and facilities.
Little River Estuary	Vegetation	▪ Enable lateral and longitudinal migration of estuarine vegetation communities on the floodplain to allow adaptation to climate change risks. ▪ Protect remnant estuarine vegetation communities by reducing threats from invasive plant species.
	Habitat	▪ Protect estuary roosting sites from excessive disturbance from humans, vehicles, dogs, foxes and cats.
	Water for the environment	▪ Maintain critical flow components in refuge reaches to protect instream environmental values and platypus.

4.7.2 Floodplain Management Strategy

The Flood Management Strategy Port Phillip and Westernport (Melbourne Water, 2021a) is a 10-year strategy that aims to enhance the flood resilience of the region. It accompanies two action plans (2021 – 2026 and 2026 – 2031). The strategy identifies key directions that provide a greater emphasis on managing climate change, empowering diverse communities, and managing flooding to achieve multiple benefits for water security, liveability and sustainability. The vision, objectives, 10-year outcomes, focus areas and five-year action plans are shown in Figure 4-8.

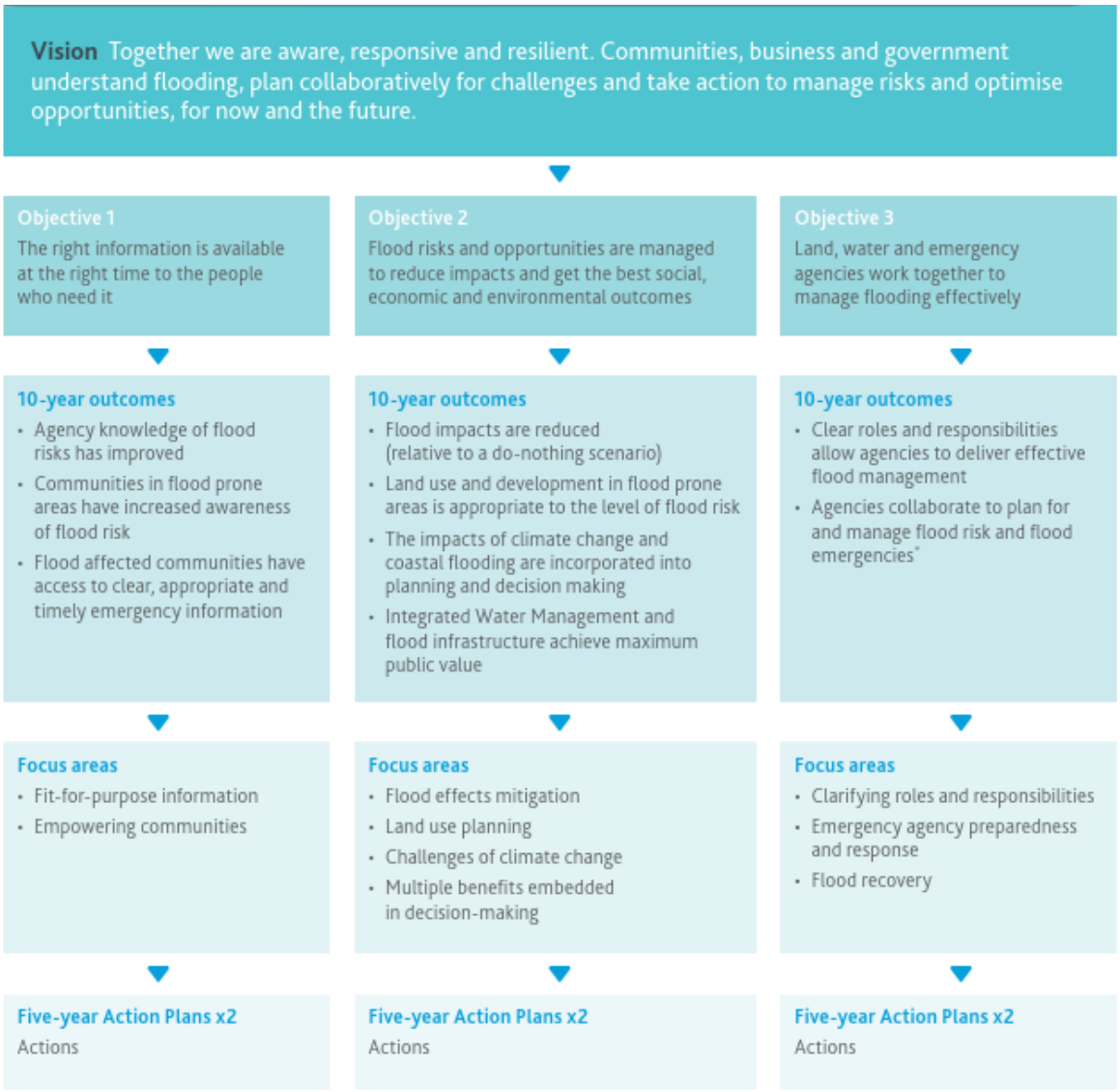

Figure 4-8 Vision, Objectives, 10-year outcomes, Focus areas and Five-year action plans of MW Floodplain Strategy (Melbourne Water, 2021a)

Out of the three main objectives, the second objective "Flood risks and opportunities are managed to reduce impacts and get the best social, economic and environmental outcomes" has the most relevance to the development of IMWP. While there are no any action specific to Little River catchment, the following general actions under the second objective would have an impact on the IWMP

Table 4-4 Key Actions and their Outcomes related to managing Flood Risks and Opportunities (Melbourne Water, 2021b)

Action Category	Action	
Focus Area 3 Flood Effects Mitigation		
Foundational Actions	3.1	Identify high-priority areas for flood effects mitigation, then consider a diverse range of potential solutions to identify the right approach for prioritised locations and their communities. Deliver outcomes in collaboration with partners and the community

Action Category	Action	
Infrastructure	3.2	Investigate, develop and deliver place-based capital asset solutions where feasible
Maintenance	3.3	Develop and deliver flood and drainage infrastructure maintenance programs
Innovation	3.4	Identify new opportunities and innovations to mitigate flooding and its effects and assess their feasibility
	3.5	Pilot feasible place-based opportunities and innovations to mitigate flooding and its effects
	3.6	Develop information (for home owners) to consider flood mitigation options for retrofitting existing homes to enhance flood resilience
Focus Area 4 Landuse Planning		
Streamline planning scheme amendment approach	4.1	Investigate opportunities to amend the Victorian Planning System to allow high-risk flood hazard information to be included directly into planning schemes
	4.2	Actively support councils in engaging with all affected parts of the community when new flood hazard planning scheme amendments are proposed to be incorporated in planning schemes
Climate change	4.3	Adopt Australian Rainfall and Runoff guidance on climate change rainfall and runoff as best practice
	4.4	Incorporate best practice climate change flood hazard modelling in flood hazard planning scheme amendments
	4.5	Incorporate best practice climate change flood hazard modelling in all emerging greenfield development schemes
Risk based approach	4.6	Undertake a review of current flood overlays and controls to evaluate the effectiveness of our current approach to permitting sensitive uses in current flood prone areas
Upstream stormwater capture	4.7	Explore planning and/or building controls in upstream areas to mitigate downstream flood impacts
Integrated design outcomes	4.8	Update the Guidelines for Development in Flood Affected Areas (2019) to support the community and all decision makers in ensuring that development decisions support design outcomes that protect and enhance places, spaces and environments in existing urban areas while mitigating future flood risk
	4.9	Investigate opportunities to amend the Victorian Planning System to better support balanced architectural and building design decisions in flood hazard areas
Supporting planning decisions	4.10	Revision of the greenfield decision guidelines for all greenfield development decision services that adopts best practice integrated water management and flood management
Focus area 5 Challenges of climate change		

Action Category	Action	
Understanding impacts	5.1	Identify an appropriate set of scenarios for use in Port Phillip and Westernport region flood planning. Develop guidance on when and how to use the scenarios
	5.2	Understand where flood risks are likely to change due to climate change
	5.3	Increase our understanding of the cost of increased damages caused by climate change
Consultation, education and engagement	5.4	Community consultation, education and engagement about the impact of climate change on flood risk
Co ordinating regional adaptation	5.5	Investigate and report on regional adaptation options
Developing tools for regional and place based adaptation projects	5.6	Develop and adopt a common approach to assess the effects of climate change on risk and vulnerability to inform prioritisation and flood impact mitigation
	5.7	Incorporate climate change adaptation into design, planning and implementation of flood mitigation projects
Focus area 6 Multiple benefits embedded in decision making		
Foundational actions	6.1	Unlock opportunities for integrated water management (IWM) and amenity outcomes in flood assets. Balance risk by determining a risk management approach
	6.2	Develop a collaborative process and principles to support place-based solutions that are linked to aligned policies and strategies
	6.3	Review relevant policy, governance and funding mechanisms to incorporate multiple benefits
New precincts (infill and redevelopment e.g. Fisherman's Bend)	6.4	Embed innovative, place-based approaches to deliver multiple benefits in new precincts (infill and redevelopment)
Integrated water management and stormwater	6.5	Identify high priority catchments to mitigate flood impacts through stormwater management projects and deliver projects in these areas
Greenfield development	6.6	Review the Development Services Scheme (DSS) model with all stakeholders to assess the opportunities and constraints to delivering integrated water management (IWM) outcomes in emerging and existing greenfield development schemes
	6.7	Ensure that new Precinct Structure Planning Guidelines and supporting Practitioner Guidelines include best practice Integrated Water Management and Plan Melbourne strategic water objectives
Flood infrastructure	6.8	Consider opportunities to achieve stormwater, open space and/or amenity outcomes on all existing and future flood infrastructure projects. Deliver assets that provide these benefits where appropriate

4.8 EPA Victoria guidelines

4.8.1 Environmental Reference Standards

The Environment Reference Standard (ERS) (EPA Victoria, 2021a) is a new legislative instrument made under the Environment Protection Act 2017 (the Act). The ERS is an environmental benchmark which brings together a collection of environmental values, indicators and objectives that describe environmental and human health outcomes to be achieved or maintained in the whole or in parts of Victoria. These values, indicators and objectives are used to assess and report on changing environmental conditions by providing a reference point for decision makers to consider whether a proposal or activity is consistent with the environmental values identified in the ERS. The ERS applies to four elements of the environment: ambient air, ambient sound, land and water (surface and groundwater). The study area is within the Central Foothills and Coastal Plains Rivers and Streams segment and discharging to the Geelong Arm of the Port Phillip Bay Marine and Estuarine segment (Figure 4-9)

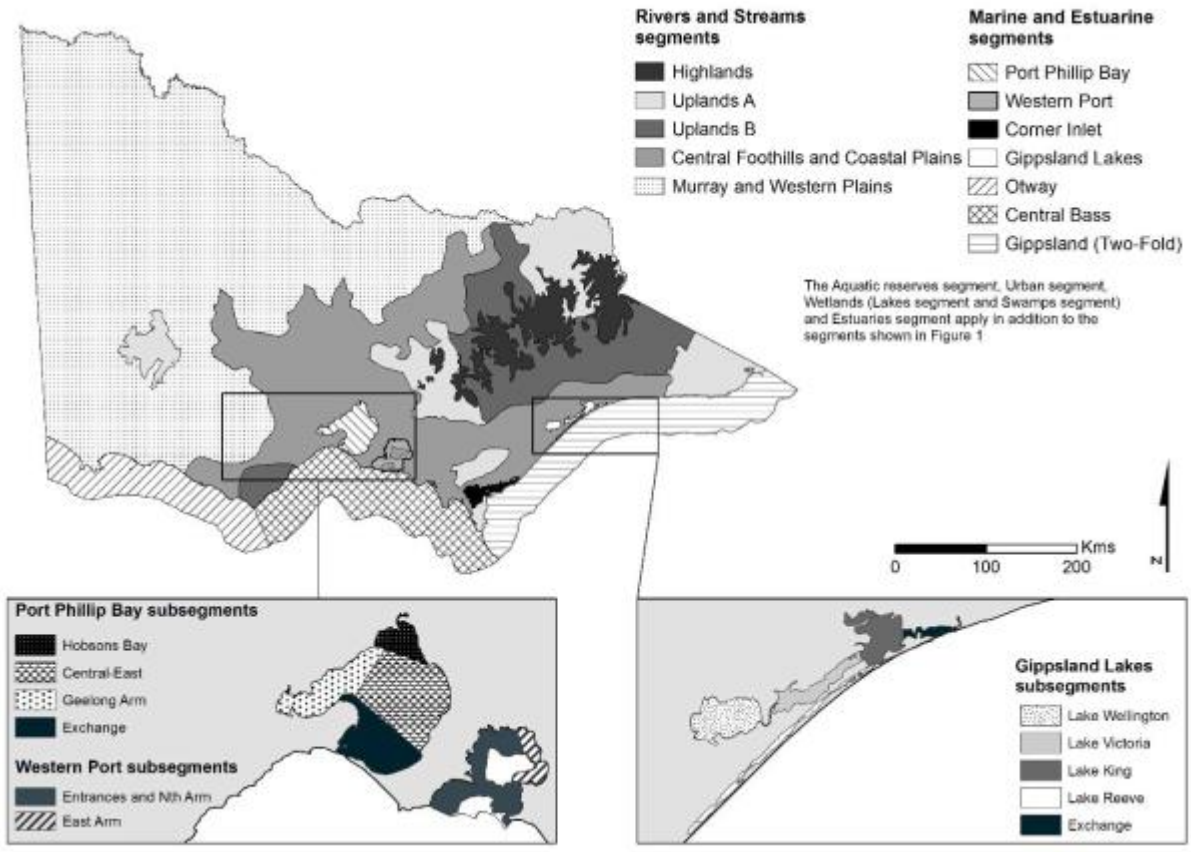

Figure 4-9 Surface water geographic regions (EPA Victoria, 2021a)

A summary of beneficial values of inland waters and estuaries are summarised in Table 4-5 while relevant indicators for inland rivers/stream and estuaries are summarised in Table 4-6.

Table 4-5 Environmental Values (EPA Victoria, 2021a)

Inland Land Waters (Central Foothills and Coastal Plains	Marine and Estuarine Waters (Port Phillip Bay – Geelong Arm)
■ Water dependent ecosystems and species (slightly to moderately modified) ■ Agriculture and irrigation ■ Human consumption of aquatic foods ■ Aquaculture ■ Industrial and commercial ■ Water-based recreation (primary contact) ■ Water-based recreation (secondary contact) ■ Traditional Owners cultural values ■ Navigation and shipping	■ Water dependent ecosystems and species (slightly to moderately modified) ■ Human consumption of aquatic foods ■ Aquaculture ■ Industrial and commercial ■ Water-based recreation (primary contact) ■ Water-based recreation (secondary contact) ■ Traditional Owners cultural values ■ Navigation and shipping

Table 4-6 Physio chemical indicators (EPA Victoria, 2021a)

Indicator	Statistic	Relevant Inland Waters[1] Threshold Value	Relevant Marine Waters[2] Threshold Value
Total phosphorus	75th percentile	≤60 µg/L	100 µg/L
Total nitrogen	75th percentile	≤1,100 µg/L	300 µg/L
Dissolved oxygen	25th percentile	≥ 75%	95%
	Maximum	130%	130%
Chlorophyll-a	75th percentile	-	3 µg/L
Turbidity	75th percentile	≤25 NTU	≤25 NTU
Dissolved inorganic phosphorus	75th percentile	-	70 µg/L
Dissolved inorganic nitrogen	75th percentile	-	20 µg/L
TSS	75th percentile	-	5 µg/L
Salinity	25th percentile	-	35 PSU
	75th percentile	-	38 PSU
Electrical conductivity	75th percentile	≤2,000 µS/cm@25^{o}C	≤2,000 µS/cm@25^{o}C
Light attenuation	75th percentile	-	0.4 m^{-1}
pH	25th percentile	≥6.8	7.5
	75th percentile	≤8.0	8.5
Toxicant in water	-	95%	95%
Toxicant in sediment	-	Default guideline value	Default guideline value

Notes:

1. Central Foothills and Coastal Plains (Slightly to moderately modified). Lowlands of Barwon, Moorabool, Werribee and Maribyrnong basins and the Curdies and Gellibrand Rivers
2. Port Phillip Bay – Geelong Arm (surface water)

4.8.2 Stormwater Management Guidance

EPA Victoria's latest guidance on urban stormwater management was published in 2021 (EPA Victoria, 2021b). The current stormwater management objectives consist of the conventional Best Practice Environmental Management (BPEM) targets together with a new flow reduction target (volume). There are two main types of flow reduction targets: priority area targets and the non-priority area target. The priority areas are defined as area of high ecological values waterways. Stormwater priority areas for the Port Phillip and Westernport catchment is defined in the Healthy Waterways Strategy (Melbourne Water), but no such definition exists for regional Victoria. The volumetric targets are aspirational, particularly for priority areas and aim to mimic the natural hydrologic cycle. This represents a new phase of stormwater management approach. However, it is worth noting the volumetric targets listed in the guidance do not have the same compliance status attached to the current BPEM targets (water quality). Therefore, further policy support is needed to integrate volumetric targets to Victorian Planning Provision or other regulations.

The relevant stormwater management objectives for the study area are:

- 80% reduction in mean annual suspended solids
- 45% reduction in mean annual total phosphorus
- 45% reduction in mean annual total nitrogen
- 70% reduction in mean annual gross pollutants
- Harvest/infiltrate 77% (priority area) or 31% (non-priority area) mean annual **impervious** run-off
- Infiltrate/filter 5% (priority area) or 4% (non-priority area) mean annual **impervious** run-off

The above represents the current guidance in relation to stormwater management best practice, acknowledging that a site-specific approach is may be warranted at this location as is presented in Section 6 of this report.

4.9 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation (EPBC) Act and regulations are Australia's main national environmental legislation. They provide a way to protect and manage nationally and internationally important plants, animals, habitats and places while promoting ecologically sustainable development through careful use of our natural resources. Protected Matters Search Tool[1] was used to identify what is protected under the EPBC Act. A summary of matters of significance categories are provided below. Please refer to Appendix B for the full search report with individual species names.

- Matters of National Environmental Significance (MNES)
  - Migratory Species x 64
  - Threatened Ecological Communities x 6
  - Threatened Species x 76
  - Wetlands of international importance (Ramsar Wetlands) x 1

[1] https://www.dcceew.gov.au/environment/epbc/protected-matters-search-tool

- Other Matters Protected by the EPBC Act
  - Commonwealth Heritage Places x 1
  - Commonwealth Lands x 22
  - Listed Marine Species x 79
  - Whales and Other Cetaceans x 7

Potential direct and indirect impact on MNES from development and associated changes could include but not limited to:

- Loss of habitat (due to development as well as sea level rise)
- Disturbance to habitat
- Altered hydrological conditions
- Changes water quality (increased sediment, toxicants, emerging pollutants of concern)
- Invasive species

4.10 Wadawurrung Traditional Owners Aboriginal Corporation IWM Statement

Wadawurrung Traditional Owners Aboriginal Corporation IWM Statement specify its position on IWM projects, stormwater, recycled water and new water sources (Refer to Appendix C for a copy of the full statement). The statement recognise the rivers and waterways are living entities that are highly modified and under threat from increased and incorrect usage. Furthermore, it specify that while treated stormwater can be use to support environmental flows and systems, it must not be used as cultural water or cultural flows. From Wadawurrungs perspective, alternative water sources such as stormwater and recycled water are to be used to reduce/replace extractions from waterways and leave water within the waterways for environmental and cultural purposes. WTOAC supports the need for investing into alternative water sources and effort to increase greater uptake of alternative water soures among major water users like agriculture and major industries.

5 IWM ISSUES AND CONSTRAINTS

This section summarises issues, constraints and some opportunities related to IWM identified through background review and initial stakeholder engagement.

5.1 Catchment Context

The project area extends across two waterway catchments, these include:

- Hovells Creek
- Little River

The catchment areas of these waterways respective to the project area is shown in Figure 5-1.

The Hovells Creek catchment begins at Mouth Anakie and flows south easterly through the township of Lara before flowing into Limeburners Bay, an inlet of Corio Bay. The Hovells Creek Catchment is approximately 306 km^2.

Limeburners Bay at the outlet of Hovells Creek is within the Port Phillip Bay (western Shoreline) and Bellarine Peninsula Ramsar Site. Limeburners Bay is recognised for its international importance and also has a state significance rating.

The Hovells Creek Catchment includes the smaller Avalon catchment, sometimes referred to as the Austin Swamp Catchment. This catchment drain overland south of the You Yangs towards the Princess Highway and through Avalon towards the former saltworks and Avalon Coastal Reserve. The catchment to the bay is approximately 53 km^2.

The Little River catchment starts in the Brisbane Ranges flowing easterly through the Werribee plains before discharging to Port Phillip Bay immediately downstream of the township of Little River. The catchment area of the Little River is approximately 554 km^2.

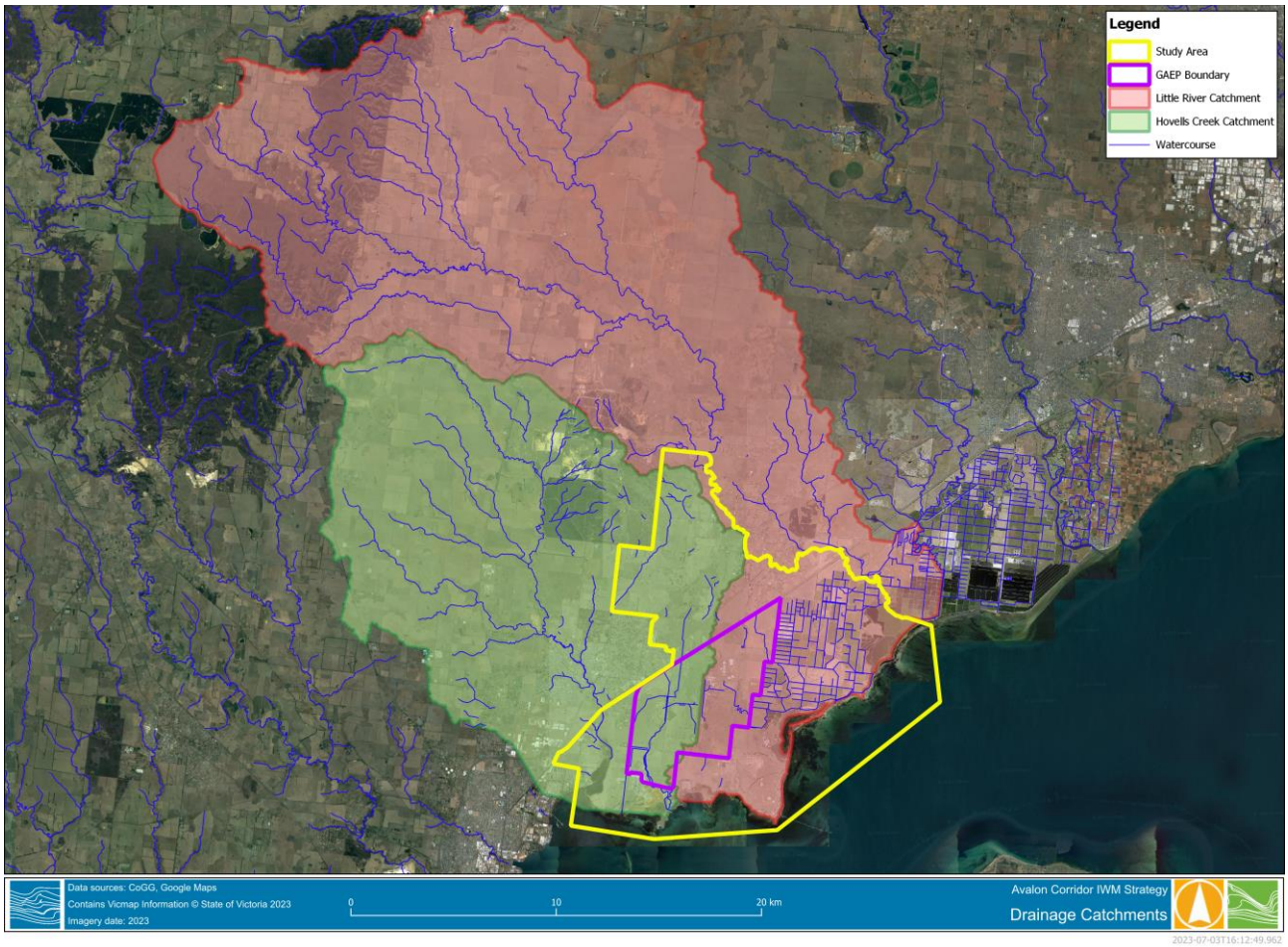

Figure 5-1 Drainage Catchments

5.2 Land Ownership

Public land and land owned by Melbourne Water are shown in Figure 5-2. Melbourne Water own 3,705 ha from the west of the proposed GAEP boundary to the study area boundary. This portion of the study area has limited development potential. The crown land is generally spread along the coastal fringe and extend up to the southern boundary of the proposed GAEP and covers approximately 2,028 ha. Additionally, the Australian Government Department of Defence own the land within Avalon Airport and surroundings. It is understood that this land is not subject to PSP process. Refer to Section 5.13 for further details about the proposed Airport masterplan development and potential impact on the Avalon Corridor PSP.

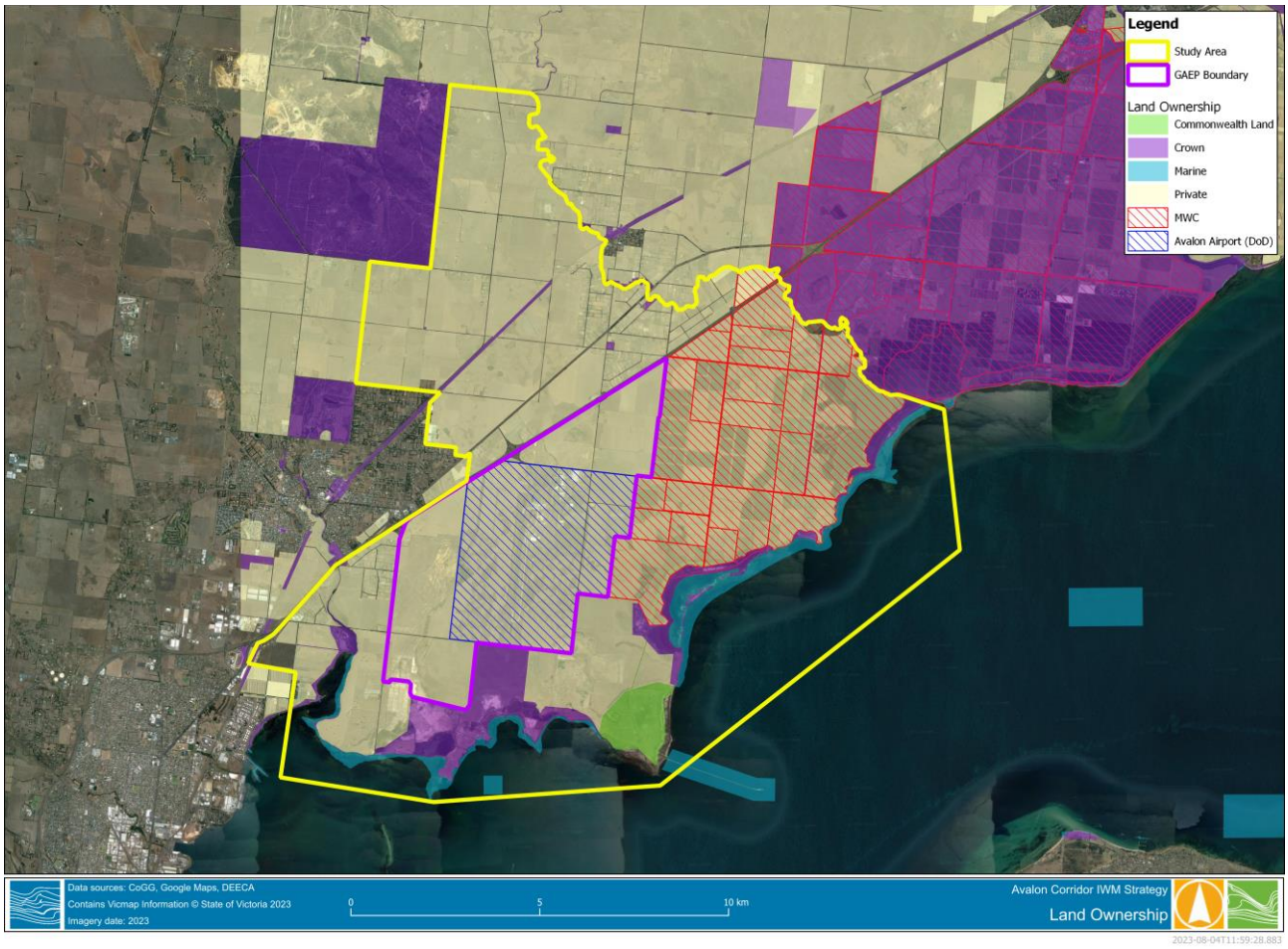

Figure 5-2 Land Ownership

5.3 Topography

Existing surface elevation across the study area is shown in Figure 5-3. The elevation varies from 175 mAHD towards the northwest edge of the study area in the You Yangs Regional Park to -13 mAHD in the Mountain View Quarry (based on 10m Digital Elevation Model (Vicmap Elevation dataset)). The average elevation upstream of the Princess Highway is 29 mAHD while the study area downstream of the Princess Highway has an average elevation of 7 mAHD.

The relatively low elevation poses a risk of some areas being lost in future, due to sea level rise particularly along the coastal fringe. In addition to the low elevation, the overall study area is relatively flat and gradually sloping towards the southeast and Port Phillip Bay. The average slope across the area downstream of the Princess Highway is approximately 1.3%. Relatively low elevation coupled with flat gradient will be a significant constraint when establishing drainage outfalls as well as operating gravity fed water and sewer infrastructure. Given land topography, there will likely be a series of pressure systems operating in the GAEP and surrounding area.

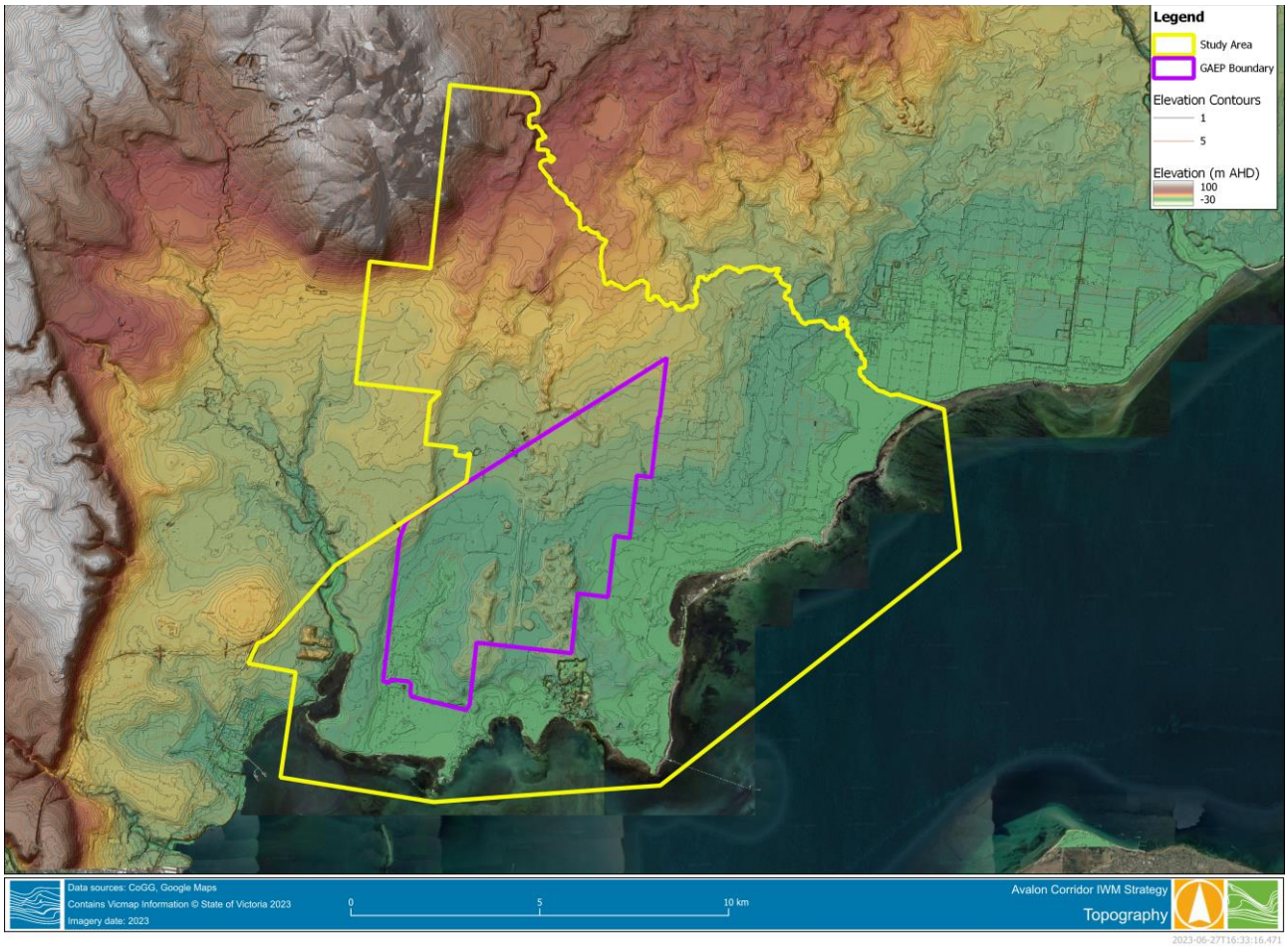

Figure 5-3 Topography

5.4 Soil

Geological features of the study area extracted from Vicmap dataset are shown in Figure 5-4. Majority (~53%) of the study area consists of Newer Volcanic Group. The group is characterized with major proportions of alkali basalt and tholeiitic basalt and minor proportions of tuff, scoria and alluvium. The second largest geology group (~20% coverage) is the waste deposits within the MWC land. A recent Land Capability Assessment (LCA) conducted by VPA for the GAEP area (Jacobs, 2023) have identified sodic soils with dispersive nature that are present in the proposed GAEP area. These soil characteristics could lead to erosion of drainage channels/features and associated blockage/sedimentation of downstream drainage areas or undermining of constructed works. Sodic soils by their characteristics are highly problematic for construction materials if untreated or not improved.

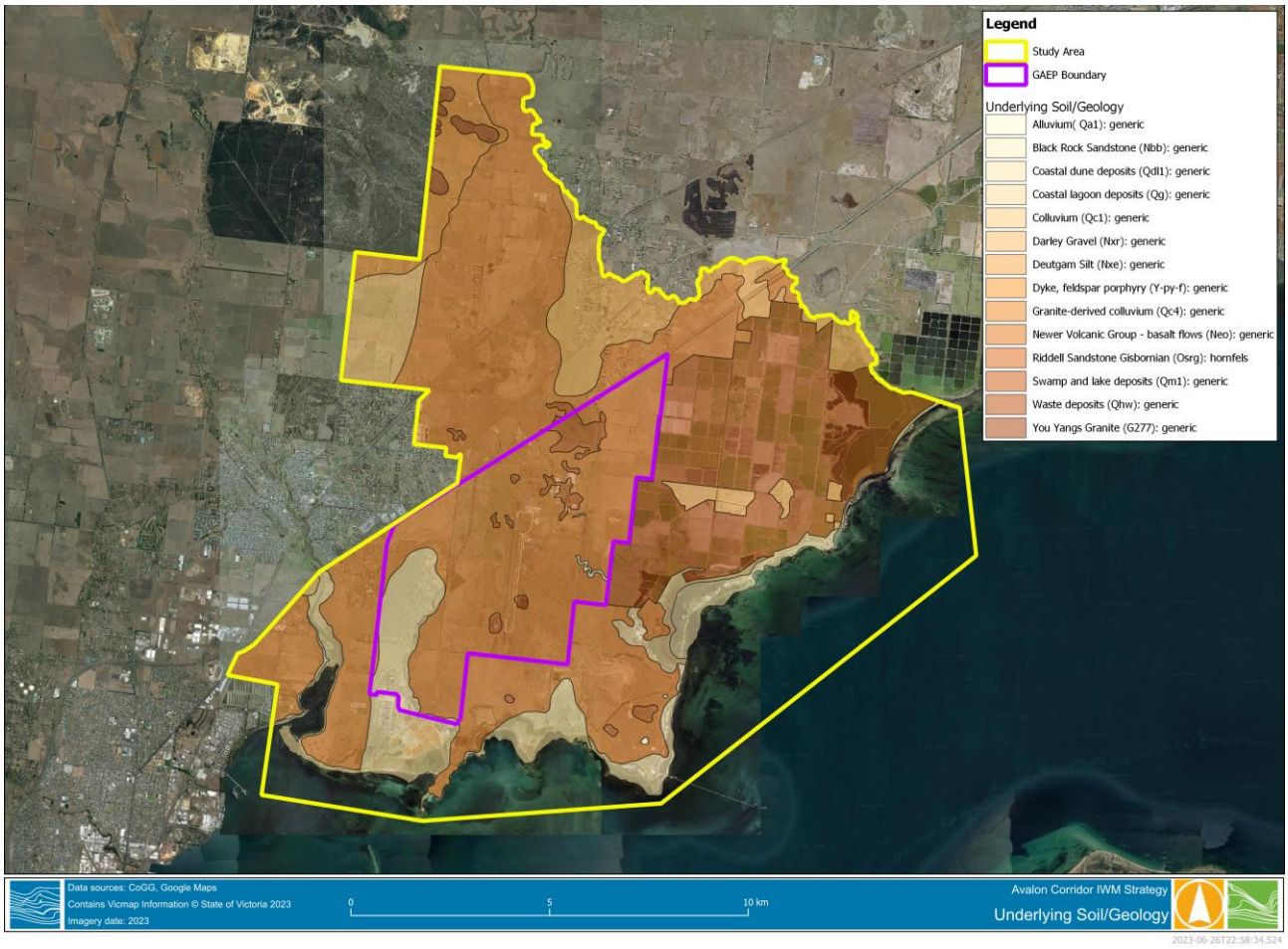

Figure 5-4 Soil Map

5.4.1 Acid Sulphate Soils

The acid sulfate soil impact is considered an environmental impact on the downstream waters when the future developments disturb the topsoil and groundwater. Approximately 560 ha within the study area is identified to contain Potential Acid Sulphate Soils. Most of these areas are scattered throughout the low-lying areas adjacent to coastal fringe including Limeburners Bay and shown in Figure 5-5. Most of these areas are either adjacent to existing waterways within the GAEP area or would be likely to have low development potential. The recent LCA conducted by VPA for the GAEP area (Jacobs, 2023) has identified a high probability of Acid Sulphate Soils occurrence coincides with the locations of Coastal lagoon deposits (the extent generally aligns with made land and prospective coastal acid sulphate soil extent in Figure 5-5. Therefore, Acid Sulphate Soils has relatively low potential impact on the proposed development except for the area west of the Avalon Airport. However a detailed soil investigation is proposed to undertaken as the PSP process progresses further. The relevant guidelines such as Assessing and Managing Coastal Acid Sulfate Soils[2] and EPA Publication 655.1: Acid sulfate soil and rock[3] must be in further investigation into Acid Sulfate Soils

[2] https://www.marineandcoasts.vic.gov.au/__data/assets/pdf_file/0016/31237/CASS-BPMG-2010.pdf
[3] https://www.epa.vic.gov.au/about-epa/publications/655-1

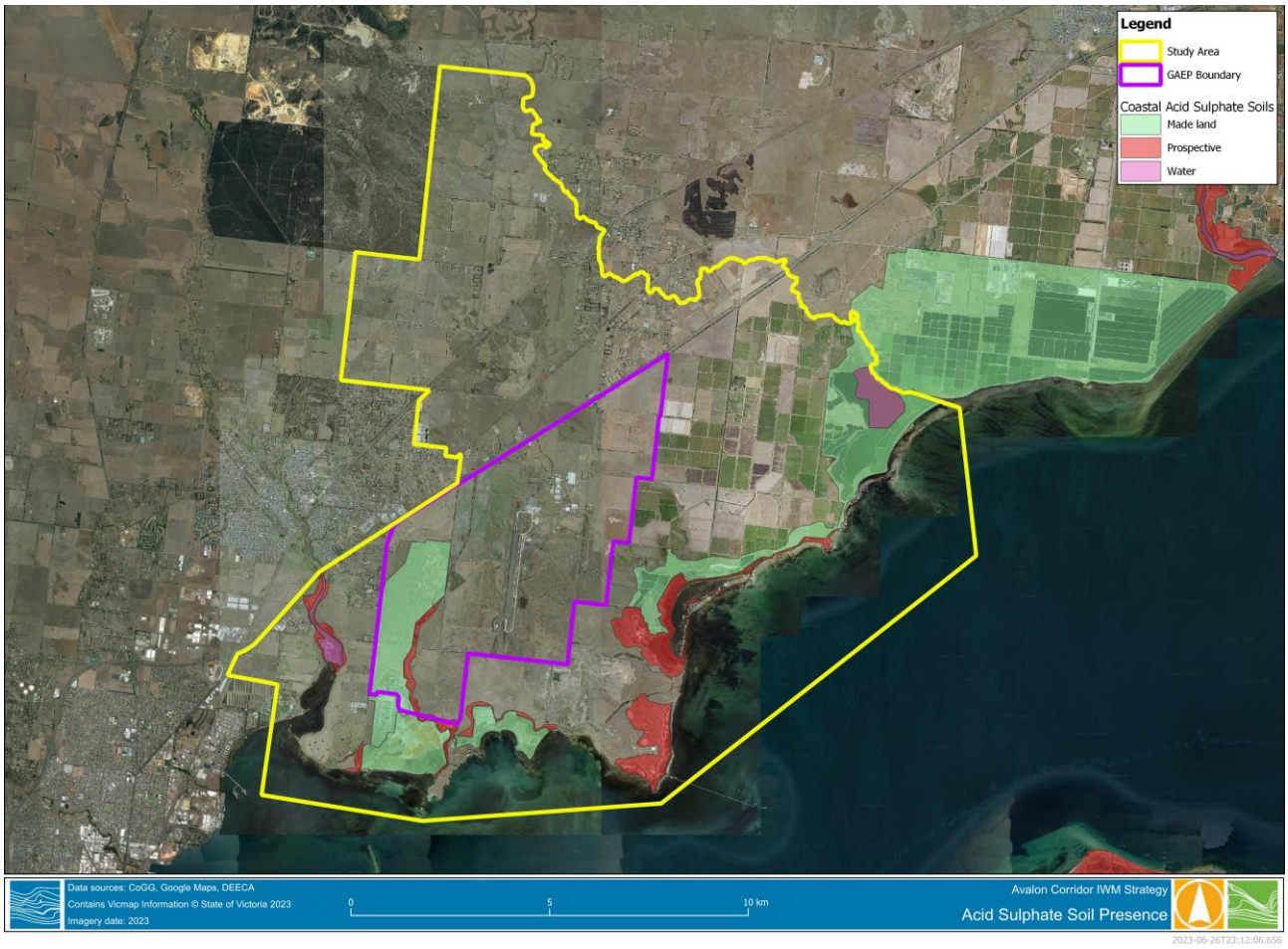

Figure 5-5 Acid Sulphate Soils Presence

5.5 Environment

5.5.1 Sensitive Wetlands and Coastal Areas

Sensitve wetlands and coastal areas consists of:

- wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention)
- wetlands listed in the Directory of Important Wetlands of Australia
- internationally important sites for Migratory Shorebirds of the East Asian-Australasian Flyway.

There are several wetlands of national and international significance in the study area (Figure 5-6). The study area falls within the Werribee River/Avalon and Point Wilson/Limeburners Bay area of the Port Phillip Bay Western Shoreline Ramsar site (DELWP, 2018). Port Phillip Bay (Western Shoreline) and Bellarine Peninsula is also identified as an East Asian-Australasian Flyway site[4]. Key ecological values of the two Ramsar site segment presents within the study area is summarised in Table 5-1 and the key threats to each segment is summarised in Table 5-2. It is understood that these threats were assessed prior to the large-scale

[4] https://www.eaaflyway.net/australia/

development now being considered within the area and hence, there may be additional development related threats to Ramsar wetlands that need to be considered.

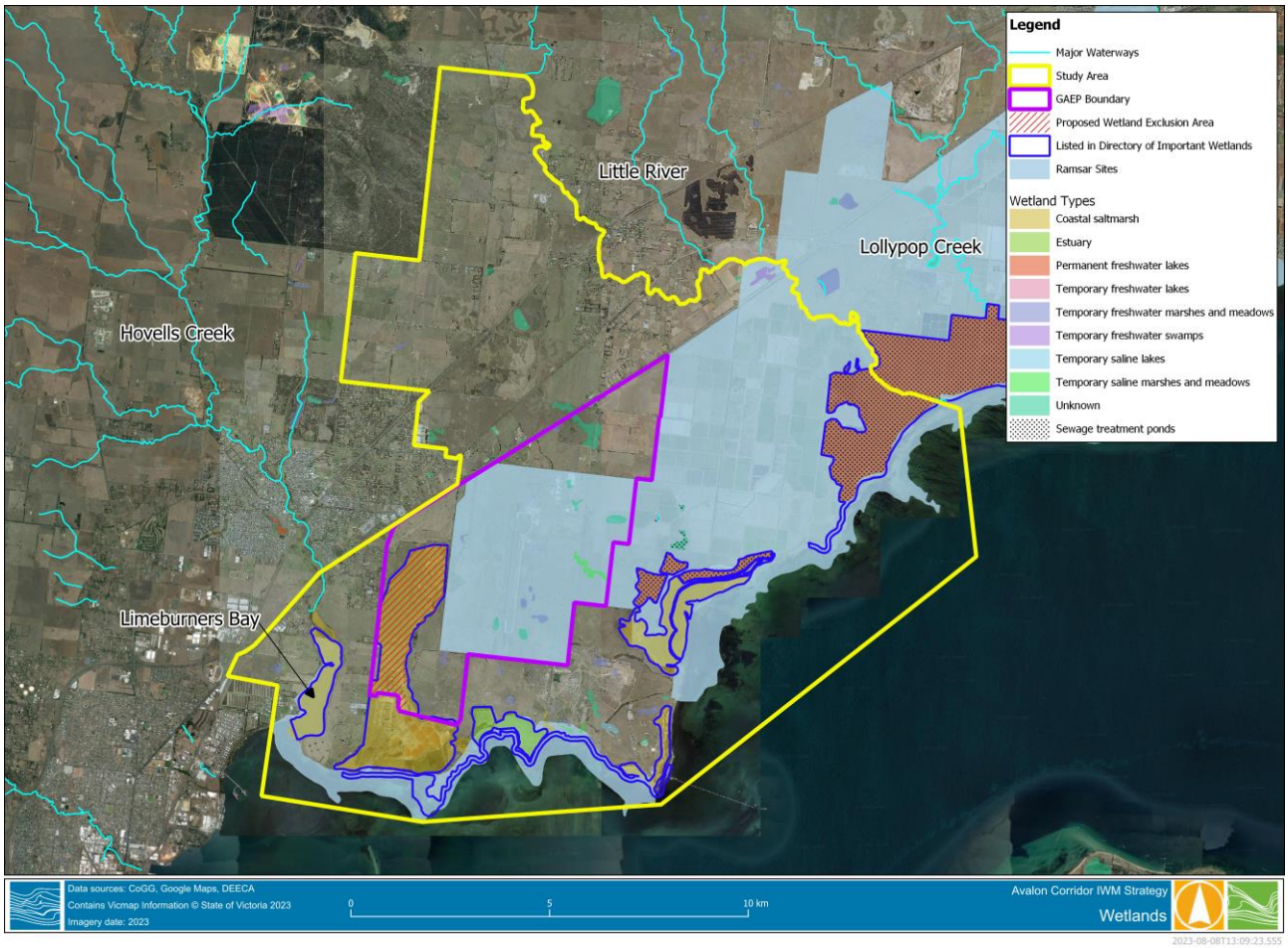

Figure 5-6 Wetlands of National and International Significance

Table 5-1 Values at each location in the Ramsar site (those shaded are identified as the highest priority) (DELWP, 2018)

Value	Werribee	Point Wilson
Ecological		
Hydrology (including connectivity)	x	x
Intertidal flats	x	x
Intertidal reefs		x
Seagrass	x	x
Coastal saltmarsh	x	x
Mangroves		x
Freshwater aquatic vegetation	x	
Waterbird abundance and diversity	x	x
Waterbird breeding	x	x

Value	Werribee	Point Wilson
Diversity and abundance of fish	x	x
Threatened species: Australian Bitten	x	
Threatened species: beach nesting birds	x	x
Threatened species: shorebirds	x	x
Threatened species: orange bellied parrot	x	x
Threatened species: growling grass frog		x
Socio-economic and cultural values		
Recreational fishing		x
Water based recreation (swimming, boating)	x	x
Water based recreation (camping, bushwalking, nature observation)	x	x
Aboriginal cultural heritage	x	x
Game hunting	x	x
Tourism	x	x
Education	x	x

Table 5-2 Priority Threats at each location in the Ramsar site (those shaded are identified as the highest priority) (DELWP, 2018)

Threats	Werribee	Point Wilson
Climate change: sea level rise impacting on intertidal vegetation and waterbird habitat	x	x
Climate change: increased temperature increases the frequency and severity of avian disease	x	
Climate Change: increased intensity of storms resulting in erosion of shoreline habitats	x	x
Changed operations at the Western Treatment Plant decreasing nutrients and carbon	x	x
Toxicants from catchment inflows and stormwater	x	x
Emerging chemicals of concern from the Western Treatment Plant	x	x
Urban development: direct habitat removal and loss of buffer	x	x
Litter (including micro-plastics) effects biota	x	x
Invasive species: foxes and cats predating on waterbirds	x	x
Invasive species: salt tolerant weeds impacting saltmarsh and waterbird habitat	x	x
Invasive species: non-native grazing animals (rabbits and deer) impacting vegetation and habitat	x	x
Recreation: boats, jets skis, kite surfers disturbing waterbird feeding, breeding and roosting	x	x
Recreation: walkers, horse-riding disturbing waterbird feeding, breeding and roosting	x	x

Threats	Werribee	Point Wilson
Recreation: vehicles damaging saltmarsh		x
Duck hunting impacts to non-target species	x	x

Additionally, there are nationally significant wetlands in the areas consisting of:

- Permanent freshwater lakes
- Temporary freshwater swamps
- Temporary freshwater marshes and meadows
- Temporary saline marshes and meadows
- Temporary freshwater lakes
- Temporary saline lakes
- Coastal saltmarsh
- Estuary

It is understood that a portion of the coastal saltmarsh area within the GAEP (hatched area in Figure 5-6) has currently been marked to be excluded from the state's list of current wetlands, however, this wetland is still currently listed in wetlands of national significance. The study area is with 'Location 3' category which is defined as s locations where the removal of less than 0.5 hectares of native vegetation could have a significant impact on habitat for a rare or threatened species (Guidelines for the removal, destruction or lopping of native vegetation[5]). Therefore, any removal of native vegetion must follow the process ountilined in the guidelines for the removal, destruction or lopping of native vegetation which are incorporated into the VPP and all planning schemes in Victoria.

Avalon Coastal Reserve and The Spit Nature Conservation Reserve and Big Marsh are two of saltmarsh areas that have been investigated recently for impacts on ecological health of saltmarsh systems and their restoration. The Spit Nature Conservation Reserve and Big Marsh study (Taylor, Bachmann, Farrington, & Roberts, 2020) investigated the impacts of tidal flow restrictions caused by road infrastructure, streamflow diversion of Avalon Creek, seepage from T-sections lagoons, grazing by livestock and sea level rise on saltmarsh health and made recommendation for improvements. Parks Victoria, Blue Carbon Lab in partnership with UNSW Water Research Lab developed a Restoration Action Plan for Avalon Coastal Reserve to take an industrial wasteland (former salt works) and transform back into a natural wetland[6]. The study investigated six future management and tidal restoration options.

The significance of presence of important wetlands, raises the need for a detailed environmental values assessment and an environmental impact assessment to determine the areas of where the development can take place without degradation of these sensitive environments. Sufficient buffers should be placed around wetland alongside waterways with a detailed assessment (including but not limited to a environmental values and or environmental impact assessment) to understand the eco-hydrological impacts on these wetlands also needing to be undertaken. It should also be noted that like waterways, wetlands are generally associated with cultural sensitivity and cultural values.

[5] https://www.environment.vic.gov.au/__data/assets/pdf_file/0021/91146/Guidelines-for-the-removal,-destruction-or-lopping-of-native-vegetation,-2017.pdf
[6] https://storymaps.arcgis.com/stories/f44a22f56d264d0ea6bbcc09f6d78c5d

5.5.2 Flora and Fauna

Distribution of threatened vegetation communities and fauna species listed under the Flora and Fauna Guarantee Act (1988) is shown in Figure 5-7. There is a significant presence of Western Plains Grassland across the study area followed by some Coastal Moonah Woodland in the WTP area. The Western Plains Grassland has been identified as important environmental and cultural value to the Wadawurrung Traditional Owners. MW have confirmed significant presence of *Pimelea Spinescens* and Natural Temperate Grasslands of the Victorian Volcanic Plains within the WTP. It is understood that VPA are currently undertaking further biodiversity and targeted surveys for the GAEP area.

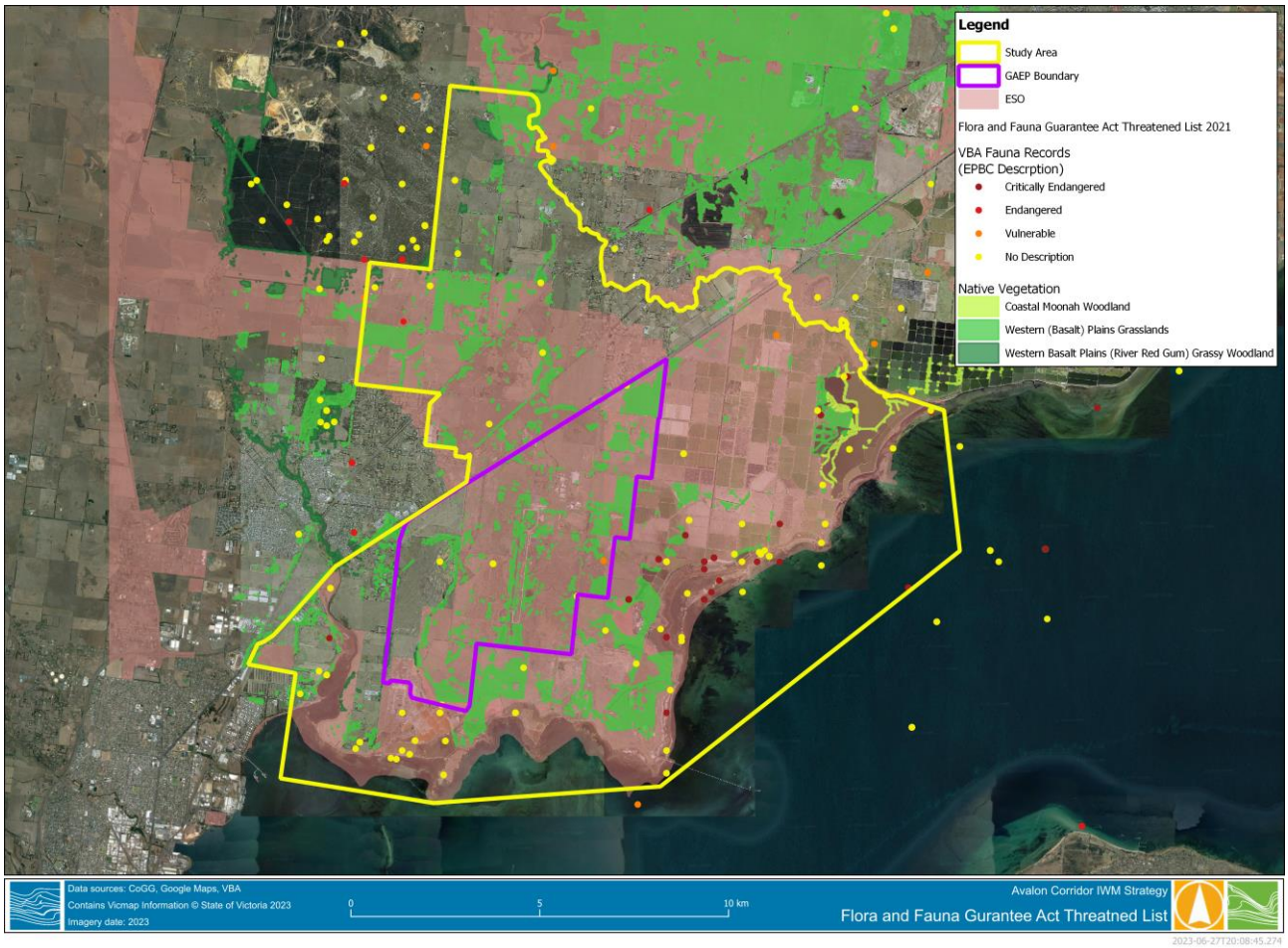

Figure 5-7 Flora and Fauna Guarantee Act Listed Communities

A total of seven EPBC listed fauna species were identified within the study area (Table 5-3). Additionally, there has been a significant rediscovery of Victorian Grassland Earless Dragon (VGED) in the region. The VGED was previously thought to be extinct, with the last recorded sighting in Victoria in 1969. The recent potential habitat map produced by DEECA shows the study area as a potential habitat (Figure 5-8).

The significance of presence of threatened flora and fauna species within the study area, raises a heightened need for a detailed environmental values assessment and an environmental impact assessment to determine the areas where the development can take place without degradation of these sensitive environments.

Table 5-3 EPBC listed Species

EPBC Description	Common Name (Scientific Name)
Critically Endangered	Orange-bellied Parrot *(Neophema chrysogaster)*
Endangered	Swift Parrot *(Lathamus discolor)*
	Regent Honeyeater(*Anthochaera phrygia)*
	Southern Giant-Petrel *(Macronectes giganteus)*
Vulnerable	Yellow-nosed Albatross *(Thalassarche chlororhynchos)*
	Growling Grass Frog *(Litoria raniformis)*
	Grey-headed Flying-fox *(Pteropus poliocephalus)*

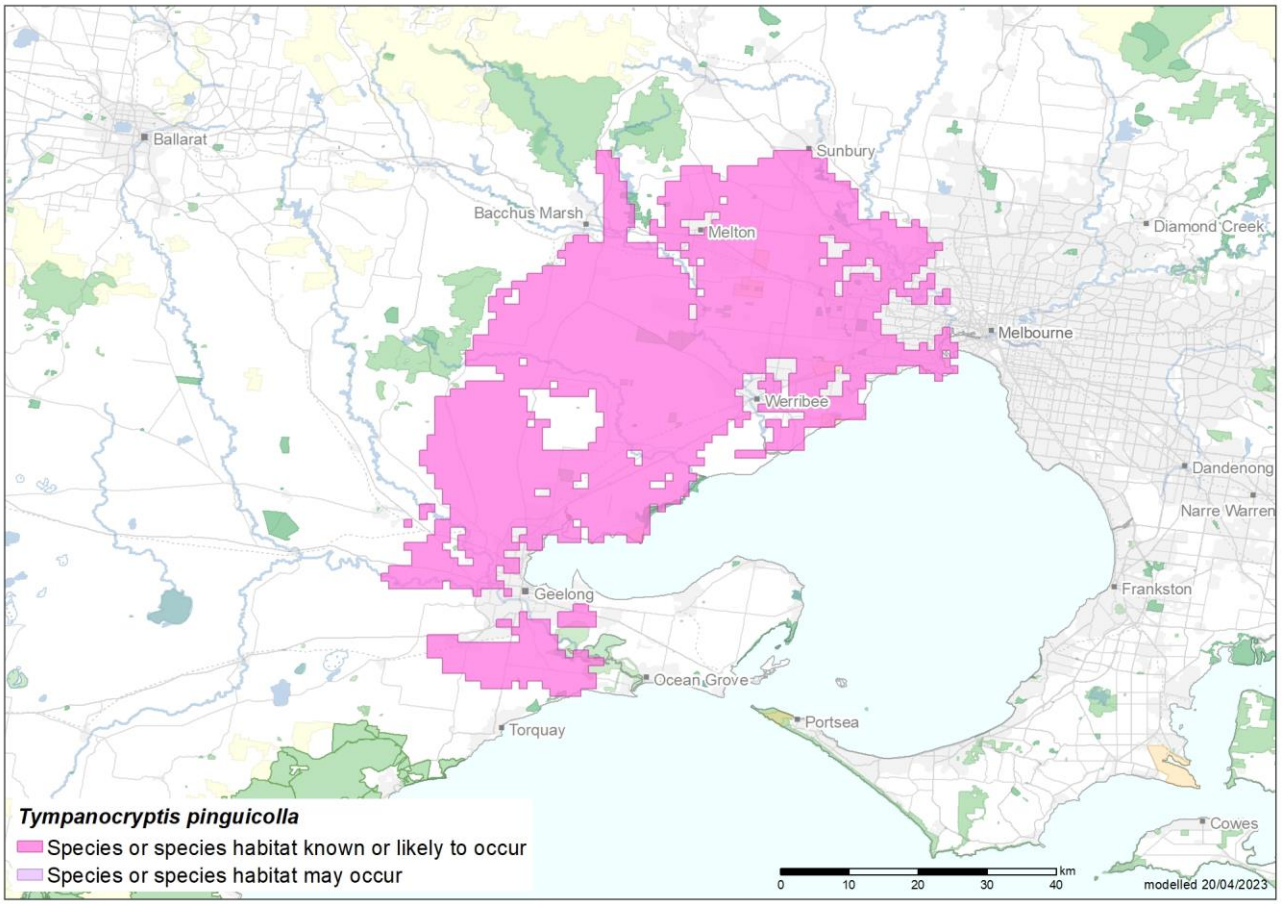

Figure 5-8 Victorian Grassland Earless Dragon Habitat (Source: DEECA)

5.6 Cultural and Heritage

Wadawurrung Cultural Values Statement of Significance

Mula mula-a Anakie Youang baa Wurdi Youang ngubitj-iyu baa maiwan parrarr Nerm baa Wadawurrung ngoon di kinkinbil bango di tonak baa benganak marlo, booyankal, tolam ngubitj baa lakoora-bul, wul-a baa karringa-a.

In the shadows of Anakie Youang / The Anakies and Wurdi Youang / You Yangs down to the waters and former grasslands of Nerm / Port PhillipBay and Corio Bay, this is a special place for Wadawurrung People and their animals, plants, birds, waters and skies; a place to care for and nurture.

Wadawurrung Traditional Owners Aboriginal Corporation

The majority of the study area, particularly downstream of Princess Highway is identified as areas of cultural heritage sensitivity (Figure 5-9). It is understood tha an Aboriginal Cultural Values Assessment to be undertaken by WTOAC to identify potential impacts on Wadawurrung living cultural heritage and the natural and avian environment. A pervious cultural values assessment (Unearthed Heritage, 2021) identified the Aboriginal Heritage Places likely to be located within the study area are to be:

- Isolated or very low density stone artefact occurrences: dominated by silcrete and quartz and dispersed across the flat volcanic plains with the majority in surface contexts and limited numbers in shallow subsurface contexts impacted by past agricultural activities.
- Moderate to high density stone artefact scatters: located in proximity to water courses, or on elevated landforms or a combination of both and dominated by silcrete and quartz in with the majority in surface contexts and limited numbers in shallow subsurface contexts impacted by past agricultural activities.
- There is low potential for scarred trees to be present, due to extensive past European vegetation clearance in the region.
- There is moderate potential for shell middens to be present along the coastline.
- There is moderate potential for ancestral remains/burials to be present in proximity to the coastline where sand deposits occur.
- There is moderate potential for stone artefact scatters to be located in proximity to the flats surrounding Wurdi Youang / You Yangs.

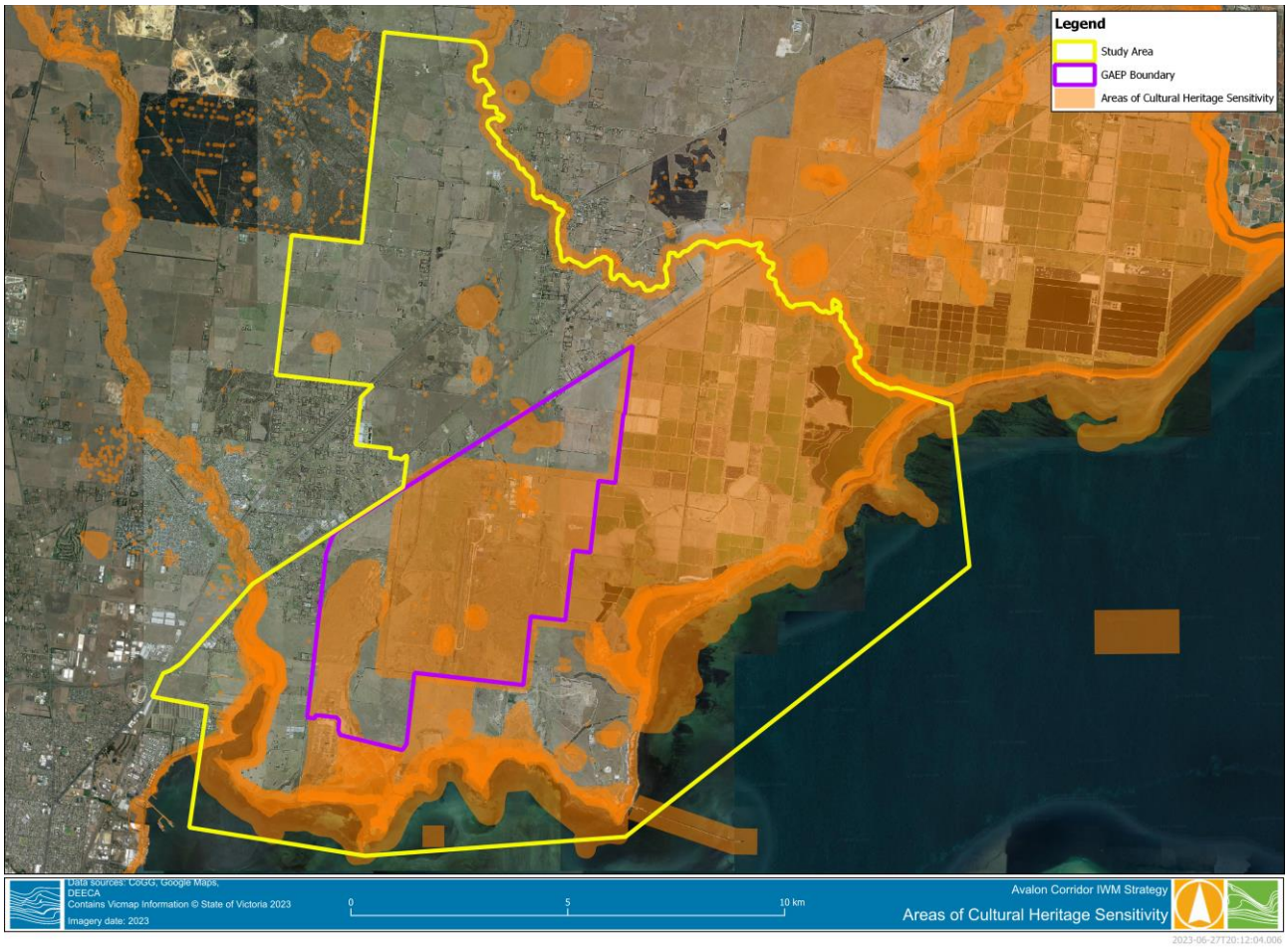

Figure 5-9 Areas of Cultural Heritage Sensitivity sites of importance

5.7 Flooding and Drainage

The current LSIO extent is shown in Figure 5-10. Overall, existing flooding information suggests that the study area is significantly impacted by flooding which will have a major impact on the development within this area. When considering riverine flooding impacts, coastal sea level rise (and its impact on stormwater and floodwater outlets), shallow groundwater, the presence of acid sulphate soils, Ramsar wetlands and vulnerable coastal saltmarsh ecosystems, as well as a flat gradient making drainage difficult, management of excess water will indeed be challenging and needs to be considered holistically.

The study area falls within the two catchment management authorities. The CCMA manage the Hovells Creek catchment portion of the study area while MW manage the Little River catchment. Existing flood mapping data and specific requirements for development within each CMA are summarised in sections below.

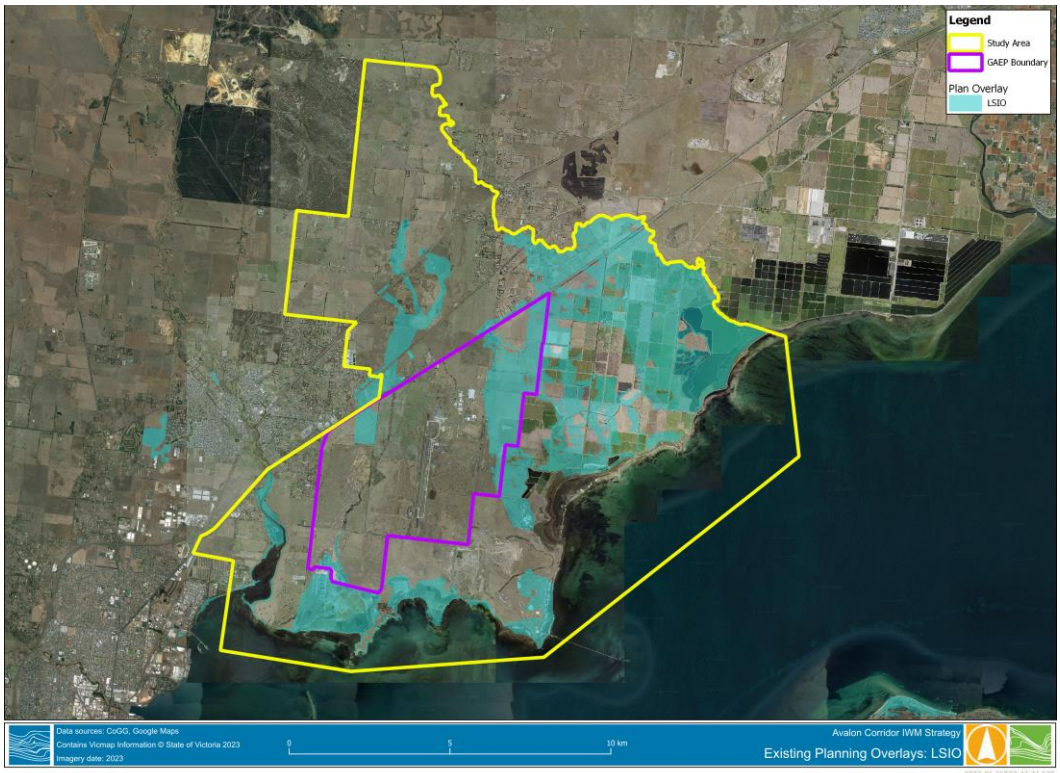

Figure 5-10 LSIO Extent

5.7.1 Hovells Creek Catchment Flooding

The Hovells Creek catchment was recently flood mapped as part of the Lara Flood Study, 2019. The detailed study provided flood depth, height, velocity and hazard information for a range of flood events including the 1% Annual Exceedance Probability (AEP) event and represents the best available flooding information for this catchment. A map of the 1% AEP flood depth across the Hovells Creek Catchment within the project area is shown in Figure 5-11. The results of the study indicate a number of areas within the project area where flood waters are shown to exceed 0.3 metres. This will need to be carefully considered (on top of stormwater impacts) to manage onsite and offsite flood impacts. Note that the CCMA generally require no offsite flood impacts as a result of development. If offsite flooding can't be avoided, then appropriate flood protections will need to be considered. Consideration will also need to be given to the environmental role of floodplains to slow down the floodwaters and filter out nutrients prior to discharge. Any proposal to manage the flood risk will need to be accompanied by an environmental impact assessment.

Additionally, the flood mitigation will need to consider the impacts of climate change on riverine flooding. Coastal sea-level rise also needs to be taken into consideration. Currently, the planning scheme requires planning for a 0.8 m sea level rise by the year 2100 (which impacts much of the site). However, this is expected to be raised soon to 1.1 m sea level rise by the year 2100. The CCMA would expect the 1.1 m sea level rise scenario[7] to be used for the PSP.

[7] The existing coastal flood information for this site comes from the Corio Bay Bellarine Peninsula Local Coastal Hazard Assessment, 2015 using a static (bathtub) model. This is not as accurate as dynamic modelling which takes topography and hydraulic controls into account. It is understood updated modelling may be available soon. The CCMA do not consider the current bathtub model to be accurate

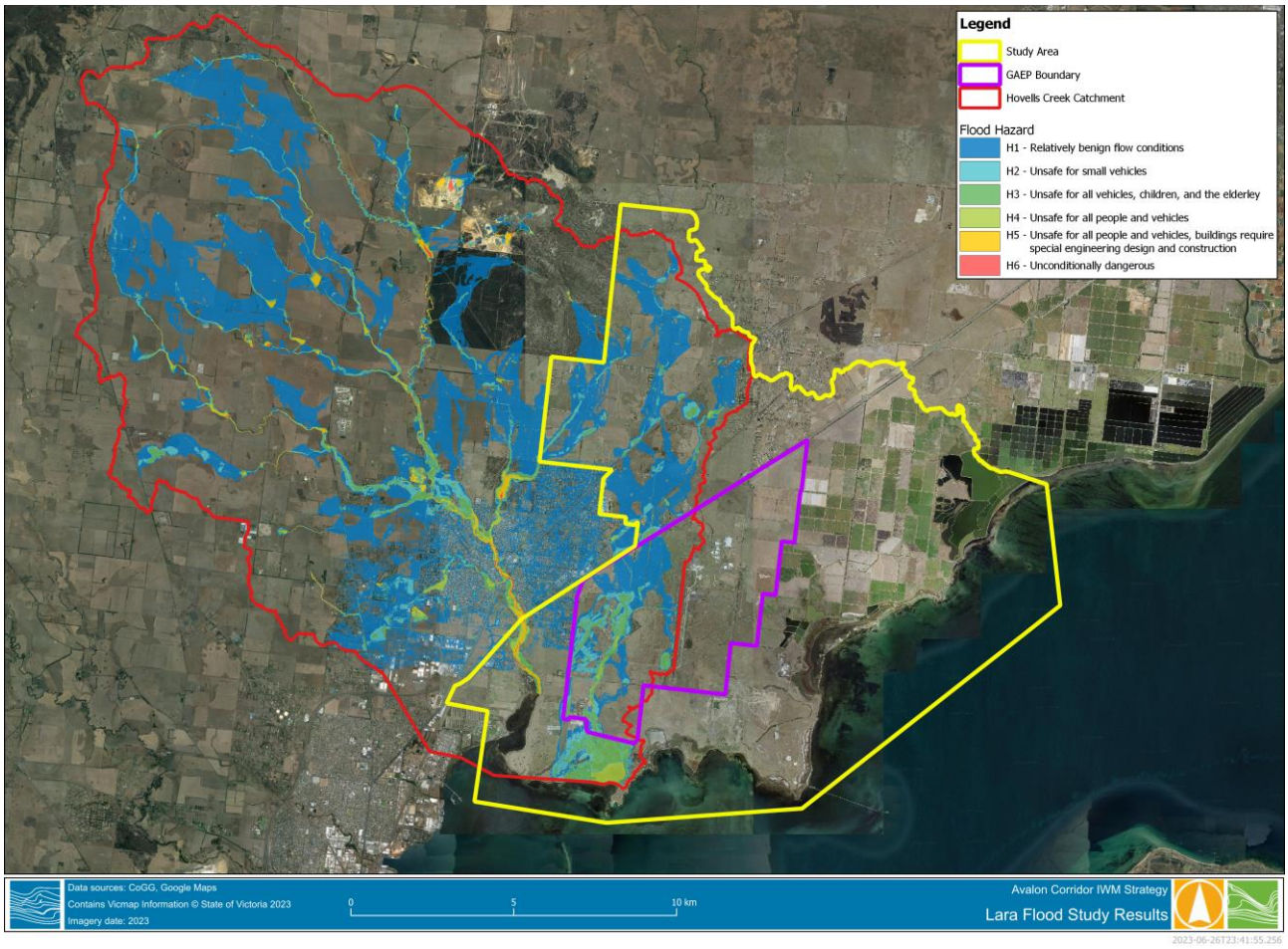

Figure 5-11 Lara Flood Study – Existing Flood Hazard

5.7.2 Little River Catchment Flooding

Available 1% AEP flood extent information for the Little River catchment was provided by Melbourne Water. This information is considered to be of limited reliability, but provides an indicative flood extent within the lower Little River catchment as shown in Figure 5-12.

Any development within the MW catchment would need to comply with DEWLP Guidelines for Development in Flood Affected Areas 2019, and demonstrate meeting 600mm freeboard, no afflux on private land, no loss in flood storage, meet downstream existing condition requirements for flow rate and volume, checking minor and major events up to 1% AEP, meet best practice SWQ treatment. In addition, consideration should be given to stormwater runoff discharging to MW catchment and to MW owned land that is presently leased to other parties (the lease term would need to be considered in consultation with WTP team and Melbourne Water Property team).

enough for use in design of the PSP. If no other coastal flood modelling is available, a conservative approach to setting development levels will need to be considered.

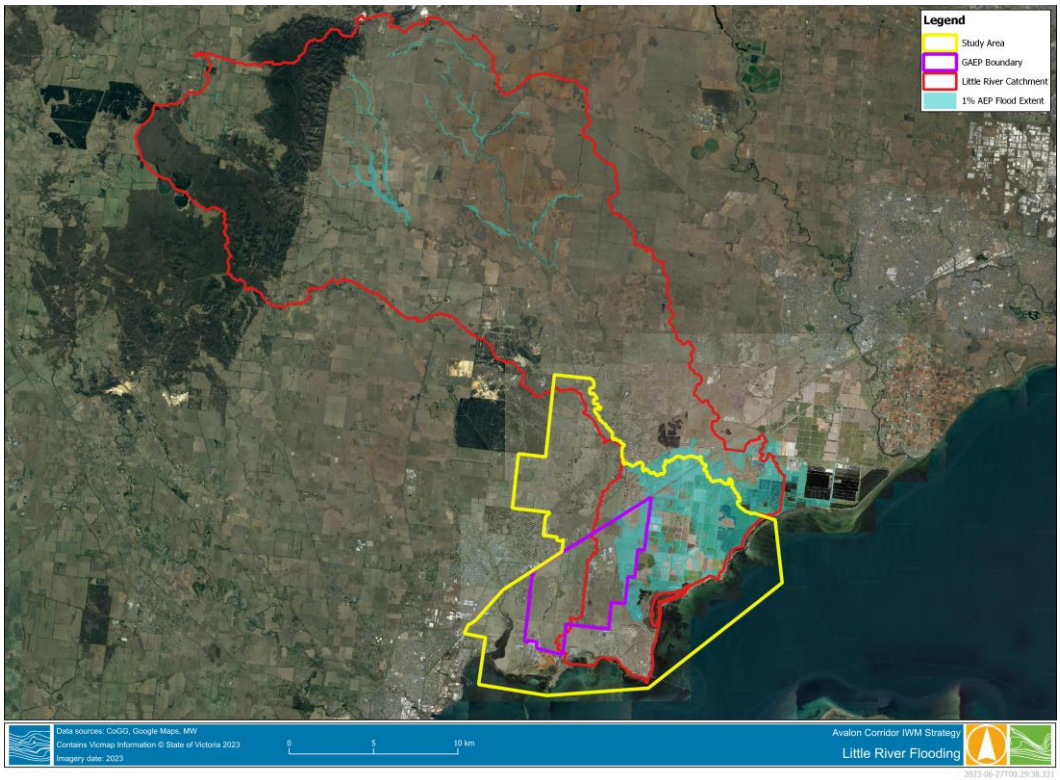

Figure 5-12 Little River Flood Extent

5.7.3 Existing Drainage Network

The extent of the Council drainage network is shown in Figure 5-13. It is evident that there is currently limited drainage pipes within the study area. The majority of the flood outlet locations for the catchments exist at the bay interface and are tidally influenced (GHD, 2021). Key issues relate to sediment in the runoff and the impacts of floodwater retention.

Significant upgrade to Council drainage infrastructure is needed to service the study area. Climate change-induced sea-level rise is predicted to reduce the discharge capacity of existing catchments and hence leading to increased retention (GHD, 2021).

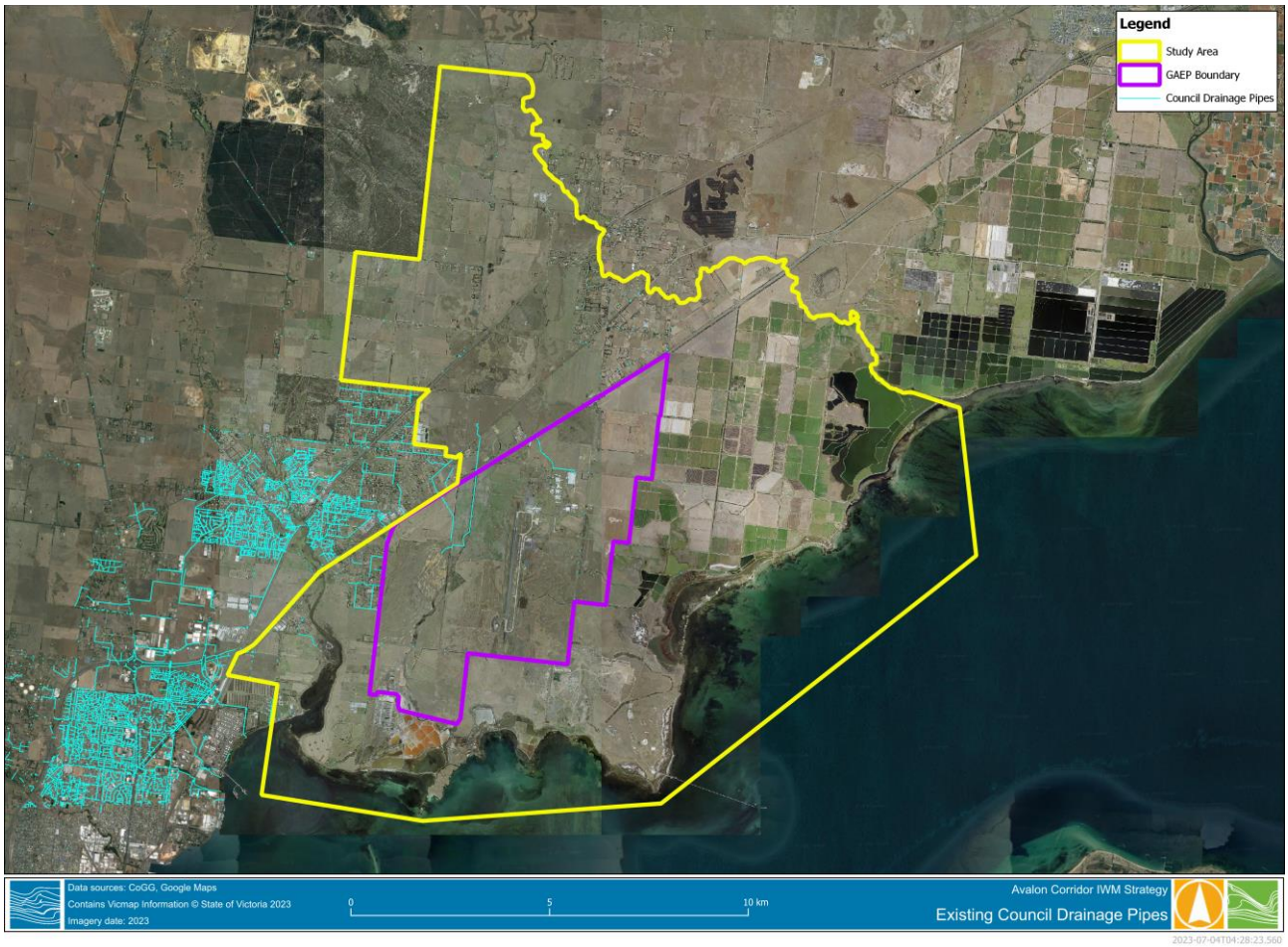

Figure 5-13 Existing Council Drainage Network

5.8 Groundwater

Shallow groundwater exists across the majority of the study area (Figure 5-14). The average depth to groundwater in areas downstream of the Princess Highway vary from 0.1 m to 17.5 m with and average depth of 2 m. Shallow groundwater will pose a risk for infrastructure and specially Water Sensitive Urban Design (WSUD) assets will likely need to be lined in response to the shallow groundwater within this area. Further to this, shallow groundwater will increase the exposure potential for groundwater to become contaminated from urban runoff. Potential groundwater impacts need to be considered as part of the riverine and coastal flood risk and should not just be considered separately.

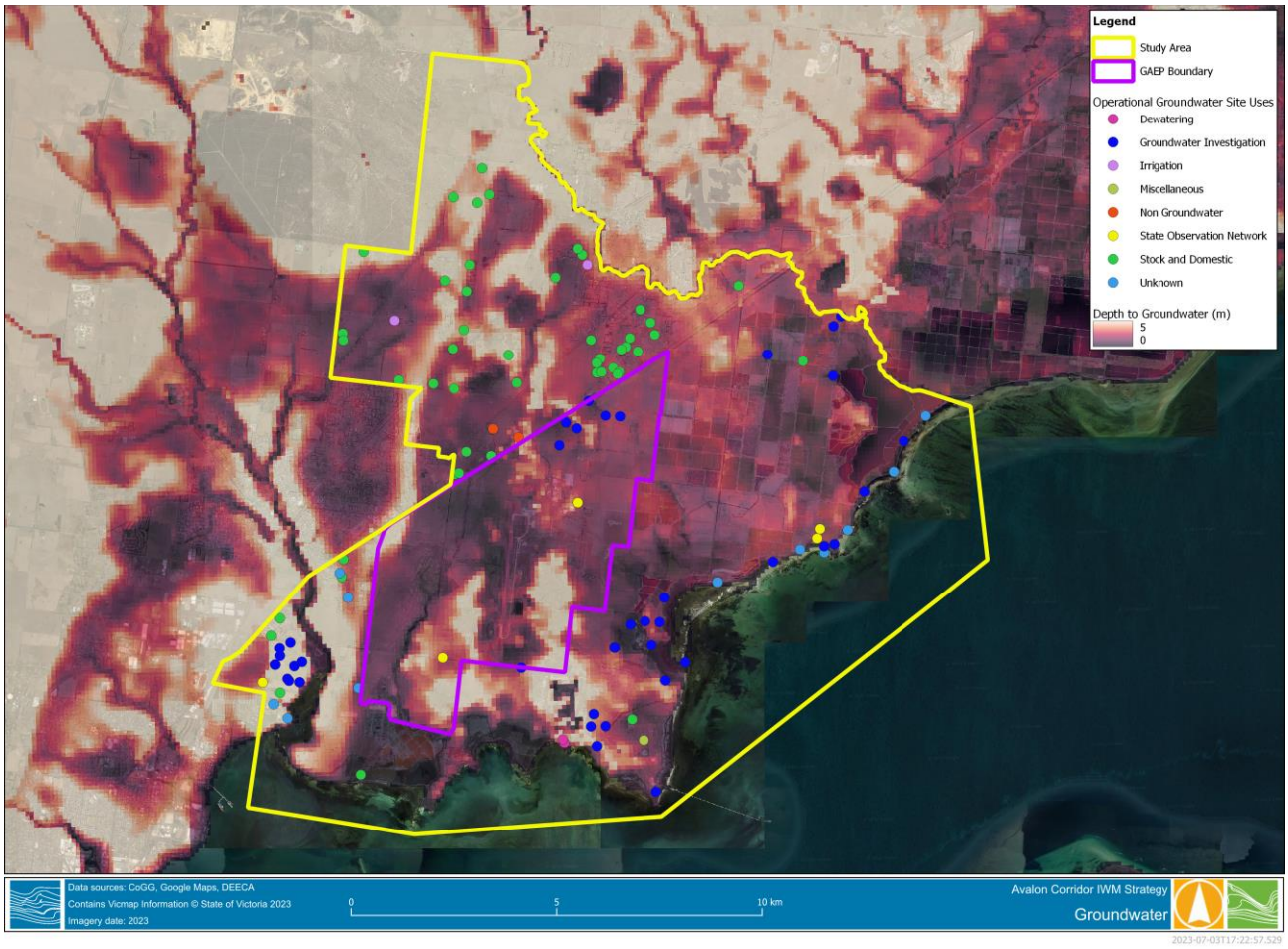

Figure 5-14 Depth to groundwater and operational groundwater sites

5.9 Water Supply, Sewer and Recycled Water

5.9.1 Water Supply

The study area is within the Barwon Water service area. There is limited water supply infrastructure located within the area and no sewer infrastructure currently servicing the site (GHD, 2021). Avalon airport is currently supplied via a single private connection, but this system is believed to be at or nearing capacity. Avalon Airport are currently connected to Barwon Water's water supply network governed by a Water Supply by Agreement (WSBA). Barwon Water guarantees minimum water pressure and quality requirements as per Barwon Water's Customer Charter at the point of Avalon Airport's connection (located on the corner or Princes Hwy and Beach Rd, Avalon). Beyond this connection point, Avalon Airport are currently responsible for managing water supply requirements to their individual tenants. Additional tenants/customers may require an alternative water supply and/or a change to the WSBA.

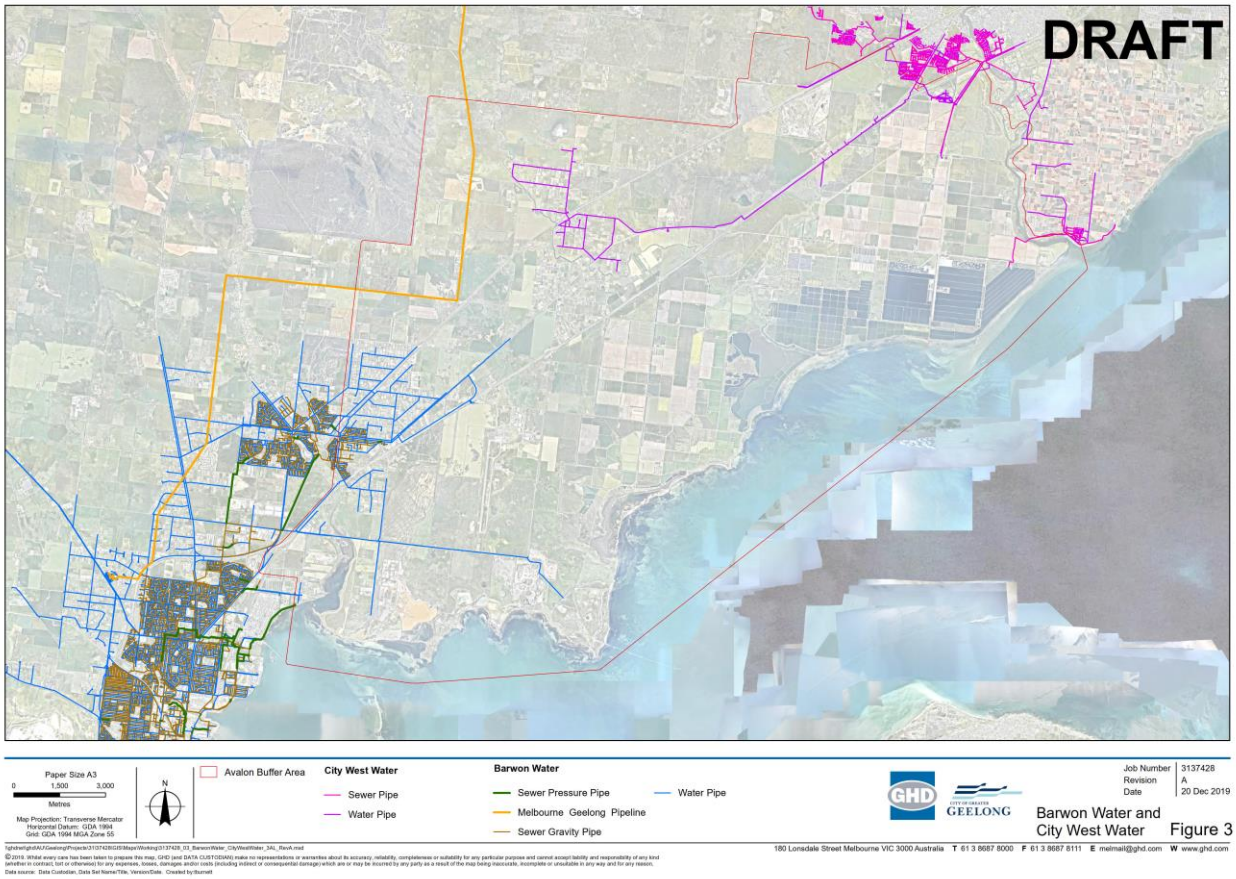

Figure 5-15 Existing Water Supply and Sewer Infrastructure (GHD, 2021)

Future service strategies are guided by the type of development expected in the area. In absence of sufficient information on development context, Barwon Water has provided some preliminary advice on potential service strategies. It is important note that these are preliminary advice only and subject to change as a result of further investigations.

Since the Avalon system is considered to be at its capacity, a new connection is required from Barwon Water's Lara/Lovely Bank supply network. This will require an extension to the existing DN600 Northern Feeder Main. Two potential alignments that have been investigated by Barwon Water are shown in Figure 5-16 and Figure 5-17. Furthermore, it is noted that the Department of Defence is constructing a new DN300 Barwon Water-owned pipeline along the Dandos Rd (between Avalon Rd and Pousties Rd) which is expected to be commissioned by end of 2023.

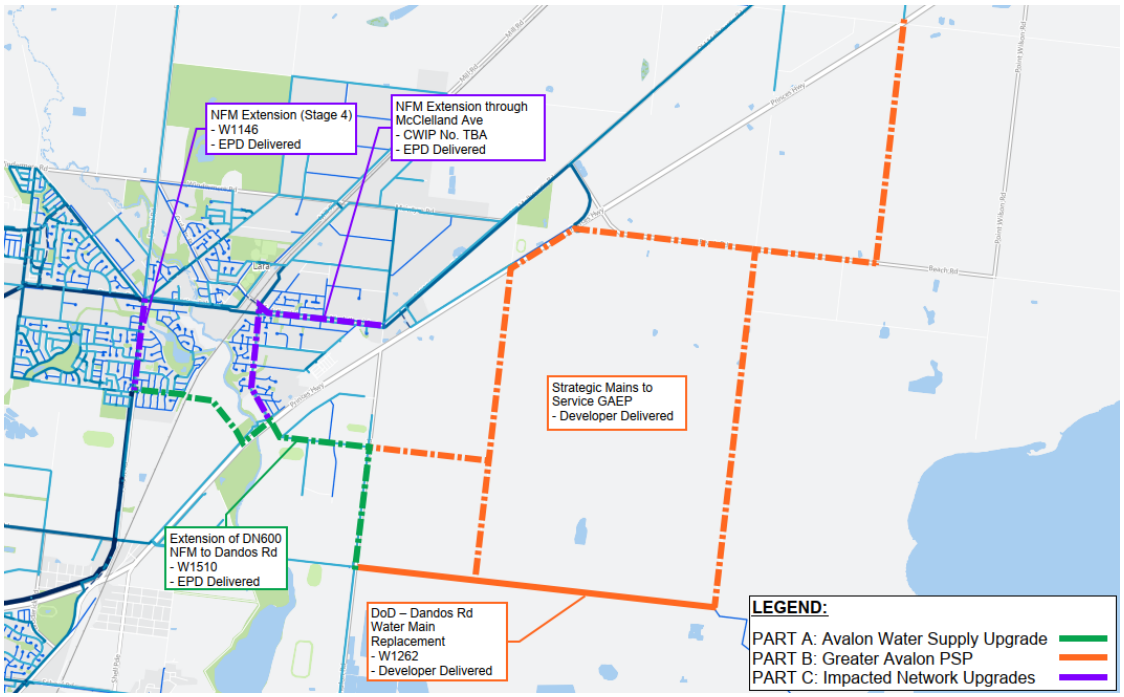

Figure 5-16 Potential Water Supply Alignment 1 (Preliminary option subject to further investigation. Source: Barwon Water)

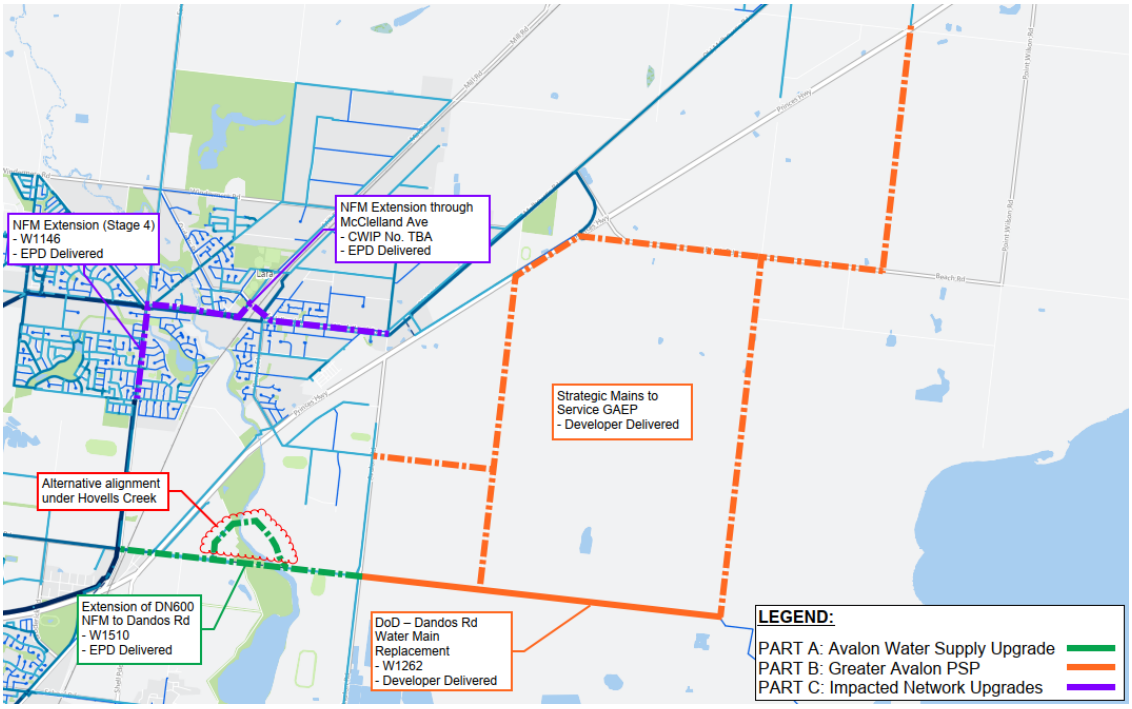

Figure 5-17 Potential Water Supply Alignment 2 (Preliminary option subject to further investigation. Source: Barwon Water)

5.9.2 Sewer Servicing

Currently there is no Barwon Water owned sewer assets within precinct and the existing properties except for Avalon Airport are serviced by septic systems. It is understood that Avalon Airport is managing their sewer on-site using a private treatment plant and it is possible that this will be the case for the proposed expansion of the airport. However, Barwon Water's strategic intent for the GAEP, is for all properties within the GAEP to ultimately discharge to BW-owned and maintained infrastructure. It is understood that interim arrangements may be required.

The sewerage strategy for the area is to be determined. Since there are no existing sewer assets, a new sewer servicing strategy will be required for the area. The nearest Barwon Water sewer asset that has capacity for additional inflows is 3.3km from the western boundary of the precinct (near Heals Rd and Forrest Rd intersections). However, two of the main constraints identified during previous investigations (GHD, 2021) and the current study are: flat terrain and insufficient capacity at existing wastewater treatment plants (WWTPs). The flat terrain would limit any future sewer system to be pressured system while WWTP capacity issues to be dealt with system planning (e.g. pumping at low flow periods) or new on-site treatment and reuse scheme. At present, Barwon Water is considering four potential options:

1. Send untreated sewer to Barwon Water system through Lara, where it could be transferred to the Geelong network or North Western Geelong Growth Area (NWGGA) Water Reclamation Plant (WRP) in ~2033
2. Send untreated sewer directly to Northern Water Plant (NWP).
3. Send untreated sewer to Melbourne Water network into Western Treatment Plant inlet (WTP).
4. Construct a new on-site WRP and send treated and disinfected wastewater to external customers, WTP lagoons or surrounding land within the corridor.

It should be noted that there are various sub-options with each of the above parent option.

5.9.3 Recycled Water Supply

The study area except for the airport is not supplied with recycled water. It is noted that the airport's recycled water system is managed privately and not by Barwon Water. Furthermore, it is noted that the study area was not considered in the NWGGA IWM strategy. The recycled water service strategy largely depends on the sewer servicing strategy (e.g. on-site WRP or connecting to existing recycled water network) as well as the stormwater strategy (e.g. availability of local stormwater harvesting and reuse). A local or regional recycled network could lower the potable water demand locally and externally.

A summary of highest potable water users in 2020/21 period is presented in Table 5-5 and Figure 5-18. A few of the highest water users such as the refinery, school and plant nurseries are located closer to the subject site indicating potential reuse customers. It should be noted that some of these highest users may already supplied with alternative water such as recycled water and rainwater. For instance, one of the highest water users, the refinery in Corio is understood to utilize approximately 1,300 ML/year Class A recycled water from the Northern Water Plant (NWP) (Rhys Bennet pers comms. 28/06/2023).

It is understood one the primary objectives of the IWMP is to provide a sustainable alternative water source to nearby agricultural land (north of Princess Highway). However, the cost of recycled water to support agricultural production in the Avalon Corridor remains an issue, with price exceeding farmers' willingness to pay (CoGG and WCC, 2022). Another important aspect of reuse demand for agriculture is the existing water sources being uses. For example, it is believed that much of the farmland to the north and east of the GAEP are supplied with recycled water from the WTP (as per information provided by Barwon Water). This was further confirmed by the Australian Bureau of Statistics Water Use data on Australian Farms for 2020-21 period (Table 5-4). These data revealed that agricultural areas in Lara, Geelong and Bacchus Marsh are already

supplied with alternative water sources such as recycled water and the potential for substituting potable water usage for agricultural purposes is limited except for Corio and Lovely Banks area.

Table 5-4 Agricultural Irrigation Water Supply Options in surrounding areas (ABS, 2022)

Water Source	Lara	Geelong	Corio – Lovely Banks	Bacchus Marsh
Irrigation channels or irrigation pipelines	0.1%	0.2%	0%	68%
On-farm dams or tanks	0.2%	8%	3%	0%
Rivers, creeks, lakes, etc.	0%	29%	0%	0%
Groundwater	0.3%	1%	41%	32%
Recycled/re-used water from off-farm sources	98%	74%	0%	0%
Town or reticulated mains supply	**1%**	**2%**	**56%**	**0%**

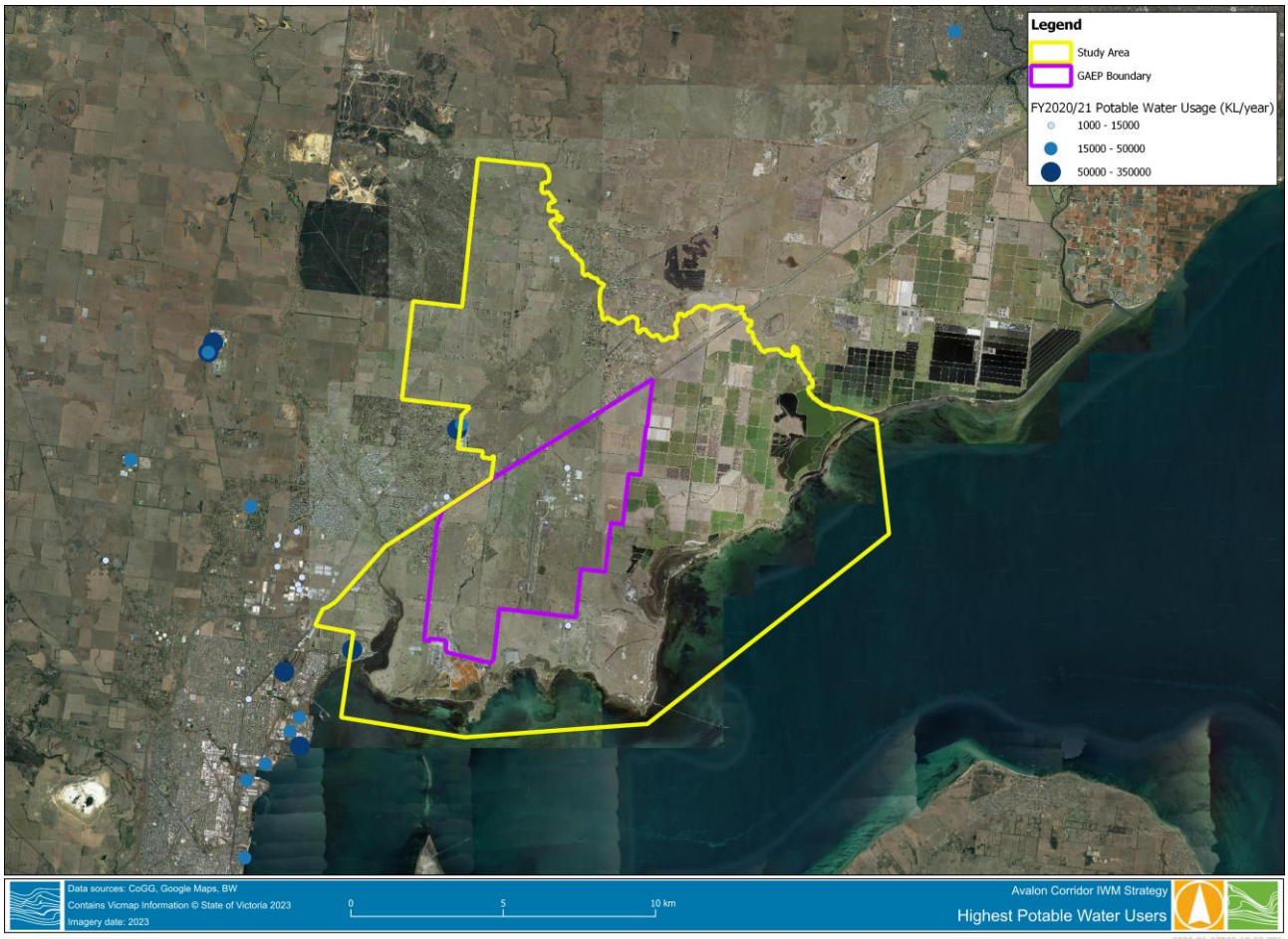

Figure 5-18 Highest Potable Water Users in 2020/21 (Source: Barwon Water)

Table 5-5 Highest Potable Water Users (Source: Barwon Water)

Property Type	No. of users	FY21 Water Usage ML/year
Refinery	2	361
Gaol	3	151
Factory	6	135
School	1	86
Plant Nursery	2	73
Unknown	5	61
Farms (with house)	2	58
Port	2	37
Golf Course	1	35
Vineyard	1	29
Parks, Gardens and Reserves	1	23
Horticulture	1	11
Agri-business	1	10
Commercial	1	10
Air Field	1	3
Total	30	1,084

5.10 Climate Change

Climate change predictions for Moorabool River basin indicates average air temperature will be increased by 1.4 – 2.2 ^{o}C (RCP 4.5 and 8.5 respectively) by 2065 (DELWP, 2020). The average rainfall is predicted to be decreased by 3.2 – 5.9% (RCP 4.5 and 8.5 respectively) by 2065 while the potential evapotranspiration rates will be increased by 5.3 – 7.7% (RCP 4.5 and 8.5 respectively) by 2065 (DELWP, 2020).

Climate change will have a significant impact not only on the water cycle but also the extent of the precinct. A Dryer climate will exert pressures on water resources and intensive rainfall events on drainage infrastructure. The sea level rise and coastal erosion will impact the coastal fringe of the precinct. Several different sea level rise scenarios were assessed the coastal hazard assessments (DELWP, 2017) (Figure 5-19). It is estimated approximately 1,360 ha (~6% of the precinct area) of the coastal land will be inundated due to predicated sea level rise in 2100. Victorian Resiliant Coast Guidelines (DEECA, 2023) recommend considering multiple planning horizons when planning for sea level rise in coastal areas. To enable consistency in adaptation planning across the state, the planning horizons in Figure 5-20 are recommended as a minimum.

Coastal erosion vulnerability index data (Figure 5-19) suggest that approximately ~1.5 km from the coastline has moderate vulnerability for erosion. Land downstream of the Princess Highway and to ~1.5 km from the coastline which comprise of the majority of the GAEP only has very low coastal erosion vulnerability. The highest erosion vulnerability is predicated at the mouth of Hovells Creek and along the downstream end of the Little River.

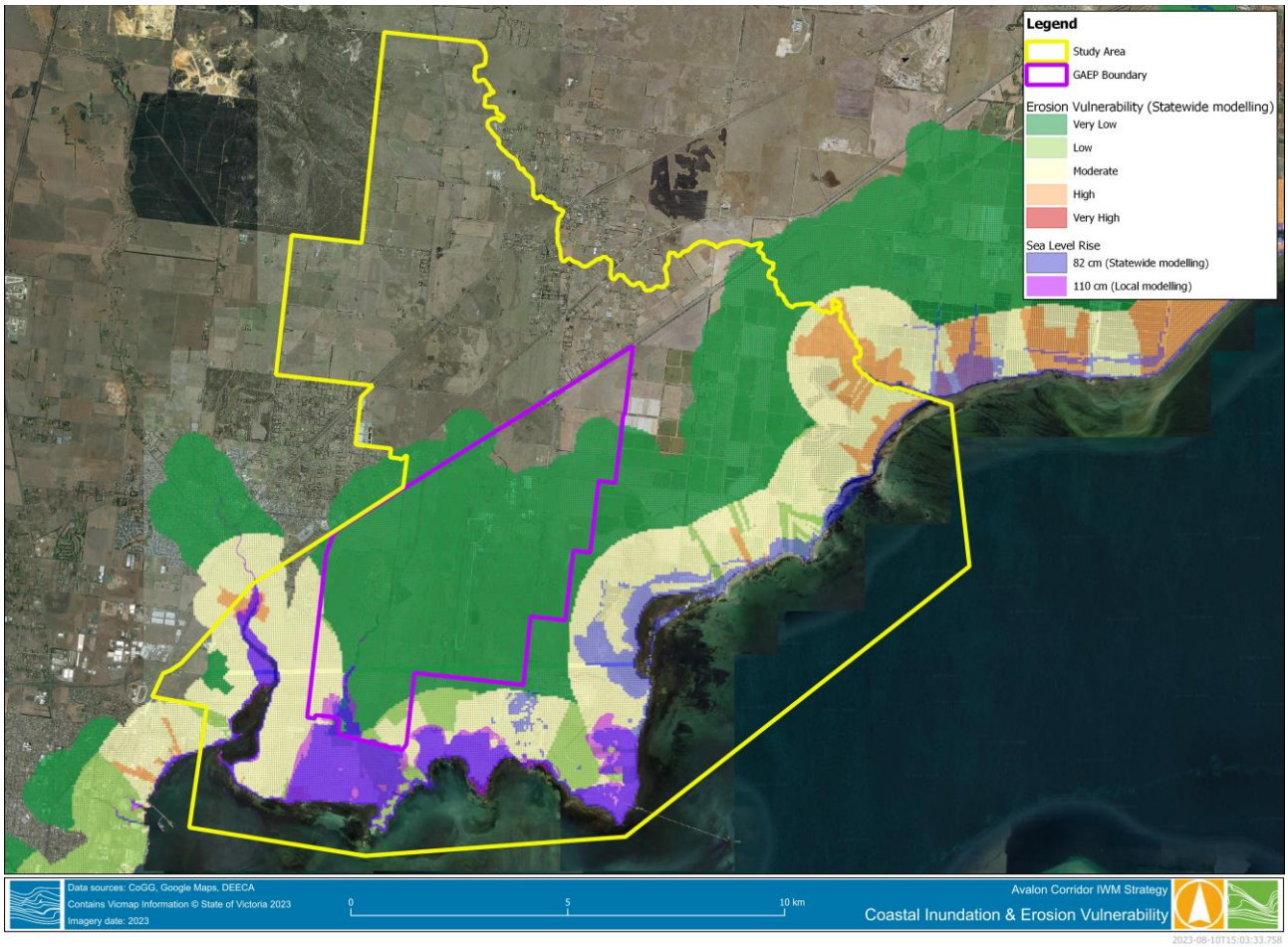

Figure 5-19 Coastal Inundation and Coastal Erosion Vulnerability due to sea level rise by 2100 (DELWP, 2017)

Period	Time step	Indicative horizon	Sea level rise*
Base line	Baseline of historic and current data	Present day ***	Mean Sea Level (MSL)
Short term	10 to 25 years	2040	MSL + 0.2m
Medium term	25 to 50 years	2070	MSL + 0.5m**
Long term	50 to 100 years	2100	No less than MSL + 0.8m by 2100
Sensitivity scenarios (examples)		2100	1.1m 1.2m 1.3m 1.4m

* Based on IPCC AR6 - subject to future updates in sea level rise benchmarking

** Where already available, 0.4m may be used

*** Baseline year set by technical analysis

Figure 5-20 Recommended Planning Horizons for Sea Level Rise (DEECA, 2023)

5.11 Bushfire Risk

Majority of the GAEP is identified to be within bushfire prone area (Figure 5-21). A bushfire risk assessment is needed to identify the areas of high risks and develop an appropriate management strategy. It is understood that VPA has commissioned a bushfire risk assessment for the GAEP area.

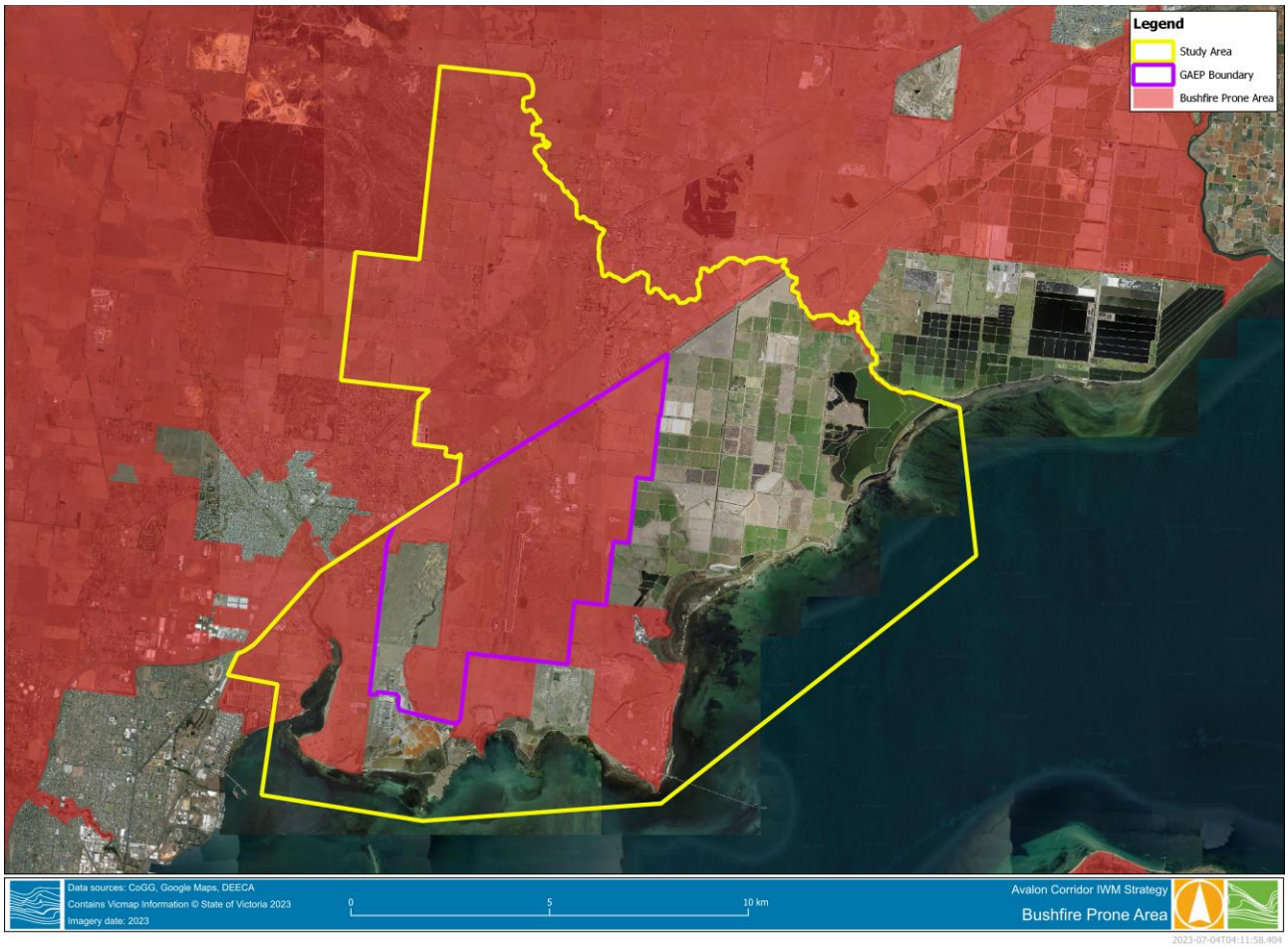

Figure 5-21 Bushfire Prone Area

5.12 Oil and Gas Pipelines

There are several critical oil and gas pipelines runs along the norther boundary of the GAEP (Figure 5-22). APA Group has two high-pressure gas transmission lines that run through existing properties within easements as well as along road reserves (GHD, 2021). Additionally, there are three main oil pipelines within the corridor that are owned and operated by VIVA energy. Any development adjacent to these pipelines must meet APA and VIVA energy standards. Given these pipelines are adjacent to the northern boundary of the GAEP boundary it likely that they do not have significant impact on the water management infrastructure within the GAEP expect for properties adjacent to these pipelines.

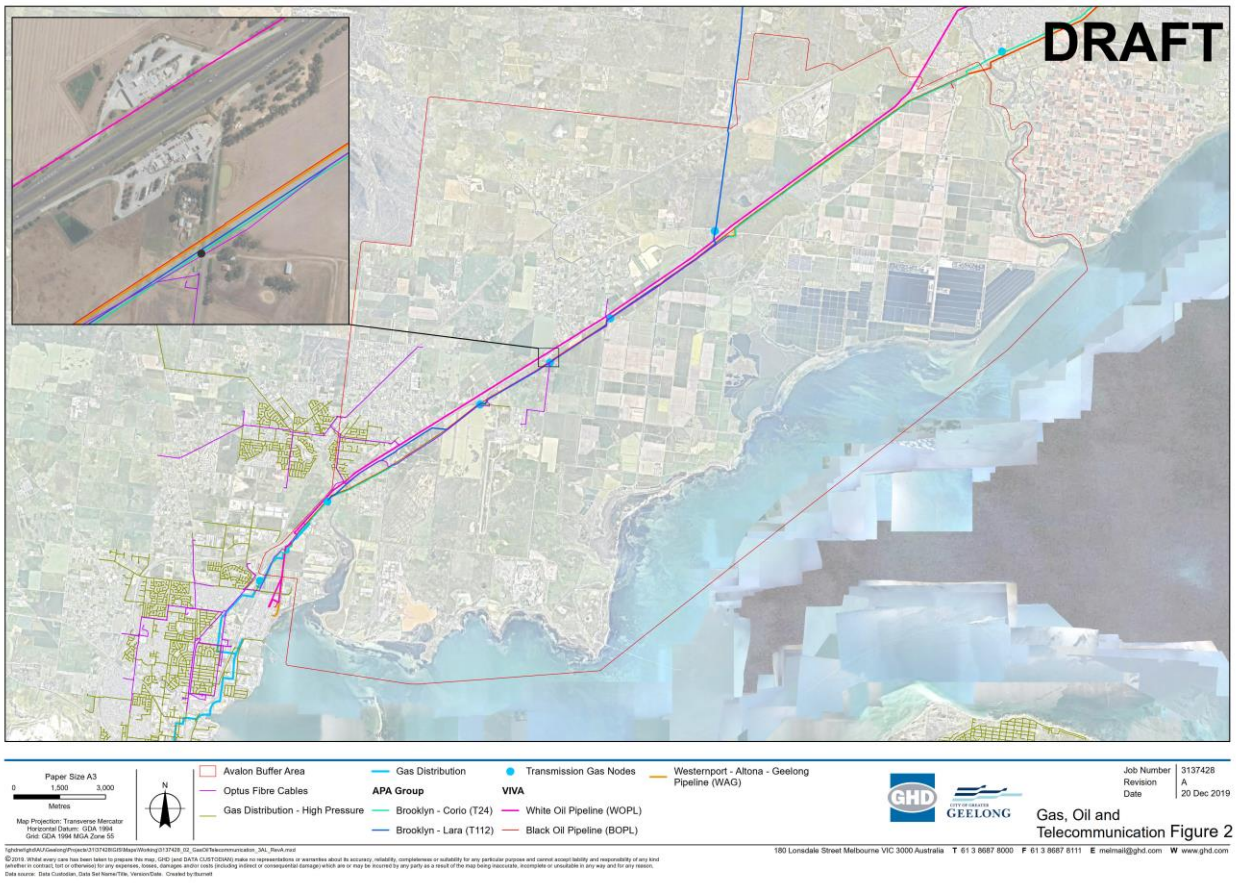

Figure 5-22 Existing Gas, Oil and Telecommunication Infrastructure (GHD, 2021)

5.13 Avalon Airport

Avalon Airport land occupies ~1,860 ha with the GAEP and comprised of 54% of the GAEP area. In 1997, Avalon Airport Australia Pty Ltd (AAA) acquired Avalon Airport from the Department of Defence through a 50 year lease agreement, with an option to extend for a further 49 years. Unlike other major capital city airports, as a Defence asset, Avalon Airport is not subject to the provisions of the Airports Act 1996. However, as a condition of lease, AAA is required to have an approved airport Master Plan in place at any given time that provides direction on the future development of the airport over a 20 year period. In addition, the airport is not subject to PSP process. The operations and future development within the area are subject to approval of the Department of Defence. Nonetheless the airport is an integral part of the Avalon Corridor and therefore maintaining a consistency in development character and IWM strategies is desired.

A significant expansion of the airport's operations, as well as the establishment of non-aviation related developments is planned for the airport. The Avalon Airport Master Plan was approved by the Department of Defence in September 2015 (Avalon Airport, 2015). It is understood the master plan is currently being updated at the time of reporting and the final version could be different to the 2015 version. An Ultimate Airport Development Plan shown in the Master plan (Figure 5-23). This plan accommodates aviation, commercial, retail and industrial development identified in this Master Plan as well as development well beyond its expiry. This plan illustrates the ultimate capacity of the airport, and represents the possible long term layout of the facilities well after the life of the Master Plan. The use of off airport land will be required to achieve the full capacity of this ultimate plan. Overall, a significant expansion of existing services and infrastructure is expected

over the coming years. Airport's approach for water, sewerage, stormwater and drainage and environmental management are of interest to IWMP development and hence the following sub-sections provide a summary of water and environmental management within the Avalon airport.

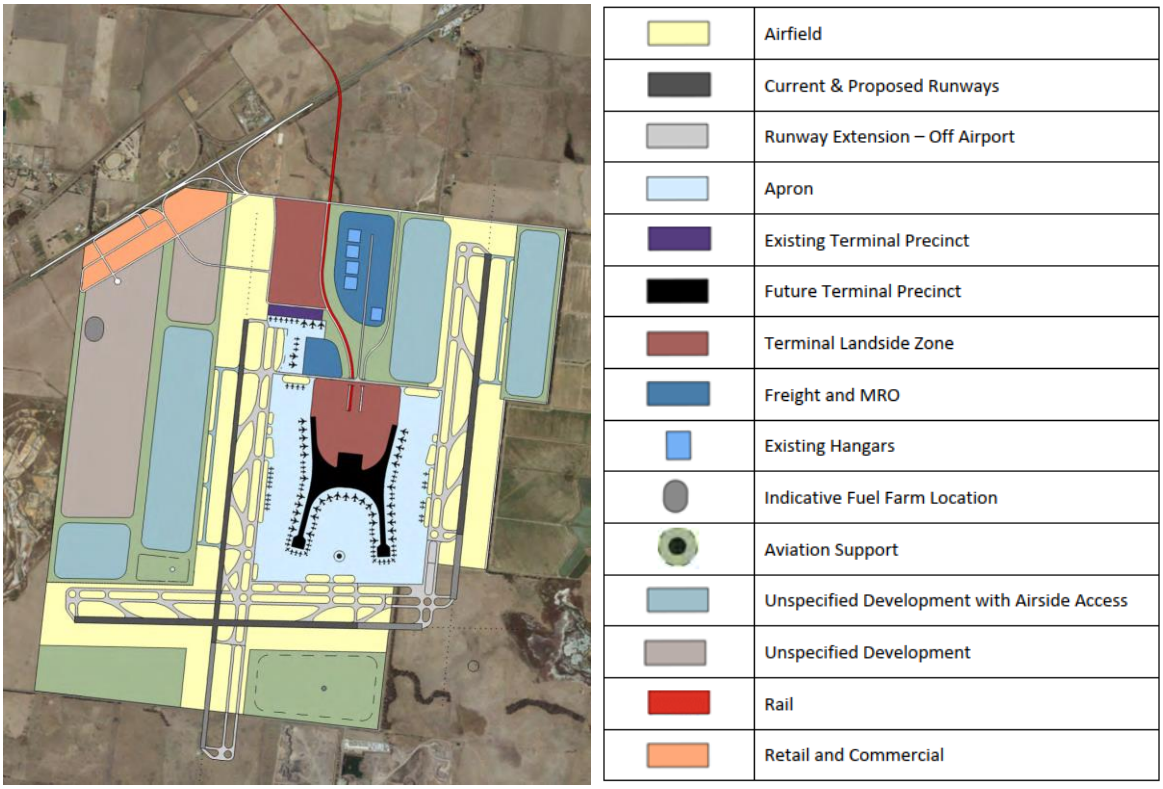

Figure 5-23 Ultimate Airport Development Plan (Avalon Airport, 2015)

5.13.1 Water

The existing water supply enters the airport boundary along the north-western fence line via a 100mm diameter pipeline extending from the Barwon Water system in Lara.

Within the airport complex, the supply pipeline provides water to West, South and East Pump Houses which in turn supply water to existing buildings and garden watering points. The domestic service and the fire service utilise the same mains supply. The airport has an estimated total system storage capacity of 1.5 ML.

While the capacity of the existing water system is adequate for current levels of service[8], future developments may require additional supply, storage and distribution infrastructure. No details of the proposed expansion of water infrastructure are available within the master plan and understood that these requirements will be assessed individually as part of development planning processes.

5.13.2 Sewerage

A septic tank system is used to collect wastewater from the airport premises. The septic tanks facilitate the primary sedimentation. Septic tank effluent is pumped to a treatment plant located south of the existing airport hangar precinct. The treatment plant consists of a trickling filter, humus tank and maturation pond. It is

[8] Barwon Water confirm that the development has progressed at Avalon Airport, the potable water supply at Barwon Water's connection point has not increased in the past. Barwon Water's understanding is that is that different areas of the airport facilities are buffered by various private infrastructure (tanks, pumps, etc.).

understood that the treated effluent is discharged in accordance with Environment Protection Authority (EPA) licence requirements. No information on any existing recycled water reuse is provided within the master plan, however, the Airport Environmental Strategy (Ecosure, 2014) refers to on-site reuse of treated wastewater for irrigating tree plantation area.

Any significant development outside of the terminal may require new wastewater treatment infrastructure or the addition of municipal sewer facilities. No details of the proposed expansion of sewer infrastructure are available within the master plan and understood that these requirements will be assessed individually as part of development planning processes.

5.13.3 Stormwater and Drainage

Land to the east of the runway drains directly to Pousties Road through natural landfall and a series of open cut and stormwater drains, while land to the west of the runway typically drains to the neighbouring property via Salt Creek. Existing flood information indicate a significant extent of the airport to be impacted by flooding (refer to Section 5.7). Subsequently, the foundations of existing hangars have previously been raised by approximately 500 mm, while the runway and associated taxiways are approximately 1000 mm above adjoining surface levels.

The master plan acknowledges potential impacts on the overall stormwater and drainage system due to proposed expansion, however, no information is available on proposed upgrades or changes to drainage management within the premises. It is critical that the stormwater be treated if possible, to avoid impacts of contaminants on the coastal saltmarsh and Ramsar wetland. A recent environmental site assessment conducted by MW has found the high level of PFAS in a drain receiving stormwater from Avalon Airport. Consideration should be given to creating vegetated buffer zones between the airport and key conservation areas such as saltmarsh.

5.13.4 Environmental Strategy

The Avalon Airport Environmental Strategy (Ecosure, 2014) was approved by the Commonwealth Government in 2014. The Strategy Period is 26 September 2014 until 25 September 2019. It is assumed a recent version of the Airport Environmental Strategy is in place or being updated in parallel to the master plan. However, such document is not available to public.

The 2014 strategy provides an overview of environmental features, along with the possible impacts which airport operations may have on each of these. Of particular interest to the current project, airport actively manage potential adverse impacts of water pollution by monthly surface water and groundwater monitoring, minimising wastewater discharges by promoting on-site reuse for irrigation.

5.13.5 Wildlife Strike Hazard Buffers

The National Airports Safeguarding Framework (NASF) Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports provides guidance on the land uses that present a risk of attracting wildlife and triggers (based on distance from an airport) for adopting active measures to mitigate that risk. Figure 5-24 is a copy of the tool given in the NASF guidelines to assess plans for new or revised land uses within 3 km, 8 km and 13 km of an airport. Figure 5-25 shows the corresponding 3 km and 8 km buffer zones of the Avalon Airport. It is evident that GAEP is within the 3 km buffer zone which suggests mitigatory actions are needed for any of the existing wetland conservation areas while the new wetland conservation areas are incompatible.

Land Use	Wildlife Attraction Risk	Actions for Existing Developments			Actions for Proposed Developments/ Changes to Existing Developments		
		3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)
Agriculture							
Turf farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Piggery	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fruit tree farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fish processing /packing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Cattle /dairy farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Poultry farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Forestry	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Plant nursery	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Conservation							
Wildlife sanctuary / conservation area - wetland	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Wildlife sanctuary / conservation area - dryland	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Recreation							
Showground	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Racetrack / horse riding school	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Golf course	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sports facility (tennis, bowls, etc)	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Park / Playground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Picnic / camping ground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Commercial							
Food processing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Warehouse (food storage)	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Fast food / drive-in / outdoor restaurant	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Shopping centre	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Office building	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Hotel / motel	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Car park	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Cinemas	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Warehouse (non-food storage)	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Petrol station	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Utilities							
Food / organic waste facility	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - landfill	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - transfer station	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Non-putrescible waste facility - landfill	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Non-putrescible waste facility - transfer station	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sewage / wastewater treatment facility	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Potable water treatment facility	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action

Figure 5-24 Wildlife Attraction Risks of Landuses surrounding Airports and Associated Level of Mitigation Actions Required

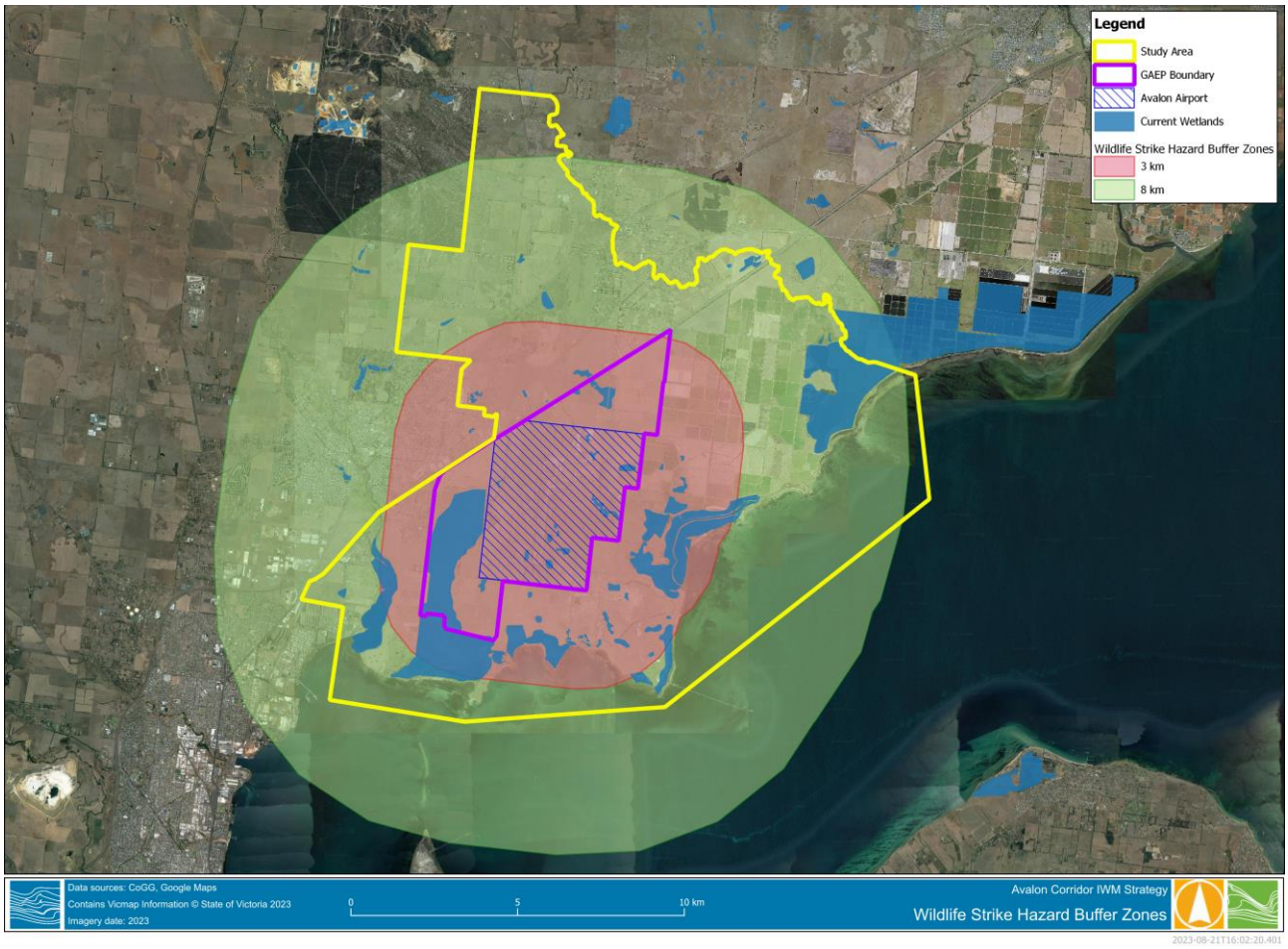

Figure 5-25 Wildlife Strike Hazard Buffers around the Avalon Airport

The NASF guidelines acknowledge that it may be difficult or impossible to change the existing usage of the land which serves as a wildlife attractant at many existing airports. Furthermore, risk mitigation measures are recommended to be considered when local authorities seek to establish land uses which may increase the risk of wildlife strike near existing airports. These measures should be developed in consultation with the airport operator and qualified bird and wildlife management experts and may include.

- a requirement for a wildlife management program;
- the establishment of wildlife management performance standards;
- allowance for changes to design and/or operating procedures at places/plants where landuse has been identified as increasing the risk of wildlife strike to aircraft;
- establishment of appropriate habitat management at incompatible land uses;
- creation of performance bonds to ensure clean–up and compensation should obligations not be met;
- authority for airport operators to inspect and monitor properties close to airports where wildlife hazards have been identified; and
- consistent and effective reporting of wildlife events in line with Australian Transport Safety Bureau guidelines.

5.14 Stakeholder Drivers, Initiatives and Limitations

This section summaries any additional considerations discussed with key stakeholders during initial consultation.

5.14.1 City of Greater Geelong

An online meeting was held with City of Greater Geelong on 22 June 2023. A summary of discussions around Council's vision for IWM and potential issues of concerns are listed below.

Values

- Sensitivity of receiving waters
- Environmental protection of Limeburners Bay
- Areas of cultural sensitivity

Concerns

- Development will increase stormwater volume and impact waterways
  - Need to consider ecological needs of the waterway
- Absence of regulatory enforcement of stormwater volumetric reduction targets
  - It is understood that DEECA is currently working on a framework to determine the priority waterways in regional Victoria
- Relatively flat surface will be challenging for stormwater infrastructure strategy
  - Council is committed to Melbourne Water Floodplain Management Strategy
- Stormwater harvesting is encouraged. However, there is uncertainty of asset/scheme ownership at different scales. Council's current suggestion is summarised as below.
  - Council will be the responsible authority for local stormwater harvesting schemes
  - Barwon Water to be the responsible authority for regional scale stormwater harvesting schemes
    - Potential to connect to existing Barwon Water sewer network for a shandied supply
      - *Barwon water have subsequently informed the existing sewer system is at capacity and could not accept stormwater*
    - Reclassification of recycled water may be needed if shandied supply is considered
- Lack of or limited consideration given to climate change impact on infrastructure design
  - Instead of focusing on a single point of time, need to consider different trajectories
- Uncertainty around the existing and future plans for the Avalon Airport

Opportunities

- Even though stormwater volume reduction targets are not compulsory under the current stormwater policy and regulations, consider volume reduction targets for the PSP
- Council is currently preparing the IWM strategy. It is aimed to present Council wide IWM targets and identify priority IWM projects of catchment management units.

Vision for IWMP

- Water management within the PSP is based on the ecological needs of the waterways

- No additional stormwater runoff volume discharging to waterways
  - Consider scenario assessment impact of different level of development on waterways
- Preference to keep stormwater within the landscape of irrigation, urban cooling and flood reduction
- Potential shandied wastewater and stormwater supply
- Consider climate change for developments from 2025 onwards and consider adaptive planning pathways

5.14.2 Victorian Planning Authority

An online meeting was held with VPA on 8 June 2023. A summary of key discussion points is presented below.

Concerns

- Two catchment authorities
  - GAEP is subject to two separate CMA areas (CCMA and Melbourne Water)
    - Some individual parcels are subject to two separate CMAs.
    - Each CMA has its own requirements for managing drainage.
  - Two separate DSS's are required to management catchment areas. One DSS is not good practice.
    - VPA would develop the DSS within the CCMA area.
- Development Contribution Plan (DCP) and Development Services Scheme (DSS) Cost Recovery
  - CCMA DSS would be covered by the GAEP DCP
  - Melbourne Water (MW) DSS would be covered through their own cost recovery scheme.
  - MW and CCMA have different policies for DSS development.
  - Creates issue for equity within DCP – under a standard approach, MW DSS landowner would be paying for drainage assets in CCMA DSS area. Bespoke approach for DCP required.
- Catchment Areas and Issues
  - Corangamite CMA
    - No DSS program by CCMA
    - Flood modelling undertaken in Lara Flood Study 2020 (pre-development)
    - Required modelling for post-development condition
    - Large wetland approx. 500 ha removed from DEECA mapping – potential issues with accommodating significant volume of water
      - Still waiting on federal outcome on EPBC
      - For the moment PSP design process is progressing with the assumption the wetland exclusion area is valid. Cheetham saltworks site is developable.
    - Downstream impacts (i.e. Ramsar sites)
    - Need for wetland and waterway buffer areas
  - Melbourne Water
    - No existing DSS. (There are several investigations that are either being developed in parallel to this IWMP such as GAEP PSP background investigations, Avalon Airport Master Plan, Barwon

Water's water and sewer strategy. These strategies and the proposed stormwater management plan are interconnected with the IWMP. and hence cross-collaboration)

- Flood modelling undertaken based on ARR2016. Riverine floodplains are identified based on existing conditions. (There may be gaps in extent of flood mapping on boundary of operational area)
- Update to ARR2019 is required
- Sea level rise/coastal impact is not considered a direct impact to the PSP area within MW operation area but sea level rise and coastal impact is considered a potential impact to drainage functional of shallow waterways and drains.
- Different flood-proof requirements. (e.g. 600 mm freeboard)
    - Local wetland eco-hydrology and downstream wetland and coastal saltmarsh eco-hydrology must be understood and accounted for in drainage planning, early guidance suggested increase in volumes of freshwater will be detrimental to the values/condition of vegetation and habitats.
    - Limited capacity of cut drains through WTP.
    - MW note criticality of maintaining the WTP's capacity to operate and function for treating half of Melbourne's sewage, including agricultural irrigation areas abutting the proposed PSP.

- Other
    - VIVA and APA gas pipelines – safety management works to follow.
    - Land capability assessment
        - LCA has been completed in July 2023.
        - Presence of sodic soils, salinity and groundwater are considered potential constraints.
    - Cultural Value Impact Assessment
        - It is understood that WTOAC would like to conduct their own assessment.
        - VPA has commissioned a desktop Due Diligence Assessment for the Co-Design Workshop.

5.14.3 Wadawurrung Traditional Owners Aboriginal Corporation

An online meeting was held with WTOAC on 21 June 2023. A summary of discussions related to key cultural values, concerns and opportunities to protect and preserve these values through IWM is presented below.

Values

- The main environmental values throughout the site relate to the natural environment those being the land and waterways, including Little River and Hovells Creek, salt marsh country, coastal country and significant grassland areas.
- Cultural flow – with the aim to maintain and or return to the natural flow regime (both quality and quantity). With respect to the waterways of this area the aim is to return water to waterways by enabling substitution of existing extraction demands with alternative water sources such as Class C water.

Concerns

- Diminishing environmental values with development in general, with development directly causing fragmentation of natural landscape corridors and contraction of existing valued natural areas impacting land and water (particularly RAMSAR wetlands), drastically changing the look and feel of country.
- Potential impact of untreated runoff quantity and quality on receiving environment (waterways, salt marsh, coastal wetlands)
- Impact of increased impervious areas and retention solution on the environment
- Impact of sea level rise and coastal erosion on coastal country
- Impact of illegal settlement on coastal wetlands
- Impacts of poor management practices on country which has identified environmental and cultural value

Opportunities

- An innovative research program looking into rehabilitating, enhancing and protecting saltmarsh and mangroves within the area for carbon sequestration (in collaboration with Deakin University and DEECA)
- Joint management of western grassland and other natural landscapes (opportunities for conducting biodiversity assessment, cultural burning activities, seed collection etc.) with existing land managers across the project area including potentially City of Greater Geelong, Parks Victoria, Melbourne Water and Corangamite Catchment Management Authority
- Conservation action plan with Park Vic,
- Protect and preserve the diminishing natural landscape corridors, giving them space to adapt
- Regional partnership on coastal management to address erosion, vegetation and inundation

Vision for IWM of PSP area

- Protect and preserve natural waterway flow regime by either returning water to waterways or managing wastewater/stormwater discharge (water quantity).
- Protect and preserve natural waterways, mangrove country and saltmarsh country from pollution (water quality)
- Protect and preserve coastal country from climate change impacts (inundation, vegetation recession and coastal erosion)
- Ensure the land and waterways or the area are managed with respect of country
- Adopt water sensitive design for the development and opportunities to serve environmental and cultural purposes (e.g. designing retention ponds to as stormwater control measures as well as habitat for migratory bird population)

5.14.4 Barwon Water

An online meeting was held with Barwon Water on 7 June 2023. A summary of discussions related to water supply and sewerage management and vision for IWM is presented below.

Concerns

- Uncertainty around the type of development expected with the GAEP
  - Water and sewer strategy depends on the type of users within the GAEP.
    - Typically it takes 6 – 12 months to develop service options.

        - This can be even longer if planning is multi-layered and complex, as is the case with the GAEP PSP
    - There is some informal information about a potential high water user (a battery factory) within the precinct.
        - Timing and sequencing of development is a significant issue. BW is not currently planning on building any new treatment plans of servicing this area .
- Cannot determine whether it is viable to extend the recycled water network in absence of any data on potential demand.
    - GAEP was not considered in NWGGA IWMP
    - NWP is currently operating at 1,200 – 1,300 ML/year and could be treated up to 1,900 ML/year
    - NWP will need expanding to accept ultimate sewerage flows from GAEP (not including stormwater)
- Avalon airport
    - Airport is currently supplied via a private supply. Avalon Airport store and distribute water within the premises.
    - They have their own wastewater treatment plant and use water on-site for irrigation
    - The airport has previously advised BW that it was not interested in additional recycled water for greening of the runway surrounds (at the time). Uncertainty around the road infrastructure.
    - Road ownership can be a complex issue when delivering the service strategy
        - Road ownership can generally govern pipe ownership. That is, BW-owned mains will extend through formal road reserves (i.e. owned by Council), but private infrastructure may likely extend through private roads instead).
        - As the Avalon site is wholly owned by defence, Council roads in the area are unlikely.

Vision for IMWP

- Preference is Barwon Water to be the responsible authority for water, sewer and recycled water within the area and maintain the consistency and quality of supply
- Use of alternative water sources is desired with IWM options written into PSP documents

5.14.5 Melbourne Water

An online meeting was held with MWC on 27 June 2023. It is noted that the representatives from the IWM or WTP operation teams were not present in the meeting, therefore a follow-up with relevant MW representatives regarding the IWM and WTP operation related queries is needed. A summary of discussions related to general MW operations and requirements are summarised below.

Values

- WTP is part of a significant environmental asset (Ramsar Wetland) and therefore it is a MW priority to maintain and protect heritage, biodiversity and environmental values of state, national and international significance.
- The criticality of maintaining the WTP's capacity to operate and treat more than half of Melbourne's sewage, including agricultural irrigation areas and associated drains abutting the PSP.

- If a DSS is developed for the area, the level of stormwater treatment and volume management will be governed by the need to protect the environment which includes natural wetlands, waterways, coastal environs and Ramsar wetland area.

Concerns

- MW is concerned about the changes to the stormwater runoff quantity and quality entering the WTP and other waterways that interact with wetlands and coastal areas from development
  - MW preference is to have no changes to the existing runoff volume and quality.
- Relevant MW representatives (IWM, WTP operations) needed to be involved in the IWMP development process
  - Avalon Corridor IWM is not listed as a prioritised IWM project at present. The project status is currently impacting MW resource allocation to progress MW's own investigations.
- Complexities around funding and asset ownership due to presence of multiple agencies (two local governments, two water authorities and two CMAs)
- MW is unaware of any preliminary sewerage and recycled water options assessments for the area.
  - Due to sensitive nature of WTP, the potential to receive additional treated/untreated wastewater from the GAEP is currently unknown.
    - *It is understood that BW has lead initial discussions with MW around the option to send treated/untreated effluent to WTP and will develop the feasibility further.*
    - *Initial discussions did not raise any immediate concerns should that option be preferred.*

Opportunities

- MW will consider developing a DSS if requested form VPA and/or Council, this will support more timely input and response to complex drainage issues and a funding mechanism for investigation, design and construction of drainage assets (generally no IWM included)
  - If no DSS, MWW will continue to have input as waterway and floodplain authority and land manager of WTP into PSP drainage planning and downstream waterway requirements.
- MW land in the study area is currently leased land leased predominantly for irrigation and hay production and as pasture.
  - WTP wastewater influent and effluent reuse data are summarised in Table 5-6 (data obtained post stakeholder meeting via MW Open DataHub[9])
- MW is planning to update its flood mapping for the region within the next 3 – 5 years timeframe

[9] https://data-melbournewater.opendata.arcgis.com/

Table 5-6 WTP Recycled Water Usage

Year	Onsite	Supply to City West Water	Supply to Southern Rural Water	Grand Total
2013	8439	266	2376	11081
2014	9401	394	2236	12031
2015	10530	316	4021	14867
2016	15661	282	5940	21883
2017	12441	376	5170	17987
2018	13254	261	6944	20459
2019	19770	452	6431	26653

6 IWM BASE CASE

An IWM base case is the reference scenario to which different IWM options will be compared against. The base case itself is an option which usually represents the business as usual option. It consists of assumptions on guiding principles and key infrastructure requirements to manage whole of water cycle such as water supply sewer and stormwater management and climate change considerations.

The proposed draft IWM base case of the study area is summarised below. It is informed by the stakeholder discussion and generally aligns with the current approach for stormwater management, water supply and sewer management in typical development except for additional requirements for volume management. It is acknowledged that due to significant environmental and cultural sensitivities of the area, additional measures are likely to be needed to manage potential risks.

Key assumptions related to development extent and water cycle management considerations are listed below:

- Development is limited to industrial precinct in the area identified within the GAEP and proposed expansion of Avalon Airport.
- No residential development within the study area
- Barwon Water will be the responsible authority for water supply and sewer management.
  - Potable water supply will be through extensions and upgrade to existing water supply infrastructure servicing Lara area.
  - New pressure sewer system will be servicing the area. Sewerage will be send to Barwon Water system through Lara could be transferred to the Geelong network[10].
  - The area is not serviced by recycled water.
- City of Greater Geelong will be the responsible agency for the drainage management.
  - Stormwater will be treated to current best practice management targets unless detailed assessment indicates that higher levels of treatment are required:
    - 80% reduction in post-development Total Suspended Solids (TSS)
    - 45% reduction in post-development Total Phosphorus (TP)
    - 45% reduction in post-development Total Nitrogen (TN)
    - 70% reduction in post-development Gross Pollutants (GP)
  - Discharges for a 50%AEP should be maintained at pre-development levels for stormwater treatments.
  - Post-development annual runoff volume does not exceed the pre-development volume unless otherwise informed by detailed environmental assessment.
- CCMA and MW will be the responsible floodplain management authorities
  - Development will not worsen the existing flooding within the GAEP and surrounding area
  - Post-development peak-flow rates up to and including 1% AEP event will be kept at or below pre-development levels.

[10] It is noted that BW are currently investigating the sewer strategy options for GAEP and this may not be the preferred option.

6.1 High-Level Pollutant and Water Balance

A combination of MUSIC (Model for Urban Stormwater Improvement Conceptualisation) modelling and high-level calculations of potable water and wastewater volumes was used to derive a high level pollutant and water balance for the area. Please refer to Appendix D detailed assumptions and calculations.

Figure 6-1 and Table 6-1 summarises the pollutant loading estimated under the existing and post-development (without any mitigation) scenarios. In general, an increase of sediment and nutrient loading is expected due to significant increase in impervious area within the overall GAEP area. A WSUD strategy will be implemented to reduce pollutant loading to meet the BPEM targets. Further details of the WSUD strategy are presented in Section 6.2.

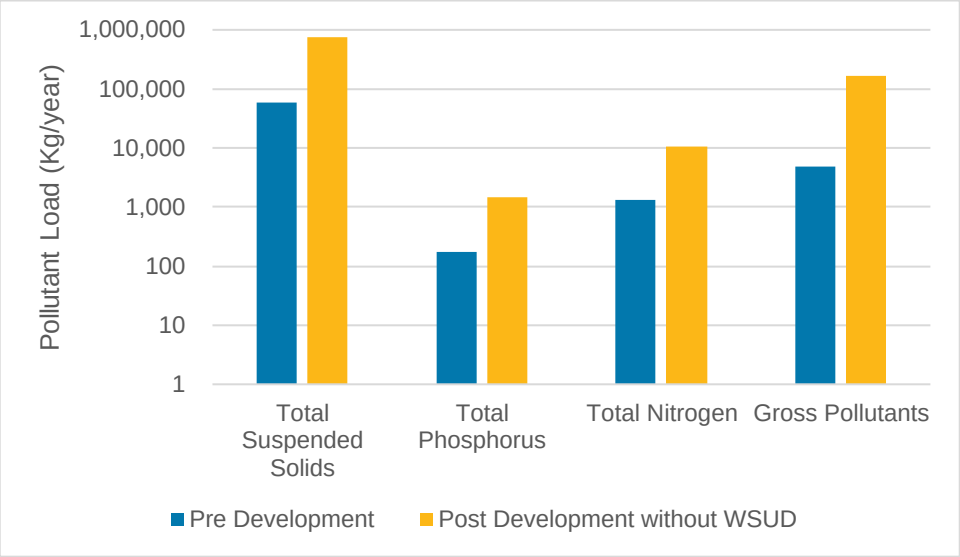

Figure 6-1 Stormwater Pollutant Comparison

Table 6-1 Pollutant Load Summary

Pollutants	Existing (kg/year)	PostDev without mitigation (kg/year)	Increase in pollutant loading
TSS	893,000	2,300,000	158%
TP	2,310	5,060	119%
TN	17,100	36,200	112%
GP	102,000	427,000	319%

Initial MUSIC modelling suggests the average annual stormwater runoff volume will increase from 5,490 ML to 12,900 ML with the proposed development (without any WSUD or volume management strategies).Under the assumed condition of no increase in post-development runoff volume, an additional 7,410 ML/year needs to be retained/diverted away for the downstream receiving environment. Refer to Section 6.2 for further details of volume reduction strategy considered for the base case development.

Water demands and potential alternative water sources available in the study area was also considered. BW notes there is significant difficulty in estimating the water demand (potable and alternative) for the GAEP (including Avalon Airport Masterplan) given the level of uncertainty around the development. Similarly, there is a greater uncertainty in estimating reuse demands of the nearby agricultural land due existing alternative

supply availability to (Figure 6-2). Therefore, the current water balance is only a high-level estimate. Refer to Appendix C for detailed assumptions adopted in estimating these demands.

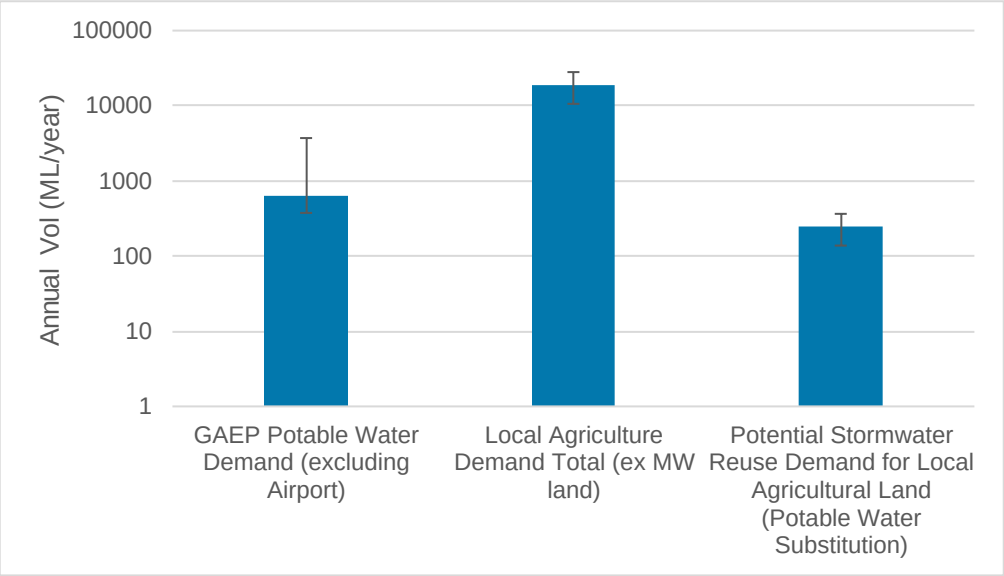

Figure 6-2 Uncertainty in Demand Estimates

Under an average water usage scenario, the total water demand for the whole study area was estimated to be ~37,500 ML/year with 98% of the demand originating from agricultural irrigation (Figure 6-3). On the other hand, the total volume of alternative water source available was estimated to be ~21,500 ML/year. On average ~63% of the alternative water comprised of wastewater.

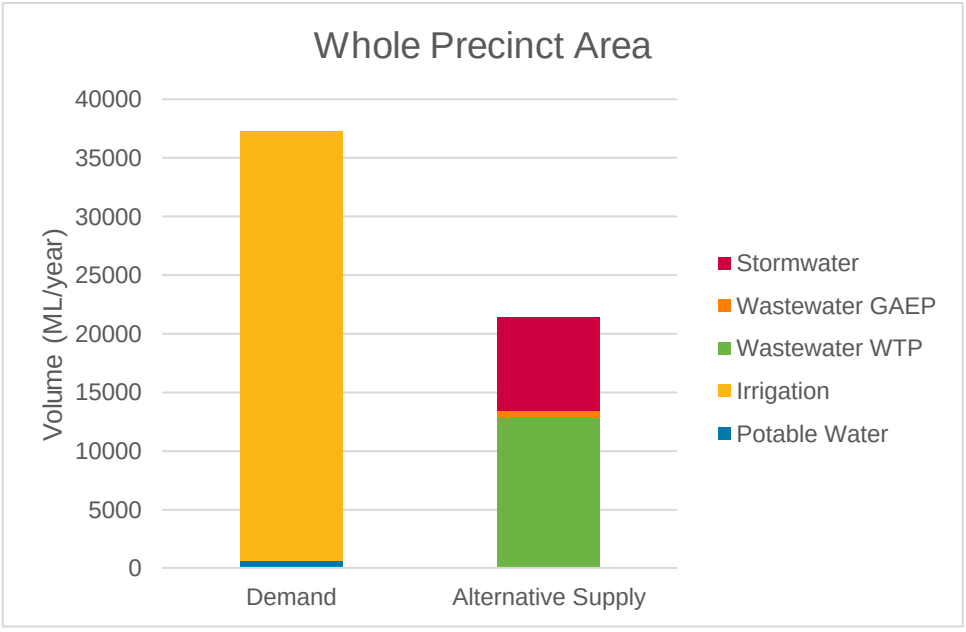

Figure 6-3 Future Water Demand and Potential Alternative Water Supply Options (Whole Study Area)

Since Melbourne Water WTP has its own recycled water supply and on-site irrigation. A separate analysis was conducted excluding Melbourne Water land (Figure 6-4). The total water demand was estimated to be ~19,900

ML/year of which 96% was generated through agricultural irrigation. Similarly, the available alternative water volume was decreased to 8,700 ML/year of which only 8% consist of wastewater.

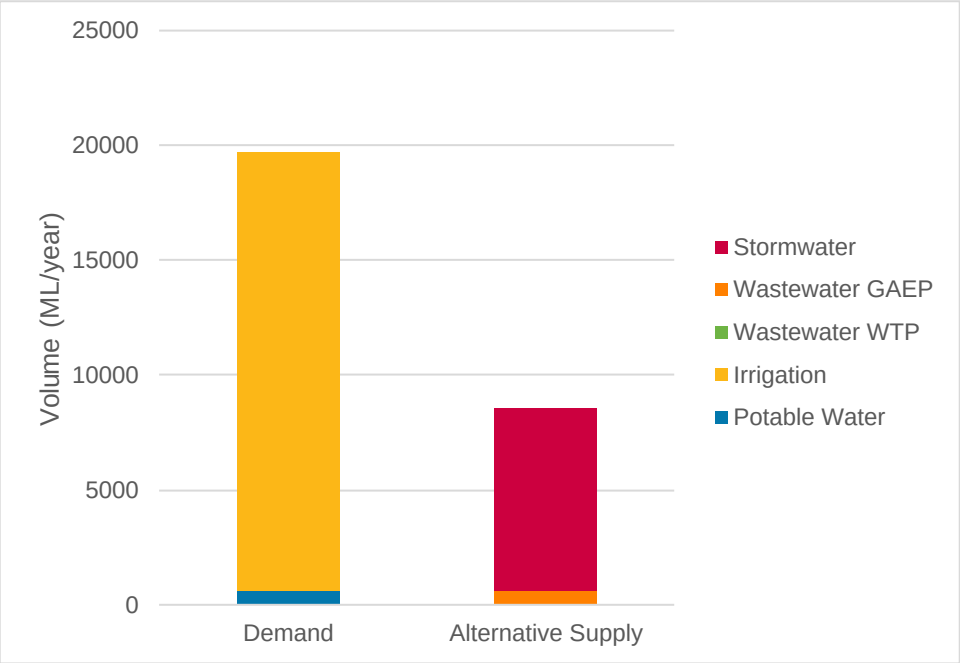

Figure 6-4 Future Water Demand and Potential Alternative Water Supply Options (Excluding WTP its on-site reuse)

The water balance indicates great potential to use utilise alternative water source agriculture which is one of the main aims of the IWMP (Section 1). However, the currently available data suggests that majority of the nearby agricultural demands are already being supplied with recycled water from WTP (Table 5-4). Therefore, opportunities to reuse stormwater on-site for industrial uses or elsewhere may be required.

6.2 Stormwater Management Strategy

GAEP including Avalon Airport are the two main areas considered to be developed. Impervious area in the overall GAEP area is expected to be increased significantly once the proposed development takes place. An estimated increase of runoff volume from the GAEP area are summarised in Table 6-2. It is evident that significant efforts will be required to maintain the runoff volume at pre-development levels.

Table 6-2 GAEP Volume Summary (MUSIC Modelling Results)

	Avalon Airport	Remaining GAEP Area	Overall GAEP Area
Area (ha)	1,856	1,579	3,435
PreDev Impervious Fraction (%)	10	4	7
PostDev Impervious Fraction (%)	60	59	59
PreDev Volume (ML/year)	927	439	1,366
PostDev (unmitigated) Volume (ML/year)	4,340	3,630	7,970

	Avalon Airport	Remaining GAEP Area	Overall GAEP Area
Increase in Volume (ML/year)	3,413	3,191	6,604
% Volume Reduction Required for no increase in volume	79%	88%	83%

Given the airport is an integral part of the overall development, it was assumed the same pollutant and volume reduction targets applicable to remaining GAEP area also apply to the airport. It is acknowledged that there is a significant uncertainty associated with this assumption, however in absence of relevant information on future development plans for the airport, it was assumed current approach is adequate for the base case assessment. The stormwater strategy described below only includes the GAEP area excluding the airport.

The current stormwater management strategy will consist of flood storage, stormwater quality and volume management infrastructure. Required flood storage is assumed to be achieved via a combination of on-site detention tanks and a few precinct scale retarding basins. A treatment train comprising of sediment ponds and wetlands is assumed to provide the pollutant load reduction targets and a secondary volume reduction opportunity. Given the potential issues associated with shallow groundwater, it was assumed that infiltration will not be a feasible solution to reduce runoff volume. Therefore, it was assumed that the volume reduction will be primarily achieved via evapotranspiration and reuse. Two potential options were considered for achieving volume reduction target.

- Option 1 – Evaporation losses via constructed wetland and reuse demand (either industrial or agricultural)
  - A relatively oversized wetland (approximately 3.1% of the GAEP area or an equivalent treatment surface area of approximately 48.5 ha including a sediment pond) with a closed storage (either above ground or below ground) of approximately 926 ML to supply a reuse of approximately 2,600 ML/year.
    - It was assumed that only treated water from the wetland will be available for reuse
    - A constant daily reuse demand was assumed.
- Option 2 – Evaporation losses via a constructed wetland and an open storage pond and agricultural reuse demand
  - A similar wetland as in the above option, where treated water from the wetland is pumped to an open storage pond (approximate water surface area of 46 ha and a permanent pool volume of 460 ML) located in the current farm zone upstream of the Princess Highway to supply at least ~330 ML/year for agricultural demand.
    - A shallow storage pond was considered to minimise interaction with shallow groundwater
    - Since the current irrigation water usage data indicates only ~1% of the total agricultural demand is supplied via reticulated supply (Table 5-4), it was assumed that the irrigation demand would be relatively low. Therefore, volume reduction through evaporation losses were maximised using a large surface area.
    - In absence of irrigation distribution demand, recommended irrigation water demand distribution for open space by CoGG MUSIC modelling guidelines were adopted.

It should be noted that asset sizing and reuse demands used for the above options represent one of many possible combinations to achieve these targets under each of the option. Potential combinations would be explored in detailed during the next stage of the IWMP development. A summary of key pollutant and volume generated from the GAEP precinct (excluding the Avalon Airport) is presented Table 6-3.

Table 6-3 GAEP Pollutant Load and Volume Summary (excluding Avalon Airport)

Pollutants	Existing	Option 1	Option 2
Runoff Volume (ML/year)	439	436	433
TSS (kg/year)	59,800	45,400	45,900
TP (kg/year)	176	122	118
TN (kg/year)	1,330	1,130	1,050
GP (kg/year)	4,760	1,230	1,230

7 KNOWLEDGE GAPS AND RECOMMENDED FURTHER INVESTIGATIONS

The situational analysis is the first phase of the Avalon Corridor IWMP which is aimed to identify key information on the existing drainage and servicing situation as well as high level opportunities and constraints influencing the IWMP.

A range of national, state and local policies and strategies related to IWM were reviewed. All policies and strategies encourage IWM and in particular support the use of alternative water sources to address climate change and population growth related challenges and aim to return water to environment and cultural flows.

A review of existing background reports and stakeholder interviews revealed that there are limited existing infrastructure servicing the area. There is no Barwon Water owned sewer or recycled water infrastructure servicing the area at present. There is limited potable water supply infrastructure and or council managed drainage network servicing the area. This indicates that significant upgrades/extension to existing drainage, water supply and sewer infrastructure is needed for servicing the proposed development in the study area.

Additionally, a range of potential issues and constraints ranging from topography, soils, environment, cultural and heritage, flooding and drainage, climate change, groundwater, land ownership and Avalon Airport were considered. A combined effect of key issues and constraints is represented in Figure 7-1.

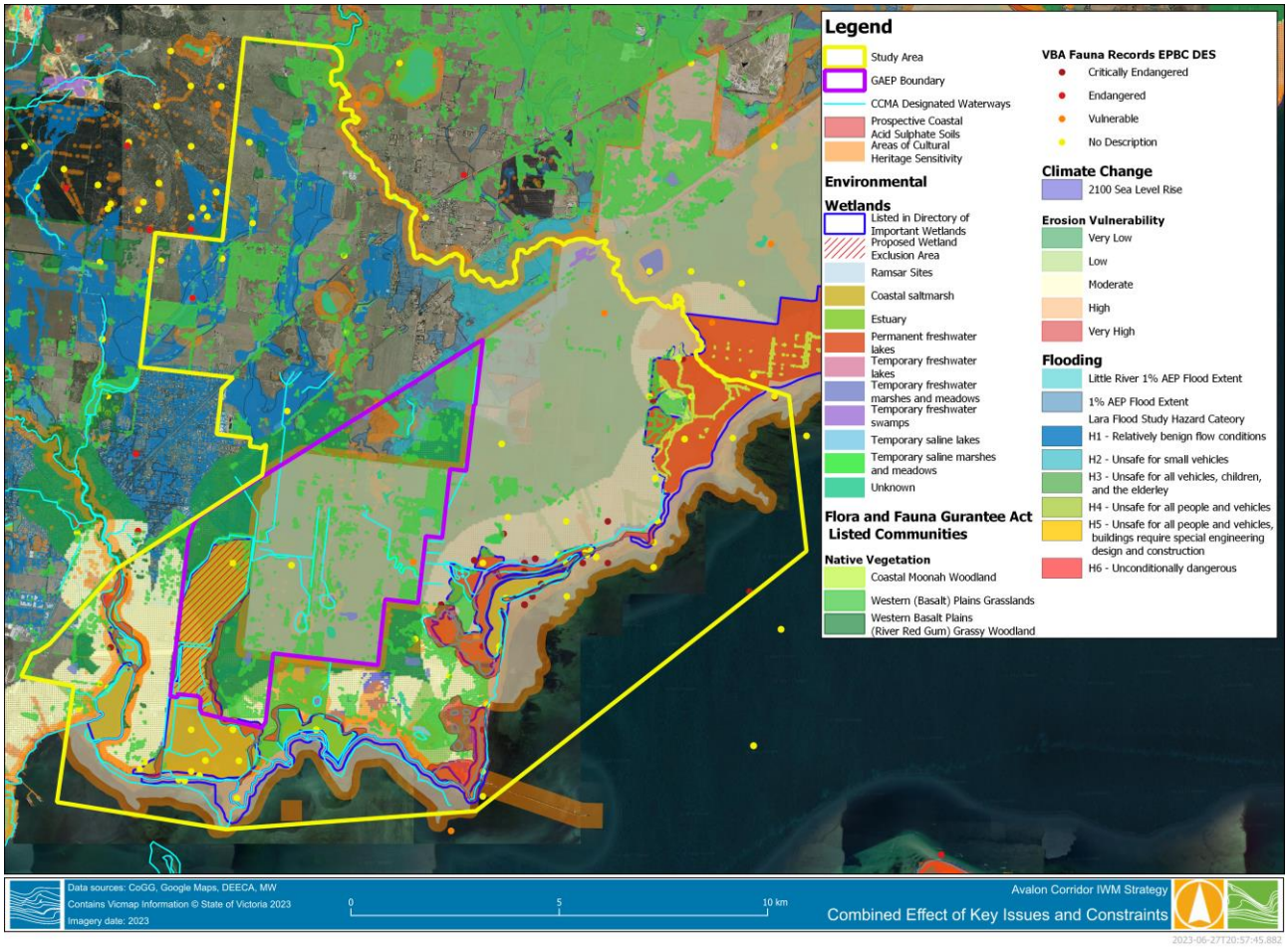

Figure 7-1 Overlap of Key Issues and Constraints

Three of the major constraints identified were:

- Significant presence of environmental and cultural heritage values within the area
  - There are nationally and internationally significant wetlands, threatened ecological communities and species, migratory species present in the area
  - Majority of the area is currently identified as an area of cultural sensitivity
- Flooding and climate change impacts
  - A significant portion of the study area is subject to flooding due to low-lying flat terrain.
  - A significant portion of the land is predicted to be impacted by coastal erosion vulnerability and some loss of land due to coastal inundation under climate change predictions.
- Uncertainty
  - Currently there is lack of information of the development type and characteristics. This information is critical in planning future infrastructure.
  - Current lack of information on proposed expansion of Avalon Airport. Avalon Airport is an integral part of the GAEP. It is understood the airport is not subject to PSP process as it is has its own master planning process, but closely coordinating the development within the airport and other areas of GAEP is desired. Furthermore, understanding of the airport drainage and water infrastructure is critical for development of this IWMP.
  - Complexities around developing a consistent service strategy with multiple agencies.

Nonetheless, the Avalon Corridor IWMP provides a great opportunity to improve whole of water cycle management while mitigating the negative impacts on the sensitive cultural and environmental values: Some of the key opportunities identified through the data review are:

- Improve consistency (and integration) in drainage, water and sewer management throughout the GAEP area including Avalon Airport
- Support fit for purpose water usage for agriculture, industries, street tree irrigation, urban cooling and supporting migratory bird habitat in drought years.
- Protect and preserve sensitive natural environment from adverse impacts of development (altered hydrology and water quality concerns)
  - Maintain the natural flow regime in waterways by either returning water to waterways or managing wastewater/stormwater discharge (water quantity).
  - Adopt stormwater peak flow, volume and water quality management strategies to protect ecological and cultural values within the area
  - Protect salt marsh and mangrove habitat, and enhance opportunities for carbon sequestration
- Respond to impacts of climate change on integrated mater management (vegetation recession, sea level rise, flood risk, urban heat)

7.1 Implications for VPA for Precinct Planning

It is evident that further investigations are needed to better understand the impact of above issues and constraints on overall GAEP development and subsequently Avalon corridor IWMP development. It is understood VPA has commissioned a land capability assessment (completed), cultural values assessment (completed), environmental impact assessment (in progress). The following investigations related to IWMP development are recommended for VPA considerations:

- Environmental Impact Assessment

- To identify the impact of proposed development on these sensitive environments and which areas may needed to be excluded from future development to avoid adverse impacts to the surrounding environment.
- For instance, altered hydrology due to excess stormwater volumes was perceived as a key threat to sensitive waterways. Expanding our understanding of the ecological and cultural needs of the waterways and appropriate mitigation options is recommended.
- It is recommended that this study to focus on the GAEP area South of Princess Highway.
- Water Quality Monitoring to understand threshold levels of pollutants of concern for receiving environment

- Cultural Values Assessment
  - An Aboriginal Cultural Values Assessment to be undertaken by WTOAC to identify potential impacts on Wadawurrung living cultural heritage and the natural and avian environment.
  - It is recommended that this study to focus on the GAEP area South of Princess Highway
- Drainage and Flooding Assessment
  - Existing flooding information are gathered from several studies developed based on different modelling procedures and at different baseline time period.
  - Therefore, a site specific flooding and drainage assessment to understand the existing flooding conditions as well as future conditions considering climate change impacts are recommended
  - It is recommended that this study to focus on the whole study area of the IWMP
- Climate Change Impact Assessment
  - A review of latest information available on climate change predictions/modelling relevant to study area to determine the potential areas prone/loss due to coastal inundation and erosion
  - It is recommended that this study to focus on the GAEP area and ACS areas identified to be impacted by coastal erosion and sea level rise.
- Avalon Airport Development
  - It is recommended that the VPA should consult with the Australian Aviation Wildlife Hazard Group and the Avalon Airport to understand the implications of off-airport wildlife strike hazard to the future open drainage assets and wetland conservation areas and any risk assessment required for optioneering. (see the *AAWHG Recommended Practice*)
  - It is understood that VPA are liaising with Avalon Airport to obtain information on the proposed expansion the airport land, including updates to the masterplan covering the site.
  - Information on proposed airport development, in particular strategies for managing, drinking water, sewer, recycled water and drainage, predicted potable and non-potable water demands, opportunities to integrate with overall Avalon Corridor IWMP is needed.
- GAEP development characteristics
  - It is understood precinct vision and purpose workshop has been conducted with the key stakeholders and a co-design workshop is planned for August 2023.
  - Further information industrial/commercial development typologies, specific high water users, reuse opportunities are desirable for IWMP development
- Collaboration between key stakeholders
  - It is understood a co-design workshop is planned for August 2023.

- Discussion between key stakeholder such as Melbourne Water, Barwon Water, Corangamite CMA, City of Greater Geelong on collaborative opportunities to manage drainage, flooding, stormwater/wastewater treatment and reuse is recommended.

7.2 Next Steps in developing the IWMP

The completion of the situational analysis leads into the IWM optioneering phase of the project. A series of two design sprint workshops with key stakeholders are planned to gather stakeholder's views on:

- Existing and future strategies upon which the IWM strategy will build on
- Main challenges and opportunities related to IWM
- Key stakeholders, drivers and responsibilities
- Potential IWM options; and
- Methods to identify, analyse and select IWM opportunities

IWM options identified through the design sprint workshops will be complemented by other potential IWM opportunities identified through desktop assessment to develop a IWM Options Long-list. The long-list will be assessed using Preliminary Assessment Method to derive a shortlist for further assessment.

It is understood that there are several investigations that are either being developed in parallel to this IWMP such as GAEP PSP background investigations, Avalon Airport Master Plan, Barwon Water's water and sewer strategy or strategies that are proposed to be developed in future (including for example the stormwater management plan) that will need to be considered when preparing this IWMP. However, it is understood that due to timing of these complementary studies alongside other constraints, relevant information may not be incorporated to the IWMP. Meaning that the IWMP may need to be revisited at the point new relevant information becomes available.

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APPENDIX A
DATA SOURCES

Table A-1 Data Sources

No	Type	Database Name	Owner	Format
1	Report	Avalon Airport Environmental Strategy	AAA	PDF
2	Report	Avalon Airport Master Plan	AAA	PDF
3	Report	Avalon Corridor Strategy	CoGG	PDF
4	Report	Avalon Corridor Strategy - Cultural Values Assessment	CoGG	PDF
5	Report	Avalon Corridor Strategy Servicing Report	CoGG	PDF
6	Report	Barwon Strategic Directions Statement	DELWP	PDF
7	Report	Central and Gippsland Region Sustainable Water Strategy	DELWP	PDF
8	Report	City of Greater Geelong IWM Strategy, Prioritisation and Targets (Final Report)	CoGG	PDF
9	Report	Corangamite Regional Floodplain Management Strategy 2018–2028	CCMA	PDF
10	Report	Corangamite Waterways Strategy 2014 - 2022	CCMA	PDF
11	Report	Environmental Reference Standard	EPA VIC	PDF
12	Report	Environmental Strategy 2020-30	CoGG	PDF
13	Report	Floodplain Development Guidelines	CCMA	PDF
14	Report	Flood management Plan	CoGG	Word
15	Report	Greater Avalon Employment Precinct Economic & Scoping Study and Planning Framework (Draft)	VPA	PDF
16	Report	Greater Avalon Employment Precinct Land Capability Assessment	VPA	PDF
17	Report	Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria	DELWP	PDF
18	Report	Melbourne Water MUSIC modelling Guidelines	MW	PDF
19	Report	Northern and Western Geelong Growth Areas Integrated Water Management Plan	CoGG	PDF
20	Report	Port Phillip Bay (Western Shoreline) and Bellarine Peninsula - Ramsar Site Management Plan	DELWP	PDF
21	Report	Precinct Structure Planning Guidelines	VPA	PDF
22	Report	Stormwater Services Strategy 2020-2030	CoGG	PDF

No	Type	Database Name	Owner	Format
23	Report	Urban Stormwater Management Guidance	EPA VIC	PDF
24	Report	Urban Water Strategy 2022: Water for our Future	BW	PDF
25	Report	Victorian Coastal Hazard Assessment	DELWP	PDF
26	Website	City of Greater Geelong MUSIC Modelling Guidelines	CoGG	Web
27	Website	Protected Matters Search Tool	DEECA (Federal)	Wet Tool
28	Historical data	BW_Potable_WaterUse	BW	Excel
29	Historical data	GREP P-Water, R-Water, Sewer Data	BW	Excel
30	Historical data	Recycled_Water_Annual_Volumes_Supplied_by_Melbourne_Water	MW	Excel
31	Historical data	WUAFDCASGS202021 - Water Use on Australian Farms, 2020-21	ABS	Excel
32	GIS data	Water Information System - Site Details (Groundwater Sites)	DELWP	Excel
33	GIS data	Erosion_Vulnerability — SA08_Port_Phillip_Bay_West	Datashare-DELWP	Geodatabase
34	GIS data	Inundation — SA08_Port_Phillip_Bay_West	Datashare-DELWP	Geodatabase
35	GIS data	Surface Hydrology Lines National	Geo Science Australia	Geodatabase
36	GIS data	Watertable Depth	Datashare-DELWP	Grid
37	GIS data	10 m Digital Elevation Model	Geo Science Australia	Grid
38	GIS data	Lara_Combined_100yr_Max_ZAEM1	Water Tech	Grid
39	GIS data	Hydro_100_unfiltered	CMA	Shapefile
40	GIS data	Avalon_StudyArea	CoGG	Shapefile
41	GIS data	Drainage Pipes	CoGG	Shapefile
42	GIS data	Employment Precinct	CoGG	Shapefile
43	GIS data	Hovells Creek Catchment	CoGG	Shapefile
44	GIS data	IWM Area	CoGG	Shapefile
45	GIS data	Little River Catchment	CoGG	Shapefile

No	Type	Database Name	Owner	Format
46	GIS data	Areas of Cultural Heritage Sensitivity	Datashare-DELWP	Shapefile
47	GIS data	Bushfire Prone Area	Datashare-DELWP	Shapefile
48	GIS data	CMA Boundaries	Datashare-DELWP	Shapefile
49	GIS data	Coastal Acid Sulphate Soils	Datashare-DELWP	Shapefile
50	GIS data	LGA Boundaries	Datashare-DELWP	Shapefile
51	GIS data	Native Vegetation - Flora and Fauna Guarantee Act Listed Communities	Datashare-DELWP	Shapefile
52	GIS data	Public Land Management	Datashare-DELWP	Shapefile
53	GIS data	Ramsar Wetland Areas in Victoria at 1:25 000	Datashare-DELWP	Shapefile
54	GIS data	Victorian Wetland Inventory (Current)	Datashare-DELWP	Shapefile
55	GIS data	Victorian Wetlands listed in - A Directory of Important Wetlands in Australia	Datashare-DELWP	Shapefile
56	GIS data	Catchments - Major River Basins	MW	Shapefile
57	GIS data	Healthy Waterways Strategy Subcatchments	MW	Shapefile
58	GIS data	Healthy Waterways Strategy Stormwater Priority Area	MW	Shapefile
59	GIS data	MW owned land	MW	Shapefile
60	GIS data	MW major river basins	MW	Shapefile
61	GIS data	Natural waterways (managed by MW) centreline	MW	Shapefile
62	GIS data	HY Watercourse	Vicmap - DELWP	Shapefile
63	GIS data	Landuse 2017	Vicmap - DELWP	Shapefile
64	GIS data	Plan overlay	Vicmap - DELWP	Shapefile
65	GIS data	Plan zone	Vicmap - DELWP	Shapefile
66	GIS data	SG Geological 50k	Vicmap - DELWP	Shapefile
67	GIS data	TR Rail	Vicmap - DELWP	Shapefile
68	GIS data	TR Road	Vicmap - DELWP	Shapefile
69	GIS data	VBA Fauna 100	Vicmap - DELWP	Shapefile

No	Type	Database Name	Owner	Format
70	GIS data	Little River 100 year ARI Flood Extent	Victorian Flood Database	Shapefile
71	GIS data	Urban Water Authorities Boundary	Victorian Spaitial Data Directory - DSE	Shapefile
72	GIS data	Wetland exclusion area	VPA	Shapefile
73	GIS data	Avalon Airport Boundary	Water Tech	Shapefile
74	GIS data	GAEP Boundary	Water Tech	Shapefile

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APPENDIX B
EPBC ACT PROTECTED MATTERS REPORT

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 03-Jul-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	76
Listed Migratory Species:	64

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	22
Commonwealth Heritage Places:	1
Listed Marine Species:	79
Whales and Other Cetaceans:	7
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	3
Regional Forest Agreements:	1
Nationally Important Wetlands:	1
EPBC Act Referrals:	29
Key Ecological Features (Marine):	None
Biologically Important Areas:	6
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Port phillip bay (western shoreline) and bellarine peninsula	Within Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area

Scientific Name	Threatened Category	Presence Text
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area

Scientific Name	Threatened Category	Presence Text
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
FISH		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat may occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
[Prototroctes maraena](#)		
Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
[Seriolella brama](#)		
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
[Thunnus maccoyii](#)		
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area
FROG		
[Litoria raniformis](#)		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
INSECT		
[Synemon plana](#)		
Golden Sun Moth [25234]	Vulnerable	Species or species habitat likely to occur within area
MAMMAL		
[Antechinus minimus maritimus](#)		
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat may occur within area
[Dasyurus maculatus maculatus (SE mainland population)](#)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
[Eubalaena australis](#)		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
[Pteropus poliocephalus](#)		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANT		
[Amphibromus fluitans](#)		
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area
Diuris basaltica Small Golden Moths Orchid, Early Golden Moths [64654]	Endangered	Species or species habitat may occur within area
Diuris fragrantissima Sunshine Diuris, Fragrant Doubletail, White Diuris [21243]	Endangered	Species or species habitat may occur within area
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat likely to occur within area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat likely to occur within area
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat likely to occur within area
Leucochrysum albicans subsp. tricolor Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat likely to occur within area
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat known to occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Pterostylis cucullata		
Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area
Rutidosis leptorhynchoides		
Button Wrinklewort [67251]	Endangered	Species or species habitat known to occur within area
Senecio macrocarpus		
Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat known to occur within area
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat may occur within area
REPTILE		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Lissolepis coventryi		
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat may occur within area
Tympanocryptis pinguicolla		
Victorian Grassland Earless Dragon [66727]	Critically Endangered	Species or species habitat likely to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		

Scientific Name	Threatened Category	Presence Text
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Defence	
Defence - AVALON AIRFIELD [21400]	VIC
Defence - AVALON AIRFIELD [21401]	VIC
Defence - AVALON AIRFIELD [21411]	VIC
Defence - AVALON AIRFIELD [21412]	VIC
Defence - AVALON AIRFIELD [21408]	VIC
Defence - AVALON AIRFIELD [21404]	VIC

Commonwealth Land Name	State
Defence - AVALON AIRFIELD [21409]	VIC
Defence - AVALON AIRFIELD [21399]	VIC
Defence - AVALON AIRFIELD [21402]	VIC
Defence - AVALON AIRFIELD [21405]	VIC
Defence - AVALON AIRFIELD [21407]	VIC
Defence - AVALON AIRFIELD [21406]	VIC
Defence - AVALON AIRFIELD [21403]	VIC
Defence - AVALON AIRFIELD [21410]	VIC
Defence - AVALON AIRFIELD [21398]	VIC
Defence - AVALON AIRFIELD [21397]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21439]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21443]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21442]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21444]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21441]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21440]	VIC

Commonwealth Heritage Places

[Resource Information]

Name	State	Status
Natural		
Point Wilson Defence Natural Area	VIC	Listed place

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area overfly marine area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area overfly marine area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area overfly marine area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area
Sterna striata		
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons as Sterna albifrons		
Little Tern [82849]		Species or species habitat may occur within area
Sternula nereis as Sterna nereis		
Fairy Tern [82949]		Breeding known to occur within area
Stiltia isabella		
Australian Pratincole [818]		Roosting known to occur within area overfly marine area
Thalassarche bulleri		
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei as Thalassarche sp. nov.		
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma		
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area overfly marine area
Mammal		

Scientific Name	Threatened Category	Presence Text
[Arctocephalus forsteri](#) Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
[Arctocephalus pusillus](#) Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptile		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
[Caperea marginata](#) Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
[Delphinus delphis](#) Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
[Eubalaena australis](#) Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Limeburners Lagoon (Hovells Creek) F.F.R	Nature Conservation Reserve	VIC
Serendip Wetlands Education Facility	Natural Features Reserve	VIC
The Spit W.R.	Nature Conservation Reserve	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State
West Victoria RFA	Victoria

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Werribee-Avalon Area	VIC

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Geelong Hydrogen Hub	2022/09288		Referral Decision
Vopak Victoria Energy Terminal	2023/09507		Referral Decision
Controlled action			
Basalt Quarry Extension (Mountainview Quarry)	2004/1329	Controlled Action	Completed
Changes in land use at the Western Treatment Plant Werribee, Victoria	2008/4221	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Extension of Mountain View basalt quarry by 490 hectares (Stage 2)	2004/1590	Controlled Action	Post-Approval
Geelong Salt Fields Urban Renewal Project	2012/6630	Controlled Action	Assessment Approach
Melbourne Geelong Interconnection Pipeline Project	2010/5380	Controlled Action	Post-Approval
Mosquito Control	2005/2132	Controlled Action	Post-Approval
Motocross Track and Associated Infrastructure	2009/4956	Controlled Action	Completed
Viva Energy Gas Terminal Project	2020/8838	Controlled Action	Assessment Approach
Western Treatment Plant Environment Improvement Project (post Effluent Reuse Stage 2)	2002/688	Controlled Action	Post-Approval
Not controlled action			
Expansion and upgrade of Biogas Utilisation Facilities at the Western Treatment	2005/2183	Not Controlled Action	Completed
Extension of Mountain View basalt quarry by 113 hectares (stage one)	2004/1591	Not Controlled Action	Completed
Geelong Bypass Sections 1 & 2	2005/2097	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Multi-species Aquaculture Enterprise	2001/404	Not Controlled Action	Completed
Regional Fast Rail Project - Geelong Country Works Package	2002/577	Not Controlled Action	Completed
Removal of Sludge to Produce Dried Biosolids, Western Treatment Plant	2002/890	Not Controlled Action	Completed
Sludge handling and biosolids management - Western Treatment Plant	2006/2620	Not Controlled Action	Completed
Wastewater Treatment System Upgrade	2004/1420	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
WTP Effluent Discharge Improvement Works (Multiple Outlets), Werribee, Vic	2015/7619	Not Controlled Action	Completed
Not controlled action (particular manner)			
Gas Pipeline	2006/3093	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
Point Wilson Explosives Area Waterside Infrastructure Remediation	2012/6376	Not Controlled Action (Particular Manner)	Post-Approval
Rail Upgrades at Geelong Port Project	2010/5363	Not Controlled Action (Particular Manner)	Post-Approval
Regional Fibre Optic Project (RFOP)	2003/913	Not Controlled Action (Particular Manner)	Post-Approval
Western Lagoon Saltmarsh Restoration, Western Teatment Plant, Werribee, VIC	2009/4831	Not Controlled Action (Particular Manner)	Post-Approval
Western Treatment Plant Stage 1 Augmentation, Werribee, Vic	2014/7313	Not Controlled Action (Particular Manner)	Post-Approval

Biologically Important Areas		
Scientific Name	Behaviour	Presence
Seabirds		
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
[Pelecanoides urinatrix](#) Common Diving-petrel [1018]	Foraging	Known to occur
[Thalassarche cauta cauta](#) Shy Albatross [82345]	Foraging likely	Likely to occur
Whales		
[Eubalaena australis](#) Southern Right Whale [40]	Known core range	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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APPENDIX C
WTOAC IWM STATEMENT

Wadawurrung
Traditional Owners
Aboriginal Corporation

Dear IWM project leads,

Please see below Wadawurrung Traditional Owners Aboriginal Corporation statement and position on IWM projects and stormwater, recycled water and new water sources.

Wadawurrung people recognize the rivers and waterways on our Country as living entities and we, the Traditional Owners are the voices that speak for their health and well-being.

When we talk about Cultural water and Cultural flows, we are talking about all water that exists on country - because Water is life. Without water, life suffers and ultimately cannot exist.

Cultural flows are Water entitlements that are legally and beneficially owned by volume or by having agency over decisions made, by Indigenous Nations, of a sufficient and adequate quantity and quality to improve spiritual, cultural, environmental, social, and economic conditions of those Nations. Inherently, Cultural flows are for us to Heal Country and to enable us to undertake our obligations to care for country and to bring our lifeblood, water, back to its natural flowing state, so that it can continue to support Country, Culture & Community.

While treated storm water can be used to support environmental flows and systems, treated storm water must not to be used as Cultural Water - it should be used as the re-allocation source for systems in place, freeing up licenses and reducing extraction from natural systems, allowing passing flow management and future water entitlements to be handed back to Traditional Owners.

Two years ago, Wadawurrung released "Paleert Tjaara Dja -Lets make country good together", 10-year Healthy Country Plan. Within this we have built our objectives, aspirations, and obligations for water on Wadawurrung Country.

Our role within the Gobata Dja - Caring for Country team as Aboriginal Water Officers, amongst tangible projects, is paramount to educating the importance of waters connection to Country, and why we must change the western understanding of water management.

Our Rivers and our water bodies are now highly modified and under threat from increased and incorrect usage. They are heavily over allocated and are suffering from everlasting extraction for irrigation, industry, and potable assets.

On Wadawurrung Country, there are no remaining water allocations within our systems. So, what does that leave for Wadawurrung People, our access and agency over Cultural Water?

Zero. Zero litres. Here in lies the challenge for Wadawurrung.

The majority of rivers on Wadawurrung Country are extensively licensed and over sold, while only receiving very small environmental entitlements and very limited passing flows, as a direct result of the building of weirs and barriers harvesting the natural flows and selling to industry.

From Wadawurrungs perspective, rather than continually extract and license water from natural flowing systems, new sources of water like storm water and recycled water, through IWM projects can be used as the asset for sale, on selling it to users like irrigators, golf courses and other major industry.

There is great need for investment into new water sources as we face increased pressure from urbanization, population growth and climate change. Our Rivers cannot support any further take.

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We need to increase the confidence of users for alternative water sources so that our waterways can begin to heal, and our Mobs can regain agency over what has always been theirs. There was never Aqua Nullius and it was never an asset for sale.

People must understand that water that exists on Wadawurrung Country, must stay on Country as it is part of the holistic wellbeing of that landscape. It supports all aspects of life, from the deep water and the life within, to the banks with the river red gums, to the grass lands and bushland surrounding, the canopies and the birds that live above right through to the sky country that feeds the water back into the landscape.

When you turn your tap on in your kitchens, or you water your vegie gardens, or when the irrigators turn their sprinklers on, I want you to imagine the word, Wadawurrung, pouring from the taps and remember, that water is not just an asset for sale, water has its own spirit and its own connection to Country, it needs to be healthy to be able to support Country. Our water is our lifeblood of Country, without water life within Country cannot be.

Please take this statement as our formal and strategic direction with IWM related projects. If opportunities for water to be returned to Country and Wadawurrung are identified, we ask to be kept informed where needed and will engage further when required.

Please use this as a tool to help us mitigate resourcing requirements as we commit to other initiatives.

Thank you and take care.

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APPENDIX D
BASE CASE CALCULATIONS

D-1 MUSIC Modelling

- MUSIC modelling was used to estimate the stormwater pollutant and volume and pre and post development conditions.
- MUSIC model was developed using 10-year CoGG MUSIC climate template for Little River using recommended parameters.
- A schematic of the MUSIC model is shown in Figure D-1 (pre-development) and Figure D-2 (post-development with mitigation).
- Fraction impervious area was estimated based on the planning zones (Table D-1). With the following exceptions;
  - The pre-development impervious area of the Avalon Airport was estimated using the impervious area visible from the aerial image.
  - The post development impervious area of the Avalon Airport was assumed to reach 60% fraction imperviousness (FI) (equivalent to typical FI used for its current planning zone (Special Use zones)
  - In absence of the proposed development layout for the GAEP, it was assumed only 65% of the PSP area is developable to be consistent with the draft GAEP Economic and Scoping Study and Planning Framework (SGS Economics & Planning, 2023)
    - Therefore, it was assumed that only 65% of the GAEP land will be developed for industrial and commercial uses with a typical industrial FI of 90%
    - The remaining area was assumed to be reserved for drainage and biodiversity conservation with a FI of 0%.
    - The resulting overall FI of the GAEP (excluding airport) was 59%
- Resulting pre and post development catchment areas and impervious fractions are summarised in Table D-2 and Table D-3 respectively.
- Since base case assume all development will meet the current BPEM targets, two catchments within the GAEP was assigned with treatment nodes
  - Avalon airport stormwater treatment was modelled using a generic treatment node with the following treatment effectiveness
    - Flow – 80.2% reduction (to achieve no increase in volume)
    - TSS – 80% reduction
    - TP – 45% reduction
    - TN – 45% reduction
    - GP - 70% reduction
  - Remainder of the GAEP was assumed to be treated via a typical treatment train comprised of a sediment pond and a wetland.

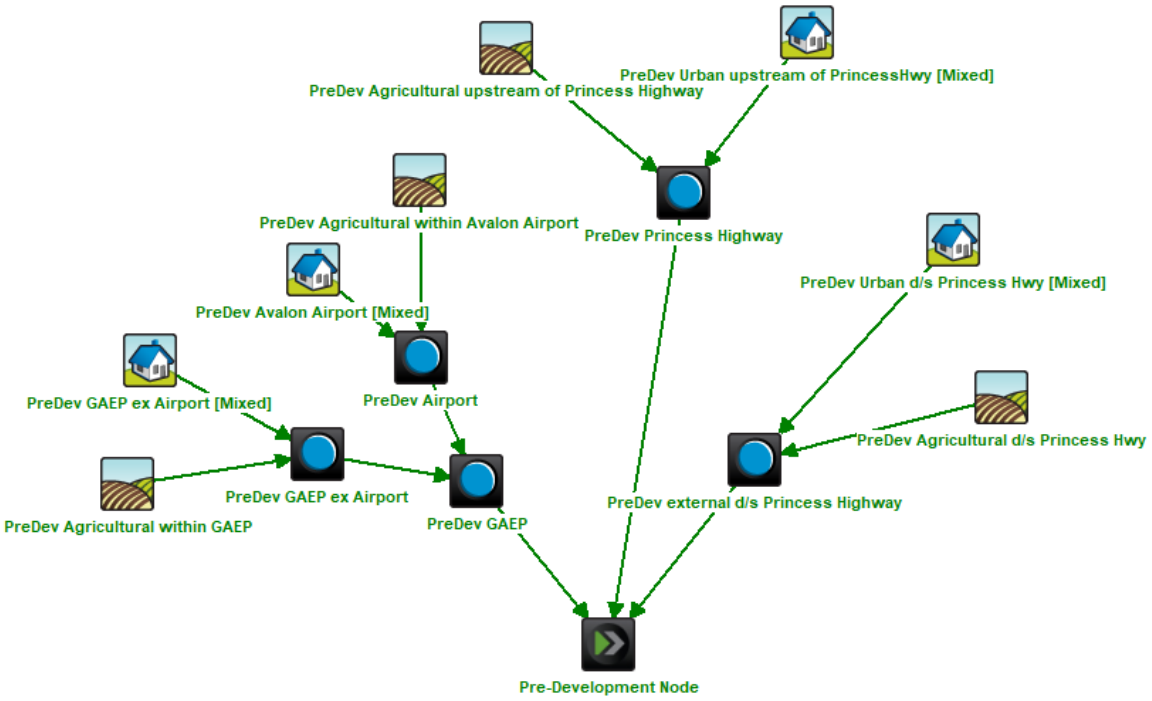

Figure D-1 MUSIC model schematic (Pre Development)

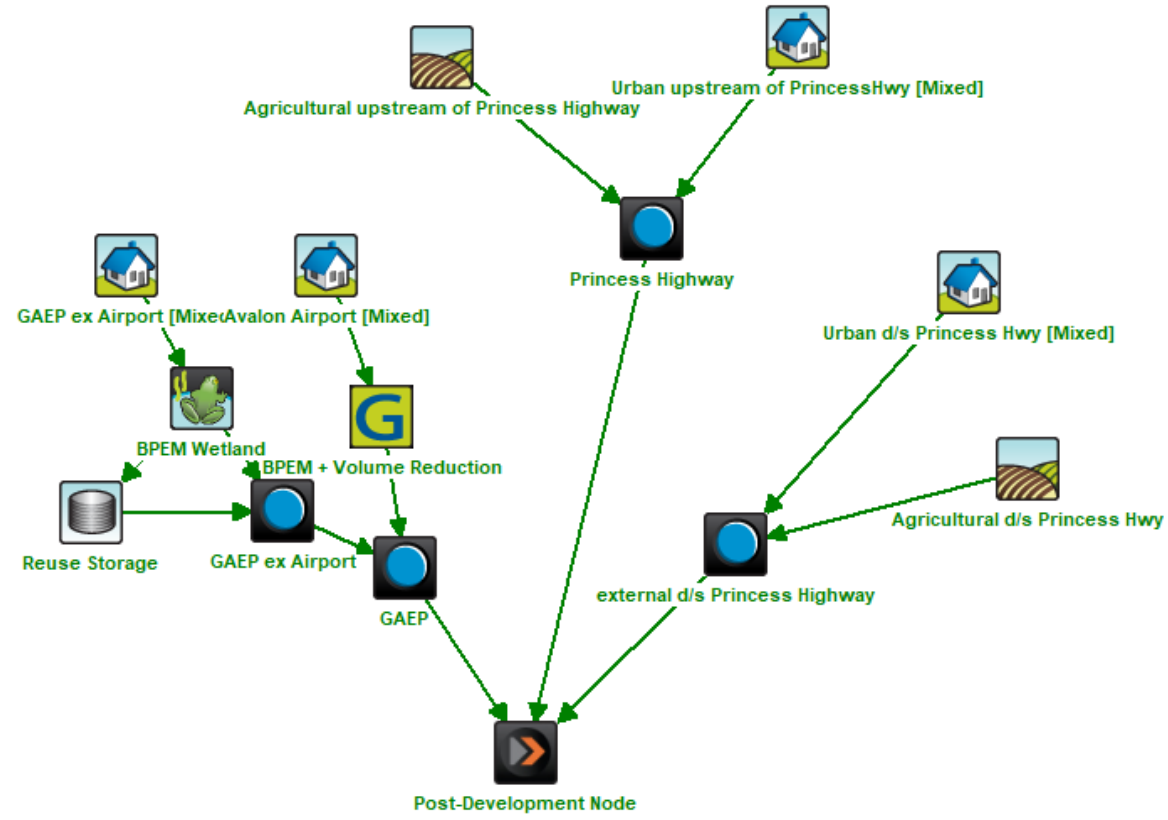

Figure D-2 MUSIC model schematic (Post Development with Mitigation)

Table D-1 Typical Impervious Fractions adopted for MUSIC modelling

Plan Zone	Impervious Fraction
Commercial	90%
Commonwealth Land	60%
Farming	5%
Green Wedge	0%
Industrial	5%(1)
Public Conservation and Resource	0%
Public Park and Recreation	5%
Public Use (WTP land)	5%
Rural Conservation	5%
Rural Living	20%
Special Use	0%(1)
Transport	60%

Notes

1. Relatively low impervious fraction was adopted than the typical value based on the impervious area visible in the aerial image.

Table D-2 Predevelopment MUSIC Catchments

Catchment	Area (ha)	Impervious Fraction
Agriculture (farming and MW land)	10117	5%
All other land uses	7125	6%
Overall	17241	5%

Table D-3 Post development MUSIC Catchments

Catchment	Area (ha)	Impervious Fraction
Farming upstream of Princess Highway (External Catchment)	4671	5%
Other areas upstream of Princess Highway (External Catchment)	159	24%
Farming downstream of Princess Highway (External Catchment)	4291	5%
Other areas downstream of Princess Highway (External Catchment)	4686	5%
GAEP - Avalon Airport	1857	60%
GAEP - Other	1590	72%
Overall	17241	16%

D-2 Potable Water Usage Estimate

- In absence of sufficient details for the development composition, the potable water usage was estimated from the past 5 years usage data from a total of 80 users in the Geelong Ring Road Employment Precinct (GREP) (Figure D-3) and the Barwon Water FY20/21 highest user data outside the GREP (Table D-4).
- Avalon Airport demand was assumed to be twice that of FY20/21 usage (3 ML/year).
- For other areas outside of the airport, the potable water demand was estimated using a combination of GREP data and BW highest user data.
  - The GREP data alone was not used for assessment as the per hectare usage estimated seems to be quite low.
    - For instance, NWGGA IWMP (E2Design Lab, 2021) adopted an industrial water demand rate of 1.5 ML/ha/year.
    - The equivalent potable water demand for GREP based on the past five years data was 0.13 ML/ha/year.
  - As such it was assumed that 75% of the users will have a demand similar to that of the GREP users while 25% of the users will have a higher usage demand of 2 ML/ha/year (equivalent to median of highest potable water users classified as factories (Table D-4).
    - It is noted that there is high uncertainty in water demand estimated using this method, but in absence of specific information on type of users and their water demand characteristics, it was assumed the assumption made for the base case development are adequate. It is recommended to revisit these assumptions when new information are available with regards to expected water demands within the GAEP.

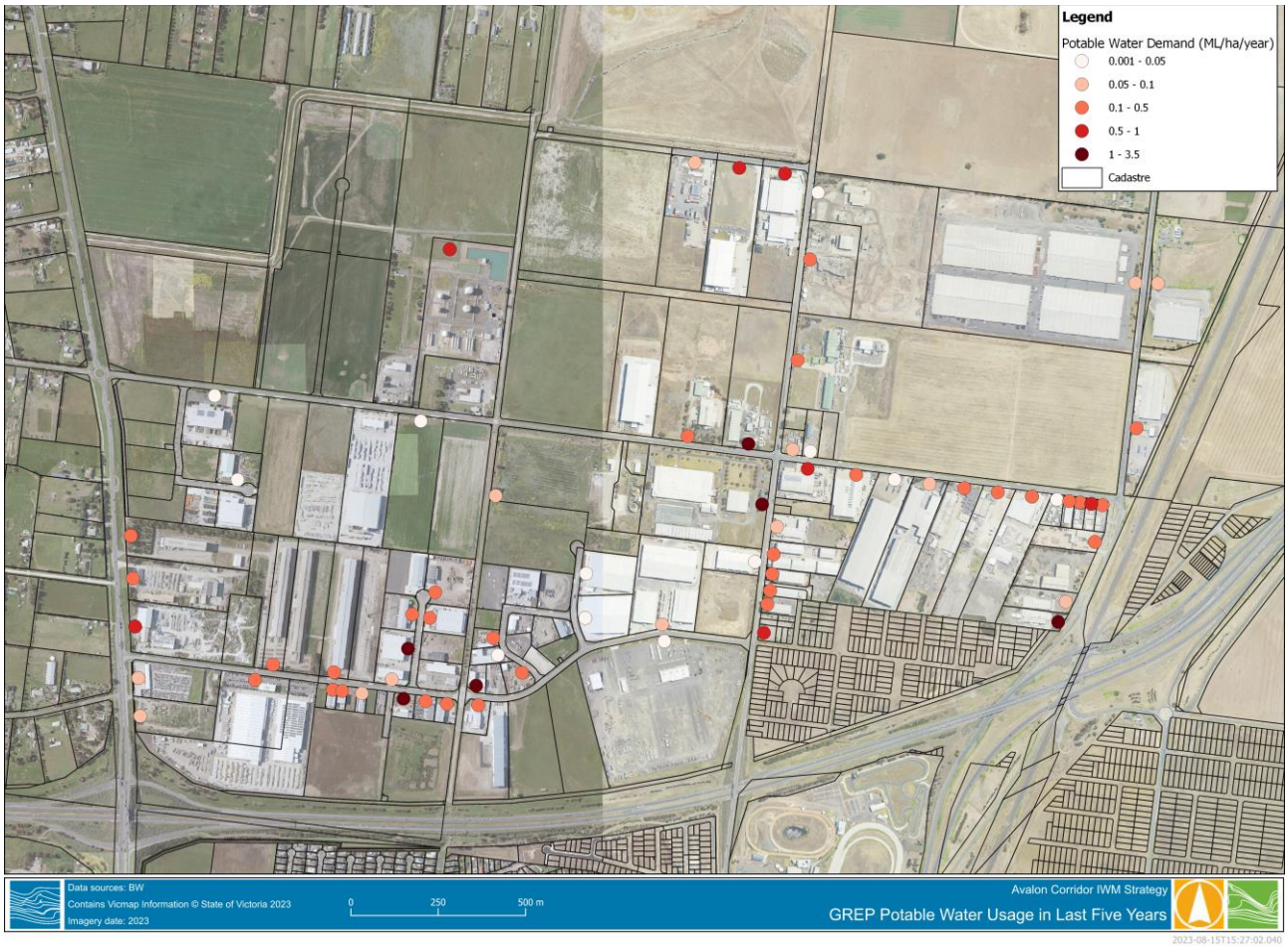

Figure D-3 GREP Potable Water Usage in Last Five Years (2018-2022)

Table D-4 Highest Industrial Potable Water Users outside GREP in FY21 (Source Barwon Water)

Property ID.	FY20/21 Potable Water Use (KL)	Lot Size (ha)	Estimated Demand Rate (ML/ha/year)
North Shore 1	51,860	25.5	2.0
North Shore 2	26,854	18.4	1.5
North Geelong	20,421	3.8	5.4

- Since there is a significant variation in usage rates within GREP, two other scenarios representing low and high usage were considered. The low and high usage were estimated at using corresponding lowest and highest usage rates within the GREP and other three users outside GREP.
- Net developable area was estimated to be 65% of GAEP (excluding Airport). This was estimated to be 1,026 ha.
- Wastewater generation was assumed to be 95% of potable water demand as data extracted from the GREP usage data.

- A summary of potable water demand and wastewater generation under different usage scenarios are summarised in Table D-5.

Table D-5 GAEP Drinking Water Demands and Wastewater Generation

Usage Scenario	Potable Water Demand (ML/year)	Wastewater (ML/year)
Average	624	593
High	3,717	3,531
Low	375	357

D-3 Agricultural Irrigation Demand

Australian Bureau of Statics data on Water use on Australian Farm for FY20/21 period (ABS, 2022) was adopted for agricultural water demand estimates. A summary of irrigation water application rate in Lara is presented in Table D-6.

Table D-6 Irrigation Application Rate in Lara (ABS, 2022)

Crop Type	Application Rate (ML/ha/year)
Pastures (including lucerne) and cereal crops used for grazing or fed off	5.5
Vegetables	3.7
Nurseries, cut flowers and cultivated turf	4.6
Cereals for grain or seed, excluding rice	2.3
Other crops	6.0
Combined Average	4.1

The average irrigation demand rate of 4.1 ML/ha/year was adopted for water balance estimates. Due to variable rates reported, two additional scenarios representing high and low application rates were also considered.

Irrigation demand was estimated for the farmland area (refer to Table D-3)

Table D-7 Irrigation Demand Estimate

Usage Scenario	Application Rate (ML/ha/year)	Farming Area upstream of Princess Highway (ML/year)	Farming Area downstream of Princess Highway (ML/year)	Total Irrigation Demand (ML/year)
Medium	4.09	19,104	17,548	36,652
High	6	28,025	25,743	53,769
Low	2.27	10,603	9,740	20,343

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