

Attachment II

Matters of National Environmental Significance

Attachment II: Matters of National Environmental Significance

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Viva Energy Gas Terminal Project

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1.0 Introduction

This attachment to the Viva Energy Gas Terminal Project (the project) Supplementary Statement presents the findings of the supplementary studies undertaken into Matters of National Environmental Significance (MNES) protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the Supplementary Statement to the project Environment Effects Statement (EES). The Supplementary Statement was required to be prepared to complete the assessment of the project's environmental effects on the marine environment (including threatened and migratory birds), noise, air quality and Aboriginal cultural heritage in accordance with the Minister's Directions issued in March 2023 following review of the EES.

1.1 Purpose of the attachment

This attachment summarises the assessments of MNES undertaken as part of the following supplementary technical studies prepared for the project:

- Technical Report A: *Supplementary marine environment impact assessment*.
- Technical Report B: *Supplementary threatened and migratory bird impact assessment*.

More detail on the matters discussed in this attachment can be found in these reports and in the relevant chapters of the Supplementary Statement.

An assessment of MNES was initially undertaken in the project EES in Technical Report D: *Terrestrial ecology impact assessment* and EES Technical Report A: *Marine ecology and water quality impact assessment*. EES Attachment IV was prepared to summarise the findings of the EES assessment with respect to the three controlling provisions: Ramsar wetlands, listed threatened species and listed migratory species.

The supplementary studies considered revised marine modelling and implications for the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site and threatened and/or migratory birds. The Ramsar site and threatened and/or migratory birds are therefore the MNES considered in this attachment.

MNES not identified in the supplementary studies are presented in EES Attachment IV: *Matters of National Environmental Significance*.

1.1.1 Matters of National Environmental Significance

The EPBC Act provides the legal framework to protect and manage designated MNES. There are nine MNES protected under the EPBC Act:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

On 21 January 2021, the delegate for the Commonwealth Minister for the Environment determined the project to be a controlled action. The relevant controlling provisions for the project include:

- The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site (a wetland of international importance) (sections 16 & 17B of the EPBC Act)

- Listed threatened species and communities (sections 18 & 18A of the EPBC Act)
- Listed migratory species (sections 20 & 20A of the EPBC Act).

The Victorian EES process is the accredited environmental assessment process for the controlled action decision under the EPBC Act in accordance with the bilateral agreement between the Commonwealth and Victorian governments.

1.1.2 Responding to the controlled action

In response to the controlled action decision under the EPBC Act, EES Attachment IV was prepared to summarise the findings of the EES assessment with respect to the three controlling provisions discussed above (Ramsar wetlands, listed threatened species and listed migratory species).

In order to provide necessary commentary on the likelihood of significant impacts specific to MNES identified in the determination under the EPBC Act, EES Attachment IV provided an assessment of the potential mechanisms through which impact on those MNES as a result of the project could be realised. Potential mechanisms of impact on MNES considered in EES Attachment IV included:

- Marine water quality changes
- Entrainment of marine organisms
- Habitat removal
- Noise and lighting
- Additional shipping movements
- Construction of the pipeline impacting waterways or groundwater.

The assessment concluded that construction, operation and decommissioning of the project would not present a substantial change to the existing industrialised environment of Corio Bay and the proposed pipeline corridor, and significant impacts on MNES are unlikely to occur.

This attachment provides a supplementary assessment of the potential mechanisms through which impact on Ramsar wetlands, listed threatened species and listed migratory species could be realised, in accordance with the further work required by the Minister's Directions for the following subject areas:

- Marine environment
- Threatened and migratory bird species.

Potential mechanisms of impact on MNES considered in this attachment include:

- Marine water quality changes
- Entrainment of marine organisms
- Habitat removal
- Noise and lighting
- Additional shipping movements

As described in the following sections, and consistent with the conclusion in EES Attachment IV, the project would not meet the significant impact criteria for Ramsar wetlands, threatened species and migratory species. With the adoption of management and mitigation measures, residual impacts on MNES would be minimised and significant impacts are unlikely.

1.1.3 Assessment overview

EES Attachment IV provided an assessment of the existing conditions in the study area to inform the environmental impact assessment for each controlling provision. This attachment provides an update to those assessments where relevant with consideration to the further work undertaken in accordance with the Minister's Directions. Detailed descriptions of the assessment methodologies used are provided in Technical Report A: *Supplementary marine environment impact assessment* and Technical Report B: *Supplementary threatened and migratory birds impact assessment*.

1.1.3.1 Marine assessment

The marine assessment undertaken for the EES considered the environmental context of Corio Bay. This included assessing the bathymetry (depth of water), monitoring currents and water quality, plankton and larvae surveys over 12 months and surveys of seabed habitat.

These investigations informed the development, calibration and verification of hydrodynamic and water quality modelling for Corio Bay as the basis of the impact assessment. These models were developed to simulate:

- Existing currents, temperatures and salinities in Corio Bay, including response to tides, meteorological conditions, Hovells Creek inflow and existing refinery intake and discharges
- Dilution in the temperature and chlorine plumes created by the various discharges
- Fate and transport of the proposed refinery and floating storage and regasification unit (FSRU) discharges (open loop, closed loop and ballast water) including heated, cooled and chlorinated discharges
- Fate and transport of fine sediments (clay and silt) likely to be mobilised during dredging and dredge material disposal
- Potential transport, dispersion and entrainment of plankton and larvae from different regions in the bay.

In accordance with Recommendations 1 - 8 of Table 1 of the Minister's Directions the marine studies undertaken for the Supplementary Statement included:

- Mapping of seagrass
- Monitoring currents and water quality
- Extensive measurements of water temperature
- Refinement, recalibration and verification of hydrodynamic and water quality modelling for Corio Bay as the basis for further impact assessment.

The modelling predictions in both the EES and Supplementary Statement benefited from the observed data collected during field surveys of the marine environment beneath the existing discharge plumes from the Refinery. The discharges into Corio Bay have been occurring for more than 60 years, with elevated temperature and residual chlorine associated with biofouling control. Accordingly, the results of the impact assessment (of the future discharges on the marine environment with the project) are supported by empirical evidence from the baseline conditions under the existing discharges.

1.1.3.2 Threatened and migratory birds assessment

The EES contained a detailed existing ecological conditions assessment of the terrestrial environment within the pipeline study area. A contextual study was also undertaken to identify 'offsite' MNES for consideration in relation to potential impacts via the marine environment. This included targeted surveys for migratory shorebirds which use intertidal habitats and the Ramsar site.

In accordance with Recommendation 9 of Table 1 of the Minister's Directions the supplementary threatened and migratory birds impact assessment included consideration of potential impacts to a consolidated list of all relevant bird species based on the results of the updated marine modelling. This list is presented in Appendix A of Technical Report B: *Supplementary threatened and migratory birds impact assessment*. This attachment considers the consolidated list of threatened and migratory bird species prepared as part of the Supplementary Statement.

2.0 Ramsar site

There was no change to the existing conditions of the Ramsar site as a result of the supplementary studies, with the exception of updated seagrass mapping. The existing conditions of the Port Phillip Bay Western Shoreline and Bellarine Peninsula Ramsar site are detailed in Section 2 of EES Attachment IV and has been summarised below.

2.1 Overview of Ramsar site

Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site covers 22,650 hectares and is comprised of six distinct areas: Point Cook/Cheetham, Werribee River/Avalon, Point Wilson/Limeburners Bay, Lake Connewarre, Swan Bay and Mud Island (Figure 2-1). The Ramsar site consists of parts of the shoreline, intertidal zones, adjacent wetlands and the Western Treatment Plant wastewater treatment facility.

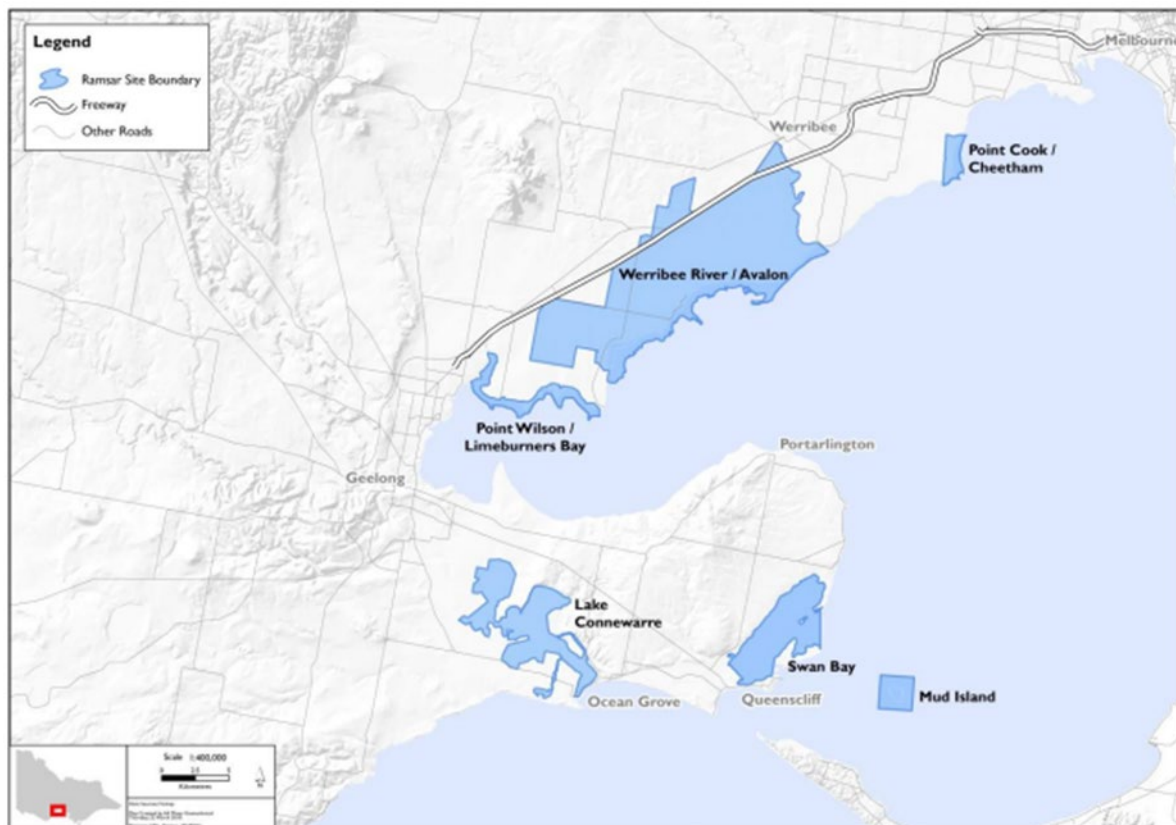


Figure 2-1 Map of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site

Source: extract of Figure 2 from DELWP 2018

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site was nominated for Ramsar listing in 1982 on the basis of four of the eight wetland criteria at the time. An assessment against the current criteria indicates that the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site would have met six of the nine criteria at the time of listing and continues to do so (DELWP, 2020). Further discussion on the wetland criteria is provided in Section 2.2.

Of specific interest to the project is the Point Wilson/Limeburners Bay area of the Ramsar site (refer to Figure 2-1), particularly Limeburners Bay and Avalon Beach within 5 km of the project area. These areas are described below based on the description of the offsite environment in Technical Report D: *Terrestrial ecology impact assessment*.

2.1.1 Limeburners Bay / Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve

As part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, Limeburners Bay is recognised as a wetland of international importance and also has a state significance rating. The area is known broadly as Limeburners Bay State Nature Reserve and comprises Limeburners Bay, Port Phillip Bay Coastal Reserve, and Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve. Hovells Creek Reserve occurs further upstream between Cummins Road and the Princes Highway.

Limeburners Bay is located on the northern shore of Corio Bay and is managed by Parks Victoria in partnership with the City of Greater Geelong.

Limeburners Bay is the best-preserved estuary system in Port Phillip Bay and an excellent example of a funnel-shaped, compound estuary (DSE, 2003). Limeburners Bay is a broad, sandy estuarine inlet which is characterised by open, shallow water at the mouth of Hovells Creek. Hovells Creek is mapped as being a high potential Groundwater Dependent Ecosystem (GDE). The shorelines and sandy spits of Limeburners Bay are important feeding and roosting habitat for birds.

The entrance of the estuary at Point Abeona is the deepest point in Limeburners Bay at over 6 m in the throat of the flood tide channel which shallows rapidly to 2-3 m opposite the boat launching area. The upper basin north of the spit averages one metre in depth and a broad area of sand and mud is exposed around its margins at low tide.

Limeburners Bay is a valuable fish breeding ground for many of the commercial fish species in Port Phillip (DSE, 2003). Large beds of seagrass are supported by the shallow waters of the inlet. Seagrass meadows and mangroves provide habitat for adult fish, nursery areas of juvenile fish and are an important component of the food chain, particularly for international migratory shorebirds. Seagrasses and mangroves also stabilise sediments and contribute to the transfer of nutrients and energy. Seagrass beds are an important component of the ecological character of the Ramsar site.

Extensive seagrass meadows are mapped in the area. The Supplementary Statement identified that the main seagrass species in northern Corio Bay are a combination of *Nanozostera muelleri* (Muelleri) in the intertidal zone and *Heterozostera nigricaulis* (*H. nigricaulis*) *Halophila australis* (Halophila) and *Althenia marina* (Althenia) in the subtidal zone. A small area of Muelleri with a broad leaf was observed in shallow water at the entrance to Limeburners Bay. Figure 2-2 presents the depths at which the different seagrass species occur.

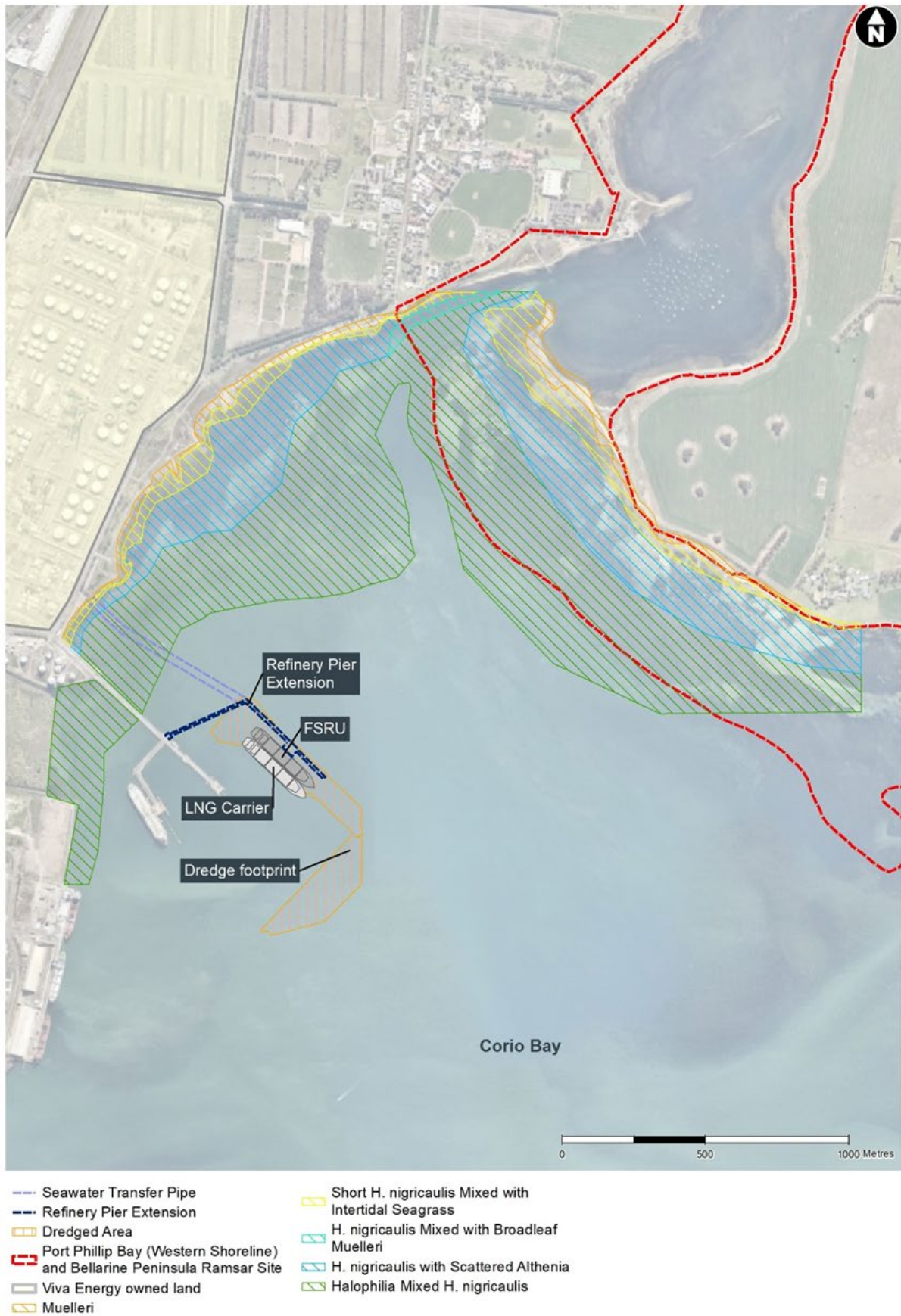


Figure 2-2 Seagrass distribution in Corio Bay (2023 – 2024)

The most extensive seagrass in the Ramsar site which extends to approximately 2 m water depth is *H. nigricaulis*. Growth of this species is seasonal, with strongest growth in spring and relative dormancy over winter. Consequently, it is susceptible to light reduction in spring and can tolerate substantial reduction in light over winter (Bulthuis, 1985).

Benthic (sea floor) habitats in Corio Bay range from muddy to sandy substrates which support infauna (burrowing invertebrates) assemblages, and the sea surface and water column are foraging habitats for seabirds and marine mammals. There is a small area of reef on the northern shore of Corio Bay by Point Lillias.

The stand of White Mangrove *Avicennia marina* subsp. *australasica* on Hovells Creek (Plate 4) is the most extensive remaining in Port Phillip and the Coastal Saltmarsh (EVC 9) of the Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (Plate 5) is probably the most intact (DSE, 2003).

Unlike most Victorian coastal saltmarshes, there is no broad zone dominated by Beaded samphire *Sarcocornia quinqueflora* and the zone of Shrubby Samphire *Tecticornia halocnemoides* (formerly *Halosarcia halocnemoides*) is broader than elsewhere in Victoria. An assemblage of halophytes established where silt deposits raise the level of the marsh forms a low type of saltmarsh that had not been noted elsewhere in Victoria at the time (DSE, 2003). Coastal saltmarsh within the reserve (Plate 5) is vulnerable in Victoria and also represents the EPBC Act listed threatened ecological community - Subtropical and Temperate Coastal Saltmarsh (Section 3.4.2).

The bay is home to more than 40 bird species. Migratory shorebirds include Common Greenshank *Tringa nebularia*, Red-necked Stint *Calidris ruficollis*, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper *Calidris ferruginea* and Red Knot *Calidris canutus*. The terrestrial habitats also support a range of wildlife including Whistling Kite *Haliastur sphenurus* (Marine) and White-bellied Sea-eagle *Haliaeetus leucogaster* (Marine and FFG Act listed).

Although not recognised as a winter stronghold for Orange-bellied Parrot *Neophema chrysogaster* (critically endangered under the EPBC Act), the reserve supports suitable habitat for the species and may be used for foraging while on the mainland or may facilitate movement along the coast to their winter stronghold at the Western Treatment Plant, Werribee.



Plate 1 Limeburners Lagoon (February 2021)



Plate 2 Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (February 2021)



Plate 3 Extensive mudflat and seagrass beds exposed in Limeburners Bay at low tide (February 2021)



Plate 4 Mangrove on Hovells Creek (February 2021)



Plate 5 Boardwalk through Coastal Saltmarsh in the Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (February 2021)



Plate 6 Limeburners Bay with Black Swan, Australian Pelican, Royal Spoonbill and Pied Oystercatcher (February 2021)

2.1.2 Avalon Beach (foreshore and saltworks)

The Port Phillip Bay Coastal Reserve extends around the coast past Avalon Beach to Point Lillias in the east, some 5 km east of the project. Avalon Beach is located within the Avalon Coastal Reserve which is part of the Port Phillip Bay Coastal Reserve, Werribee-Avalon Key Biodiversity Area (KBA) nature hotspot identified by BirdLife Australia, and the Port Phillip Bay (Western Shoreline) and Bellarine Ramsar site.

Avalon Coastal Reserve extends along the northern shore of Corio Bay and incorporates the former Avalon saltworks at Avalon Beach, Point Lillias, Point Wilson and the lagoons of the Western Treatment Plant at Werribee. Avalon Coastal Reserve is also known as 'Avalon Wetland' by City of Greater Geelong and 'Avalon Coast Day Visitor Area (Avalon Coastal Reserve)' by Parks Victoria.

The marine environment of Corio Bay links the project area to the environs of the Avalon Coastal Reserve. The foreshore of Avalon Beach includes a boat ramp, a row of dwellings and an extension of Avalon Foreshore Road which is a walking track on top of a bund between Port Phillip Bay and the lagoons of the former Avalon Saltworks (Plate 7).

The habitat that is provided by this area of the Ramsar site comprises the coastal reserve (beach) and shallow pond system of the former Avalon saltworks site.



Plate 7 Walking track along Avalon Foreshore Road reserve with Port Phillip Bay on right and lagoon of the former Avalon Saltworks on right (February 2021)

The former Avalon saltworks (aka Avalon Coastal Reserve or Avalon Coastal Park) adjacent to the Point Wilson/Limeburners Bay section of the Ramsar site is one of three areas near Geelong (and 11 wetland areas in total; Figure 2-3) that are being considered for inclusion in the Ramsar site (DEECA 2023).

Avalon Coastal Reserve (former Avalon saltworks) inland is recognised as an important shorebird site with average summer counts since 2001 of 3200 shorebirds and peak counts of over 6800 shorebirds (Rogers et al. 2010). The inland habitats are important high tide roosts (Rogers et al. 2010; DEECA n.d) and foraging areas for shorebirds and seabirds with 18 species of shorebirds recorded.

The area supports significant numbers of Red-necked Stint *Calidris ruficollis*, Curlew Sandpiper *Calidris ferruginea* and Sharp-tailed Sandpiper *Calidris acuminata* (Engage Victoria n.d). While the outcome of the review of the Ramsar site boundary is unknown at this stage, the proposal of the former Avalon saltworks in the Ramsar site is indicative of its value and ability to meet the definition of an internationally significant area for shorebirds.

Figure 9. The Werribee-Avalon Shorebird Area, showing the three properties that comprise this complex: Avalon Salt Works, Pt Wilson and the Western Treatment Plant. Major sites (used by > 1000 migratory shorebirds on a regular basis) are highlighted in red (roosts) and yellow (feeding areas).



Figure 2-3 Werribee-Avalon shorebird area showing major roost and feeding sites (from Rogers et al. 2010)

2.2 Significance and listing

A Ramsar wetland is a wetland that has been designated under Article 2 of the Ramsar Convention, or which has been declared by the Federal Environment Minister to be a declared Ramsar wetland under the EPBC Act. The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula was listed as a Ramsar site in December 1982 (RS266) and is Australian Ramsar site number 18.

According to DELWP (2020), an assessment against the nine Ramsar listing criteria indicates that the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula meets six criteria: 2, 3, 4, 5, 6 and 8 (Table 1).

Table 1 Ramsar criteria met by Port Phillip Bay (Western Shoreline) and Bellarine Peninsula

Criteria	Justification (from DELWP 2020)
Criterion 2 - Supports vulnerable, endangered, or critically endangered species or threatened ecological communities	<p>The site regularly supports one wetland dependent threatened ecological community and 13 threatened fauna species listed under the EPBC Act and or International Union for Conservation of Nature (IUCN) Red List 2012:</p> <ul style="list-style-type: none"> • Subtropical and Temperature Coastal Saltmarsh – vulnerable ecological community (EPBC Act) • Australasian Bittern (<i>Botaurus poiciloptilus</i>) – endangered (EPBC Act and IUCN) • Australian Fairy Tern (<i>Sternula nereis nereis</i>) – vulnerable (EPBC Act) • Bar-tailed Godwit (<i>Limosa lapponica baueri</i>) – vulnerable (EPBC Act) and near threatened (IUCN) • Curlew Sandpiper (<i>Calidris ferruginea</i>) – critically endangered (EPBC Act) • Eastern Curlew (<i>Numenius madagascariensis</i>) – critically endangered (EPBC Act) and endangered (IUCN)

Criteria	Justification (from DELWP 2020)
	<ul style="list-style-type: none"> • Great Knot (<i>Calidris tenuirostris</i>) – critically endangered (EPBC Act) and endangered (IUCN) • Greater Sand Plover (<i>Charadrius leschenaultia</i>) – vulnerable (EPBC Act) • Hooded Plover (<i>Thinornis rubricollis rubricollis</i>) – vulnerable (EPBC Act and IUCN) • Lesser Sand Plover (<i>Charadrius mongolus</i>) – endangered (EPBC Act) • Red Knot (<i>Calidris canutus</i>) – endangered (EPBC Act) • Orange-bellied Parrot (<i>Neophema chrysogaster</i>) – critically endangered (EPBC Act and IUCN) • Australian Grayling (<i>Prototroctes maraena</i>) – vulnerable (EPBC Act) • Growling Grass Frog (<i>Litoria raniformis</i>) – vulnerable (EPBC Act)
<p>Criterion 3 - supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region</p>	<p>The Ramsar site supports a high diversity of waterbirds, most likely relate to the diversity of habitats provided by the site.</p> <p>A total of 130 species of waterbird have been recorded within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site; the site represents the most species rich Ramsar site in the South East Coast (Victoria) Drainage Division when compared with other large marine and coastal wetland systems in the bioregion.</p>
<p>Criterion 4 - Supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions</p>	<p>Port Phillip Bay (Western Shoreline) and Bellarine Peninsula supports large numbers of migratory waterbirds, breeding of waterbirds and frogs, nursery grounds for fish and supports waterfowl during moulting of their primary flight feathers. The permanent freshwaters of Reedy Lake and the Western Treatment Plant provide valuable habitat for waterfowl and other species when most inland, freshwater wetlands in southern Victoria are dry.</p>
<p>Criterion 5 - Regularly supports 20,000 or more waterbirds</p>	<p>Waterbird counts across the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site are very high (mostly due to the large numbers of birds supported by the Western Treatment Plant). Counts of shorebirds indicate the site has supported > 20,000 every year from 1981 with a maximum count of over 300,000 in 1993. Counts of waterfowl are generally > 80,000.</p>
<p>Criterion 6 - Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird</p>	<p>Data provided by BirdLife Australia and from the DELWP Annual Summer Waterfowl Counts, indicate that 12 species meet this criterion at the time of listing. More recent records (2000 – 2019) indicate the site supports >1% of the population of 15 species:</p> <ul style="list-style-type: none"> • Australasian Shoveler (<i>Anas rhynchos</i>) • Australian Fairy Tern (<i>Sternula nereis nereis</i>) • Australian Pied Oystercatcher (<i>Haematopus longirostris</i>) • Australian Shelduck (<i>Tadorna tadornoides</i>) • Blue-billed Duck (<i>Oxyura australis</i>) • Chestnut Teal (<i>Anas castanea</i>) • Curlew Sandpiper (<i>Calidris ferruginea</i>)

Criteria	Justification (from DELWP 2020)
	<ul style="list-style-type: none"> • Double-banded Plover (<i>Charadrius bicinctus</i>) • Hoary-headed Grebe (<i>Poliiocephalus poliocephalus</i>) • Musk Duck (<i>Biziura lobata</i>) • Pink-eared Duck (<i>Malacorhynchus membranaceus</i>) • Red-necked Stint (<i>Calidris ruficollis</i>) • Red-necked Avocet (<i>Recurvirostra novaehollandiae</i>) • Sharp-tailed Sandpiper (<i>Calidris acuminata</i>).
Criterion 8 - An important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	Seagrass beds and other habitats within the Ramsar site are known to provide important nursery habitat for numerous fish species, including several that have important fisheries resource values.

2.2.1 Ecological character (values)

As a signatory to the Ramsar convention, Australia is expected to conserve and maintain the ecological character of all Ramsar wetlands in its territory. To achieve this, ecological character descriptions (ECD) are being prepared for all Ramsar sites. These provide a benchmark against which to assess any future change in ecological character.

The *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Ecological Character Description* has been prepared by DELWP (DELWP, 2020). The ECD identifies and describes the components, processes and services (CPS) that are critical to the ecological character of the Ramsar site. This covers values across the 6 areas of the Ramsar site, not all of which apply to the Point Wilson/Limeburners Bay area. Critical CPS are summarised in Table 2.

The critical CPS of the site are:

Components:

- Hydrology
- Freshwater vegetation
- Seagrass
- Saltmarsh
- Mangroves
- Native fish
- Waterbird abundance

Processes:

- Waterbird breeding

Services:

- Supports threatened species
- Provides physical habitat for waterbirds
- Provides physical habitat for fish
- Ecological connectivity

Table 2 Values of the Ramsar site

Value	Description (extract from DELWP 2020)
Critical components and processes	
Hydrology	<p>Two aspects of hydrology are considered critical to the ecological character:</p> <ul style="list-style-type: none"> • Interaction between freshwater inflows and tidal exchange in the Lake Connewarre Complex. • Artificial water regimes that maintain the highly productive lagoons of Cheetham Wetlands and the Western Treatment Plant.

Value	Description (extract from DELWP 2020)
Vegetation	<p><i>Seagrass</i> – seagrass is present at three locations: Mud Islands, Swan Bay and the coastal areas adjacent to Point Wilson / Limeburners Bay. It is dominated by two species of <i>Zostera</i>, with smaller areas of <i>Halophilla ovalis</i>. Extent and density are highly variable.</p> <p><i>Saltmarsh</i> – seven community types are present, dominated largely by succulent shrubs of the genera <i>Tecticornia</i> and <i>Sarcocornia</i>.</p> <p><i>Mangroves</i> – there are small areas of Grey Mangrove (<i>Avicennia marina</i> subsp. <i>australasica</i>) in the Barwon Estuary (~52 hectares) and adjacent to the Ramsar site in Limeburners Bay and at Point Cooke.</p> <p><i>Freshwater wetland vegetation</i> – tall marsh dominated by common reed occurs at Reedy Lake. An unusual salt tolerant lignum shrubland also occurs at this location. A variety of common emergent, submerged and floating aquatic species occur in parts of the Western Treatment Plant.</p>
Native fish	<p>The site supports a diversity of fish with different life histories. Freshwater fish are supported in the Little River, Western Treatment Plant and Lake Connewarre Complex. The site also supports a number of diadromous fish (i.e. those that regularly migrate between fresh and saltwater). The nationally vulnerable Australian Grayling has been recorded in the Lake Connewarre Complex.</p> <p>Large number of marine and estuarine fish occur in the subtidal and intertidal habitats. Swan Bay supports a high diversity of species and is an important nursery for King George Whiting. Mud Islands habitats support marine species including a number of sharks and rays.</p>
Waterbird diversity and abundance	<p>The site supports more than 120 species of wetland dependent bird, including 22 species of migratory shorebirds that are regularly recorded within the site. At the time of listing annual maximum abundance was around 180,000 birds. Large numbers of waterfowl use the Western Treatment Plant and fish-eating species such as gulls and terns are supported by Mud Islands.</p>
Waterbird breeding	<p>Breeding has been recorded for at least 49 species of wetland dependent birds. Beach nesting species (Red-capped Plover, Australian Pied Oyster Catchers) breed at Cheetham Wetlands and on Mud Islands. A number of waterfowl and an established colonial nesting colony dominated by Pied Cormorants are supported at the Western Treatment Plant. Mud Islands also supports very large numbers of colonial nesting species with combined totals of > 100,000 nests.</p>
Critical benefits and services	
Provides physical habitat (for waterbirds)	<p>The site provides a network of habitats for waterbird feeding, roosting, moulting and breeding. Species that are supported by the site represent a wide range of functional groups (e.g. shorebirds, ducks, fish-eaters, large-bodied waders) each with different habitat requirements.</p>
Provides nursery habitat for native fish	<p>Saltmarsh and seagrass communities in Swan Bay are significant nursery habitats for juvenile fish. In particular, the larval stages of some fish species, such as King George Whiting, Blue Rock Whiting, Leatherjackets and pipefish settle directly on sub-tidal seagrass beds and then the structural habitat of seagrass and saltmarsh provide protected waters for young fish.</p>

Value	Description (extract from DELWP 2020)
Threatened wetland species and ecosystems	The site provides important habitat for 13 species of threatened fauna, including: seven international migratory shorebirds (Bar-tailed Godwit, Eastern Curlew, Curlew Sandpiper, Great Knot, Red Knot, Lesser Sand Plover and Greater Sand Plover), Australasian Bittern, Australian Fairy Tern, Hooded Plover, Orange-bellied Parrot, Growling Grass Frog and Australian Grayling. The nationally vulnerable Subtropical and Temperate Coastal Saltmarsh community is also present within the site.
Ecological connectivity	The Ramsar site has a range of distinct wetland types which are ecologically connected. The connection between the marine, estuarine and freshwater components is significant for fish migration and reproduction. The site also supports significant numbers of international migratory shorebird species.

The Limeburners Bay to Point Wilson section supports values which are limited elsewhere within the Ramsar site. Those values include intertidal rocky reefs, typically colonised by mat forming brown algae; the mangrove area in Limeburners Bay, which provides good habitat for fish and invertebrates and plays a role in stabilising the soft sediments in the site; and seagrass beds which are only known from three locations within the Ramsar site.

2.2.2 Limits of Acceptable Change

The ECD for the Ramsar site sets Limits of Acceptable Change (LAC) for each critical CPS. LAC is the term used to describe the acceptable variation in a particular component of a Ramsar site without a change in ecological character leading to a reduction or loss of a value for which the site was listed as a Ramsar site. LAC are a tool by which change in ecological character and management effectiveness can be measured.

LAC for the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site are summarised in Table 3. It is noted that the LAC corresponds to all 6 areas of the site and may not be specifically measurable for the Point Wilson/Limeburners Bay area. The main values which have the potential to be affected by the project are seagrass in north Corio Bay, saltmarsh, mangroves in Limeburners Bay and migratory shorebirds which rely on intertidal areas for foraging and mangroves and seagrass to maintain their food supply.

Table 3 Limits of Acceptable Change for the Ramsar site (Extract from pg. 67-69, DELWP, 2020)

Component/process	Limit of Acceptable Change	DELWP assessment (2020)
Ecological connectivity	Connectivity between the Barwon River and the Southern Ocean is not impeded between March and November for more than two consecutive years.	Connectivity has been maintained through operational fishways. LAC is met.
Hydrology	Reedy Lake will not be continuously wet for more than 10 continuous years, or continuously dry for more than five. At least 75% of aerobic treatment lagoons at the Western Treatment Plant will contain permanent water. At least 75% of the lagoons at Cheetham will contain permanent water.	Wetlands at the Western Treatment Plant and Cheetham Wetlands have remained inundated and managed according to management plans. Reedy Lake had a wet-dry seasonal cycle in 2005-6 and 2006-7, inundated continuously for 9 years from 2001-8 to 2015-16, then successful wet-dry cycles in 2016-17 and 2017-18 (Corangamite CMA 2018). LAC is met.

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
Vegetation: seagrass	Seagrass extent will not fall below 1500 hectares for a period of greater than 20 continuous years.	Mapping from 2000 indicate a total of 2900 hectares of seagrass within the Ramsar site boundary in 2000. A recent assessment indicated that seagrass cover in Swan Bay had changed little from 2008 to 2012 (Ball et al. 2014). LAC is met.
Vegetation: saltmarsh	Total saltmarsh extent will not fall below 900 hectares.	The most recent assessment of saltmarsh extent in the Ramsar site (Boon et al. 2011) indicates 1225 hectares. There is no evidence of a significant decline in saltmarsh extent. LAC is met.
Vegetation: mangroves	Total mangrove extent will not fall below 40 hectares.	The most recent assessment of mangrove extent in the Ramsar site indicates 52 hectares. LAC is met.
Vegetation: freshwater aquatic vegetation	A habitat mosaic will be maintained at Reedy Lake that comprises open water, emergent native vegetation (sedges, rushes and reeds) and lignum shrubland with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.	Assessments of vegetation in 2014, indicated 63% emergent vegetation (sedges and reeds); 21% open water; 12% lignum shrubland and 4% other communities (Ecological Associates 2014). More recent assessments (that did not include mapping) indicate that the habitat mosaic remains and there have been improvements in some vegetation communities (GHD 2018). LAC is met.
Native fish	A minimum of 3 fish species per standard haul of a 10 m seine net from three replicate hauls in subtidal habitats of Swan Bay; A minimum abundance of 5 fish per standard haul of a 10 m seine net from three replicate hauls in subtidal or intertidal habitats of Swan Bay	There are no recent assessments of fish from Swan Bay. Insufficient data to assess the LAC.
Waterbird abundance	Abundance of waterbirds will not decline below the following (calculated as a rolling five-year average of maximum annual count): <ul style="list-style-type: none"> Total waterbirds – 100,000 Australasian waders – 1500 Ducks – 30,000 Fish eating species – 2250 Herbivores – 6000 Double-banded Plover – 1% Red-necked Stint – 1% Sharp-tailed Sandpiper – 1.5% 	Data from BirdLife Australia (shorebirds) and DELWP (non-shorebirds) indicates the following average annual maximum counts (2015 – 2019): <ul style="list-style-type: none"> Total waterbirds – 228,000 Migratory waders – 22,800 Australasian waders – 6900 Ducks – 132,000 Fish eating species – 9400 Herbivores – 26,000 Double-banded Plover – 2.8% Red-necked Stint – 1.7% Sharp-tailed Sandpiper – 4.9% LAC is met.

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
Waterbird diversity	<p>Diversity of waterbirds will not decline below the following (calculated as a rolling five-year average of number of species):</p> <ul style="list-style-type: none"> • Total waterbirds – 70 • Migratory waders – 20 • Australasian waders – 10 • Ducks – 10 • Fish eating species – 12 • Herbivores – 2 • Gulls – 2 • Large bodied waders – 7 • Other – 2 	<p>Data from Birdlife Australia (shorebirds) and DELWP (non-shorebirds) indicates the following annual average number of species (2015 – 2019):</p> <ul style="list-style-type: none"> • Total waterbirds – 105 • Migratory waders – 23 • Australasian waders – 12 • Ducks – 17 • Fish eating species – 19 • Herbivores – 7 • Gulls – 2 • Large bodied waders – 15 • Other – 5 <p>LAC is met.</p>
Waterbird breeding	<p>Annual breeding at Mud Islands of colonial nesting species of at least 25,000 pairs / nests. Presence of all of the following species breeding in at least three in every five years: Australian Pelican, Australian Pied Oystercatcher, Australian White Ibis, Crested Tern, Little Pied Cormorant, Pied Cormorant, Silver Gull, Straw-necked Ibis and White-faced Storm Petrel.</p> <p>Annual breeding at Western Treatment Plant of > 300 pairs of Pied Cormorant.</p>	<p>There has been no dedicated or comprehensive survey of breeding waterbirds at Mud Islands since 2009. Records from the Atlas of Living Australia indicate significant breeding at Mud Islands in 2016 with the following individuals recorded (although numbers of nests are unknown): Pied Cormorant 250; Straw-necked Ibis 50,000; Australian white ibis 5000; crested tern 2500; silver gull 30,000</p> <p>Nesting Pied Cormorants increased at the Western Treatment Plant to approximately 1000 nests in 2010-2012 (Loyn et al. 2014).</p> <p>LAC is met, but with a low degree of confidence.</p>
Supports threatened species: waterbirds	<p>Australasian Bittern, Bar-tailed Godwit, Eastern Curlew, Great Knot, Hooded Plover, Lesser Sand Plover and Red Knot recorded within the site in three out of five seasons.</p> <p>Abundance of waterbirds will not decline below the following (calculated as a rolling five year average of maximum annual count; percentages calculated based on Hansen et al. (2016) for migratory shorebird species and the latest Wetlands International Waterbird Population for other species):</p> <ul style="list-style-type: none"> • Australian Fairy Tern – 0.6% • Curlew Sandpiper – 1. 	<p>Data from 2015 – 2019 indicate presence of the seven species (BirdLife Australia; DELWP, Atlas of Living Australia):</p> <p>Australasian Bittern – five years Bar-tailed Godwit – five years Eastern Curlew – five years Great Knot – four years Hooded Plover – five years Lesser Sand Plover – zero years Red Knot – five years.</p> <p>Average annual maximum abundance (2015 to 2019):</p> <p>Australian Fairy Tern – 11% (171 individuals) Curlew Sandpiper – 3% (2864 individuals)</p> <p>LAC is met for all species except Lesser Sand Plover.</p>

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
Threatened species: Orange-bellied Parrot	See LAC for saltmarsh.	Although the LAC for saltmarsh is met, the decline in Orange-bellied Parrot is summarised in section 6.2 of DELWP (2020).
Threatened species: Australian Grayling	Australian Grayling continues to be supported in the Barwon River system.	Australian Grayling continues to be recorded in the Barwon River System annual including in 2019 (O'Connor et al. 2019). LAC is met.
Threatened species: Growling Grass Frog	At Western Treatment Plant > 200 Growling Grass Frogs in 3 out of 5 years. Presence of Growling Grass Frog in the Lake Connewarre complex in 3 out of 5 years.	While there was < 200 Growling Grass Frogs recorded at the Western Treatment Plant in 2011/12 and 2014/15; there have been well in excess of 200 individuals recorded each year from 2015/16 to 2018/19. This includes > 1000 frogs in 2015/16 (Melbourne Water unpublished). There are records of Growling Grass Frog from the Lake Connewarre Complex in 2016, 2017, 2018 and 2019 (Atlas of Living Australia). LAC is met.

2.2.3 Threats

Threats identified for Point Wilson / Limeburners Bay area of the Ramsar site in the *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan* (DELWP 2018) area include:

- Climate change resulting in sea level rise impacting on intertidal vegetation and waterbird habitat (priority threat).
- Changed operations at the Western Treatment Plant decreasing nutrients and carbon and emerging chemicals of concern.
- Urban development causing direct habitat removal and loss of buffer.
- Litter (including micro-plastics) effects on biota (priority threat).
- Invasive species including foxes and cats predated on waterbirds, salt tolerant weeds impacting saltmarsh and waterbird habitat (priority threat) and non-native grazing animals (rabbits and deer) impacting vegetation and habitat.
- Recreation: boats, jet skis, kite surfers, walkers and horse-riding disturbing waterbird feeding, breeding and roosting (priority threat) and vehicles damaging saltmarsh.
- Duck hunting impacts to non-target species (priority threat).

3.0 Threatened and migratory bird species

To address Recommendation 9 of the Minister's Directions, a consolidated list of threatened and migratory bird species was developed and is provided in Appendix A of Technical Report B: *Supplementary threatened and migratory bird impact assessment*. A summary of the methodology to develop this list is provided below.

The list of threatened and migratory bird species that could occur in the project area was developed by undertaking the following steps:

- An updated search of the Victorian Biodiversity Atlas (VBA) and/or predicted to occur by the EPBC Act Protected Matters Search Tool (PMST) for records of species within 5 km of the Project area (Figure 3-2).
- An assessment of the likelihood of threatened and migratory bird species occurring in the project area and offsite environment (Corio Bay, Limeburners Bay and Avalon Beach).

The likelihood of occurrence assessment for the consolidated list of EPBC Act-listed threatened and migratory bird species, prepared in accordance with Recommendation 9 of the Minister's Directions, identified that nineteen EPBC Act-listed threatened bird species may occur within 5 km of the project.

The likelihood of occurrence assessment considered potential for species to occur in the:

- Project area: as shown in Figure 3-1 including terrestrial (i.e., onshore pipeline, treatment facility and tie-in point) and marine (i.e., the FSRU which would be moored at the Refinery Pier extension) components; and
- Offsite environment: including parts of Corio Bay, Limeburners Bay and beyond to Avalon Beach. These areas were included as part of the study area due to the project's proximity to a Ramsar site and because potential marine impacts associated with the project could impact on the Ramsar site, for example, impacts on the food chain for threatened and migratory birds.

Field assessments of the terrestrial pipeline from the original EES Technical Report D: *Terrestrial ecology impact assessment* and migratory shorebird surveys in the offsite environment informed the assessment

A baseline assessment of migratory shorebirds within, and adjacent to, the project was undertaken as part of the original EES in 2021. Four surveys were undertaken in summer and one survey was undertaken in winter. All except one of the six sites surveyed are located within the Ramsar site which is recognised as an internationally important area and are therefore automatically considered important habitat for migratory shorebirds.

Monitoring focused on waders (Charadriiformes), including migratory shorebirds. Other species included in the count data were waterbirds (e.g., waterfowl, herons, egrets and grebes), seabirds (e.g. gulls, cormorants and terns) and raptors (e.g. eagles, kestrels, kites and falcons) due to their potential to interact with aquatic food chains. Four migratory shorebird species were identified during the surveys. Sharp-tailed Sandpiper *Calidris acuminata*, Red-necked Stint *Calidris ruficollis*, Curlew Sandpiper and Common Sandpiper *Actitis hypoleucos*. The migratory shorebird survey was presented in a standalone report appended to EES Technical Report D: *Terrestrial ecology impact assessment*.



Figure 3-1 Project area (terrestrial and marine) and offsite area



- EPBC Act listed species
- EPBC Act listed species - added since referral
- Aboveground Pipeline
- Underground Pipeline
- Seawater Transfer Pipe
- Refinery Pier Extension
- ▭ Dredged Area
- ▭ Viva Energy owned land
- ▭ Proposed Pipeline 5km Buffer
- Proposed Pipeline



Figure 3-2 VBA records of EPBC Act listed bird species within 5 km of the study area (8 September 2023)

3.1 Threatened species

The purpose of this section is to present which species have potential to occur in the project area and could therefore be affected by the Project.

Nineteen bird species listed as threatened under the EPBC Act were identified on the consolidated list developed for the Supplementary Statement as species with potential to occur in the project area and/or the offsite environment (likelihood ratings of possible, likely or present). Those species were:

- Terrestrial species
 - Gang-gang Cockatoo *Callocephalon fimbriatum* –endangered, but listing occurred after the referral decision for the project therefore not considered a MNES. Species therefore not considered further in this attachment.
 - Orange-bellied Parrot *Neophema chrysogaster* - critically endangered.
 - Swift Parrot *Lathamus discolor* – critically endangered.
 - White-throated Needletail *Hirundapus caudacutus* – vulnerable and migratory.
- Shorebirds
 - Australian Painted-snipe *Rostratula australis* – endangered.
 - Curlew Sandpiper *Calidris ferruginea* – critically endangered.
 - Eastern Curlew *Numenius madagascariensis* - critically endangered.
 - Great Knot *Calidris tenuirostris* - critically endangered.
 - Greater Sand Plover *Charadrius leschenaultia* - vulnerable.
 - Latham's Snipe *Gallinago hardwickii* - vulnerable, but listing as vulnerable occurred after the referral decision for the project therefore considered a migratory but not threatened MNES in this attachment.
 - Lesser Sand Plover *Charadrius mongolus* – endangered.
 - Red Knot *Calidris canutus* – endangered.
- Seabirds
 - Black-browed Albatross *Thalassarche melanophris* – vulnerable.
 - Fairy Prion (southern) *Pachyptila turtur subantarctica* – vulnerable.
 - Fairy Tern *Sternula nereis* – vulnerable.
 - Indian Yellow-nosed Albatross *Thalassarche carteri* – vulnerable.
 - Northern Giant Petrel *Macronectes halli* - vulnerable, but listing occurred after the referral decision for the project therefore not considered a MNES. Species therefore not considered further in this attachment.
 - Shy Albatross *Thalassarche cauta* – endangered.
 - Southern Giant-Petrel *Macronectes giganteus* - endangered, but listing occurred after the referral decision for the project therefore not considered a MNES. Species therefore not considered further in this attachment.

Threatened species with potential to occur in the project area and/or offsite environment are discussed below. Where species have a similar habitat, they have been grouped together. Species which were listed as threatened after the referral decision are not considered MNES in accordance with Section 158A(4) of the EPBC Act. Those species are therefore not discussed further unless listed as migratory under the EPBC Act.

Potential impacts to EPBC Act listed birds are summarised in Section 4.2.1.

3.1.1 Terrestrial species

3.1.1.1 Orange Bellied Parrot

No habitat for Orange Bellied Parrot in the terrestrial or marine components of the project area. There is a small area (0.015 ha) of coastal saltmarsh within 50 m of the terrestrial pipeline project area near the existing water intake structure although this area may be planted. The area of coastal saltmarsh is outside the project area.

Orange Bellied Parrot may occur in offsite environment in the Coastal Saltmarsh at Limeburner's Lagoon or former Avalon Saltworks on occasion, as there are previous VBA records from those areas:

- One record of Orange-bellied Parrot from Avalon Saltworks north of Dandos Road (inland adjacent to Avalon airport) from 1993.
- One record from 1986 from Limeburners Bay.

The stronghold for the species when on mainland Victoria is centred around the Western Treatment Plant/Point Wilson/Murtcaim Wildlife Area more than 10km to the west, Swan Bay/Swan Island approximately 30km to the south-east and Lake Connewarre approximately 15km south of the project. Orange-Bellied Parrot is considered possible to occur in the offsite environment.

3.1.1.2 Swift Parrot

Swift Parrot breed in Tasmania and migrate to mainland Australia during winter to forage in the forests of Victoria and New South Wales. In Victoria, Swift Parrots are primarily found in the Box Ironbark forests through central Victoria. Their preferred food trees are Yellow Gum *E. leucoxylon*, Red Ironbark *Eucalyptus tricarpa*, Mugga Ironbark *E. sideroxylon*, and Grey Box *E. macrocarpa* (DCCEEW 2024). There are a few records of Swift Parrot each year from the Melbourne and Geelong districts (Birds Australia, 2011).

A review of VBA records shows past observations from Geelong Grammar School in 1998. Most records on the VBA within 5 km of the project are from areas that provide more extensive foraging resources, such as between Lara and Little River (the You Yangs or Serendip Sanctuary) and in Newtown, Geelong. Given the general lack of foraging resources provided in the project area, they would only be anticipated to use the area on an opportunistic and occasional basis.

Swift Parrot is considered possible to occur in the terrestrial component of the project area.

While moving through to central Victoria, Swift Parrot may occasionally forage in the small, planted eucalypts which occur in and immediately adjacent to the onshore pipeline component of the project, although the habitat is limited in extent, canopy spread and maturity. Narrow strips of mixed native, non-indigenous trees occur along the pipeline alignment between School Road and Torresdale Road.

3.1.1.3 White-throated Needle-tail

White-throated Needle-tail may feed in the airspace over the onshore pipeline component of the project when in south-eastern Australia during the Australian spring to early-autumn (TSSC 2019). They may roost in trees on occasion.

White-throated Needle-tail may also feed in the airspace over the terrestrial areas of the Ramsar site in the offsite environment.

White-throated Needle-tail is therefore considered possible to occur in the terrestrial component of the project area and the offsite environment.

3.1.2 Shorebirds

3.1.2.1 Australian Painted-snipe

Australian Painted-snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains.

Australian Painted-snipe are considered rare, vagrant species in Port Phillip Bay. The species may occur beyond the project environment in association with inshore wetland habitats of the Ramsar site.

Australian Painted-snipe is considered possible to occur in the offsite environment but not the terrestrial or marine components of the project.

There is no suitable habitat for the Australian Painted-snipe in the terrestrial or marine components of the project area.

3.1.2.2 Eastern Curlew/Curlew Sandpiper/Red Knot/Great Knot/Lesser Sand Plover/Greater Sand Plover

No suitable habitat in the terrestrial or marine components of the project area for Eastern Curlew, Curlew Sandpiper, Red Knot, Great Knot, Lesser Sand Plover or Greater Sand Plover. The shoreline around the existing pier (marine component of the project area) is disturbed and modified. Shorebird surveys conducted for the EES in February 2021 did not detect migratory shorebird activity adjacent to the existing Refinery Pier. This suggests the habitat is unsuitable and these migratory shorebirds are unlikely to occur.

Eastern Curlew occurs further east on the Port Phillip Bay coast and may occur beyond the project environment in association with the habitats of the Ramsar site. Eastern Curlew have not been seen in the general area since the 1970/80s and are unlikely to occur with any regularity. The last stronghold for Eastern Curlew in Victoria is French Island in Westernport Bay (Saddler, 2019).

Curlew Sandpiper were recorded at Avalon Beach during shorebird surveys conducted for the EES in February 2021 and are likely to occur in habitats of the Ramsar site. Red Knot are likely to occur in the habitats of the Ramsar site (Limeburner's Bay/Lagoon and former Avalon saltworks). Curlew Sandpiper and Red Knot have been previously recorded at Limeburners Lagoon for the EES in February 2021.

Great Knot is likely to occur in the habitats of the Ramsar site (Limeburners Bay/Lagoon and former Avalon Saltworks). Greater Sand Plover and Lesser Sand Plover may also occur in habitats of the Ramsar site.

3.1.3 Seabirds

3.1.3.1 Black-browed Albatross

Black-browed Albatross are a pelagic seabird which spends most of its life on the open ocean but also occurs in inshore waters. They may forage in Corio Bay and are considered possible to occur in the offsite marine environment.

There is no suitable habitat in the terrestrial or marine components of the project area for Black-browed Albatross and there are no VBA records within 5 km of the project.

3.1.3.2 Fairy Prion

Southern subspecies of Fairy Prion breeds on Macquarie Island and other sub-Antarctic islands dispersing north in winter – spring during the non-breeding period to sub-tropical waters off the coast of south-eastern Australia. Species can often be seen from land particularly after strong onshore winds. Nominate species known to breed on offshore islands off Tasmania and in Bass Strait and are present in surrounding waters year-round (Menkhorst et al. 2017).

Fairy Prion may be an occasional visitor to Port Phillip Bay. Nominate species is more likely to occur than the southern subspecies listed under the EPBC Act. Fairy Prion is considered possible to occur in the offsite marine environment.

There is no suitable habitat for Fairy Prion in the terrestrial or marine components of the project area.

3.1.3.3 Fairy Tern

Fairy Tern generally occur in sheltered coasts and embayments both on the mainland, and on inshore and offshore islands. Fairy Terns utilise a variety of habitats centred on beaches and offshore islands (for nesting) and near-shore waters (for foraging) (DAWE 2020).

Fairy Tern is considered possible to occur in the marine component of the project area (foraging) and present in the offsite marine environment.

Fairy Terns regularly forage over the shallow marine waters of Corio Bay and may forage in the marine component of the project area. Individuals are likely to occasionally hunt along the shoreline of Corio

Bay adjacent to the project and may rest on anthropogenic structures beyond the project environment. There are VBA records on the seawater intake next to existing Refinery Pier.

There is no suitable habitat for Fairy Tern in the terrestrial component of the project area.

3.1.3.4 Indian Yellow-nosed Albatross

Indian Yellow-nosed Albatross is a seabird which occurs in inshore waters out to the continental slope. They are regularly observed from land (Menkhorst et al. 2017) and may forage in Corio Bay.

There is no suitable habitat for Indian Yellow-nosed Albatross in the terrestrial or marine components of the project area.

Indian Yellow-nosed Albatross is considered possible to occur in the offsite marine environment.

3.1.3.5 Shy Albatross

Shy Albatross is a pelagic seabird which spends most of its life on the open ocean, occasionally found in large bays and known from inshore and deeper parts of Port Phillip Bay. The species may forage in Corio Bay. Shy Albatross is considered possible to occur in the offsite marine environment.

There is no suitable habitat for Shy Albatross in the terrestrial or marine components of the project area and there are no VBA records of Shy Albatross within 5 km of the project.

3.2 Migratory species

The purpose of this section is to present species listed as migratory under the EPBC Act with potential to occur in the project area and/or offsite environment that could therefore be affected by the Project. Species that are also listed as threatened under the EPBC Act are also discussed in Section 3.1 above.

Potential impacts to EPBC Act listed birds are summarised in Section 4.2.

3.2.1 Project area (terrestrial)

Migratory bird species with the potential to occur within the terrestrial component of the project area are:

- Fork-tailed Swift *Apus pacificus* which is an almost exclusively aerial species that occurs in a range of habitats from inland open plains to wooded areas (DoE 2015). The species may forage over the pipeline component of the Project Area or occasionally loaf in trees.
- White-throated Needletail *Hirundapus caudacutus* (also listed as threatened – refer to Section 3.1.1.3).
- Rufous Fantail *Rhipidura rufifrons*. Rufous Fantail *Rhipidura rufifrons* which has potential to occur in grasslands and planted vegetation in the terrestrial component of the project on passage through the Corio/Avalon area. The primary habitat for this species comprises moist, dense habitats including mangroves, rainforest and wet eucalypt forests with a dense understorey (DoE 2015) which do not occur in the project area.

3.2.2 Project area (marine)

The marine component of the project area is modified by the existing Refinery Pier and associated anthropogenic industrial activity. As such, the habitat is unlikely to support many migratory bird species. Species that may occur in this area are likely to only do so on occasion as part of wider activity in the surrounding marine environment.

Migratory birds with some potential to occur in or immediately adjacent to the marine component of the project are comprised of five species of terns. The following tern species that may occasionally forage over the marine waters of the project and may roost on structures:

- Caspian Tern *Hydroprogne caspia*. Occasional birds forage over shallow marine waters of Corio Bay. May rest on anthropogenic structures. Breed mainly on offshore coastal islands.
- Common Tern *Sterna hirundo*. Occasional birds forage over shallow marine waters of Corio Bay. May rest on anthropogenic structures. Breed in the northern hemisphere.

- Gull-billed Tern *Gelochelidon nilotica macrotarsa*. Occasional birds forage over shallow marine waters of Corio Bay. Nests in colonies on large ephemeral lakes, marsh and coasts.
- Little Tern *Sternula albifrons* have been recorded roosting on the seawater intake structure immediately adjacent to the existing pier (VBA). Terns may forage along the shoreline and over the marine waters of the project, and may roost on structures. Little Terns primarily breed in Asia but smaller populations nest in Australia in colonies on sandy beaches.
- Crested Tern *Thalasseus bergii* regularly forage over shallow marine waters of Corio Bay and were observed during shorebird surveys at the former Avalon saltworks, W5 outfall in proximity to the project and Point Abeona. Crested Terns may forage along the shoreline and over the marine waters of the project, and may roost on structures. Nest in colonies on islands.

3.2.3 Offsite environment

Migratory bird species with potential to occur beyond the project environment in Limeburners Bay, Avalon Beach and Corio Bay comprise:

- Thirty-two species of migratory shorebirds. These species are more likely to occur in association with the inshore ponds of the former Avalon saltworks (and to a lesser extent Limeburners Lagoon) but some are also likely to forage along the shoreline of Corio Bay within the Ramsar site.
- Seventeen species of seabirds comprising of three species of shearwater, six species of tern, two species of giant petrel, one storm petrel, one prion, three species of jaeger, and three species of albatross. Most of those species are pelagic, which means they occupy open oceans in preference to embayments. Pelagic species are unlikely to occupy Port Phillip Bay (and therefore Corio Bay) for most of their lifespan. The species may use the shallow marine waters of Corio Bay for foraging on occasion but are more likely to use the bay opportunistically during rough weather (AECOM 2022b). Terns are known to regularly occur in the area and are the seabirds most likely to hunt in the waters of Corio Bay in the offsite environment. Terns may also roost on structures.
- Two terrestrial (non-aquatic) species White-throated Needletail that may feed in the airspace over the terrestrial areas of the Ramsar site and Rufous Fantail *Rhipidura rufifrons* which has potential to occur on passage through the Corio/Avalon area in grasslands and planted vegetation beyond the project environment.
- One species of raptor (birds of prey) Eastern Osprey *Pandion cristatus*, that has potential to occur in the habitats of the Ramsar site. There are VBA records from Avalon Beach and the former Avalon saltworks area.
- One species of waterbird, Glossy Ibis *Plegadis falcinellus*. This species would utilise the inshore ponds and wetlands of the Ramsar site rather than the shoreline or bay.

4.0 Impacts on MNES

This section describes the potential impacts on MNES identified as part of the supplementary technical studies prepared for the project (Ramsar site and threatened and/or migratory birds). Potential impacts on MNES not relevant to the supplementary studies are presented in EES Attachment IV. Measures to manage or mitigate the potential impacts are recommended and any ecological impacts that remain following the adoption and implementation of those measures (residual impacts) are outlined.

As described in the following sections, with the adoption of management and mitigation measures, residual impacts on Ramsar wetlands and threatened and migratory bird species would be minimised and significant impacts are unlikely.

4.1 Ramsar site

The project is unlikely to have a significant impact on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. There would not be a substantial or measurable change in the water quality of the wetland or to vegetation (seagrass) or fauna (waterbirds/shorebirds) at the site. The critical components, processes and services (CPS) of the site would be unaffected by the project and LAC would continue to be met.

The following sections discuss the potential mechanisms through which impact on the Ramsar site could be realised.

4.1.1 Construction

As described in the EES, the primary impact pathway for the Ramsar site from construction activities is dredging for a period of 8 weeks and its potential effects on seagrass meadows and the food chain of waterbirds through sediment mobilisation affecting phytoplankton (microscopic marine algae) productivity.

4.1.1.1 Sediment mobilisation

In accordance with Recommendations 6 to 8 of the Minister's Directions, the further assessment of the impacts of dredging was undertaken utilising the refined regional hydrodynamic model in Technical Report A: *Supplementary marine environment impact assessment*. The original EES conclusion that there would be no significant impacts on the Ramsar site from dredging was confirmed. This section summarises the findings of the Technical Report A: *Supplementary marine environment impact assessment* as they relate to the Ramsar site.

Corio Bay has been extensively modified by dredging channels to allow access by sea-going vessels, development of the Port of Geelong and development of marinas for recreational boats. As part of this project, it is proposed that 490,000 m³ would be dredged adjacent to the existing Refinery Pier over a period of 8 weeks. For comparison, this is shown against historical dredging campaigns in Corio Bay (refer to Figure 4-1).

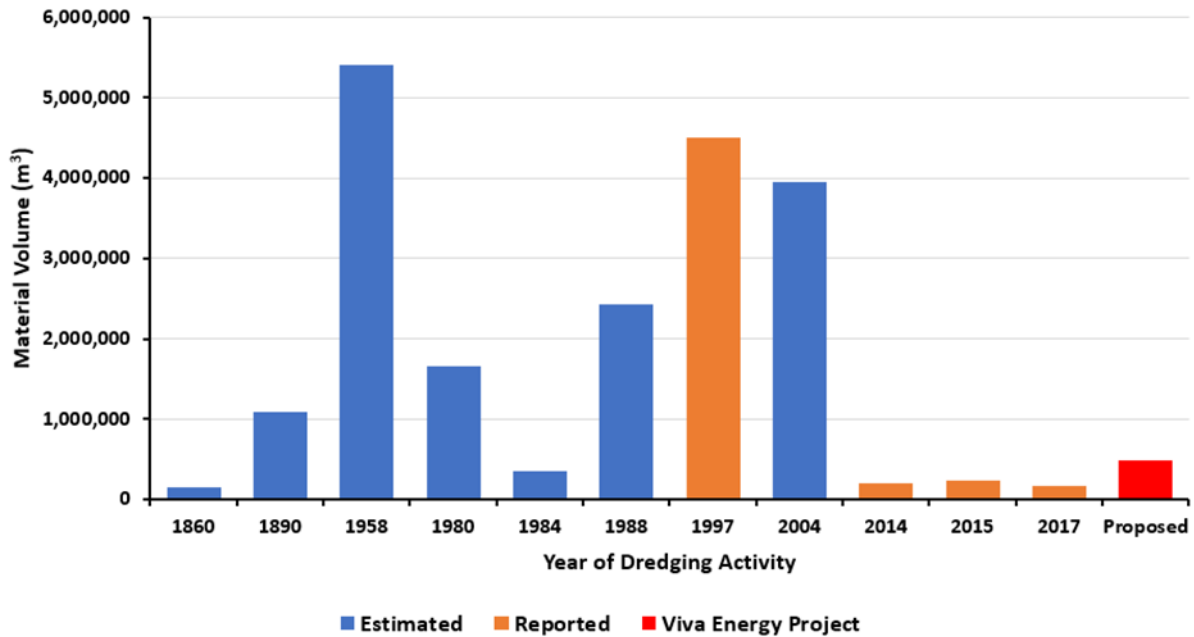


Figure 4-1 Corio Bay dredging history

The 1996-1997 Channel Improvement Program involved dredging 4.5 million m³ of sediments at the Grain Pier, Lascelles Wharf and Refinery Pier and Point Henry, mostly areas close to the proposed dredging at Refinery Pier and involving the same sediment characteristics. There was extensive monitoring of turbidity generated by the dredging in Corio Bay. This monitoring provides a reference case for comparison to the predictions made by this project.

During dredging, there would be increased turbidity (elevated suspended solids) around the dredging area. The turbidity would decline quickly after dredging ceases.

Suspended solids can influence the growth and distribution of seagrass through increased light attenuation (reduced light transmission) and smothering as the sediment settles on the seabed. Retaining healthy seagrass is essential to meet the ecological functions of the Ramsar site with respect to fish nursery and habitat, as well as a wide range of other marine organisms. Increased turbidity can also have an adverse effect on phytoplankton populations. A reduction in density or extent of seagrass or reduction of phytoplankton population could have implications for the food chain for migratory shorebirds or marine species that comprise the critical components and processes of the Ramsar site.

The area predicted to be impacted by the dredging is shown in Figure 4-2.

Modelling conducted for the supplementary study showed the predicted increase in average suspended solids concentration in north Corio Bay due to dredging over the simulated 8 week dredging period during the months of August – September. There would be a small 5 ha patch of 5 mg/L suspended solids above ambient and a large 200 ha patch of 2 mg/L suspended solids above ambient at the surface. The background level of suspended solids in the Ramsar Site is approximately 1.8 mg/L. This was the average suspended solids concentration from water samples collected from five locations across the Ramsar site in 2023, which ranged from 1.2 mg/L to 2.3 mg/L.



Figure 4-2 Average increase in suspended solids concentration above ambient at surface during dredging

A time series of suspended solids concentrations above ambient was modelled at four sites in Corio Bay, external to the dredging footprint and adjacent to the Ramsar site, as shown in Figure 4-3. The four sites are presented in Figure 4-2.

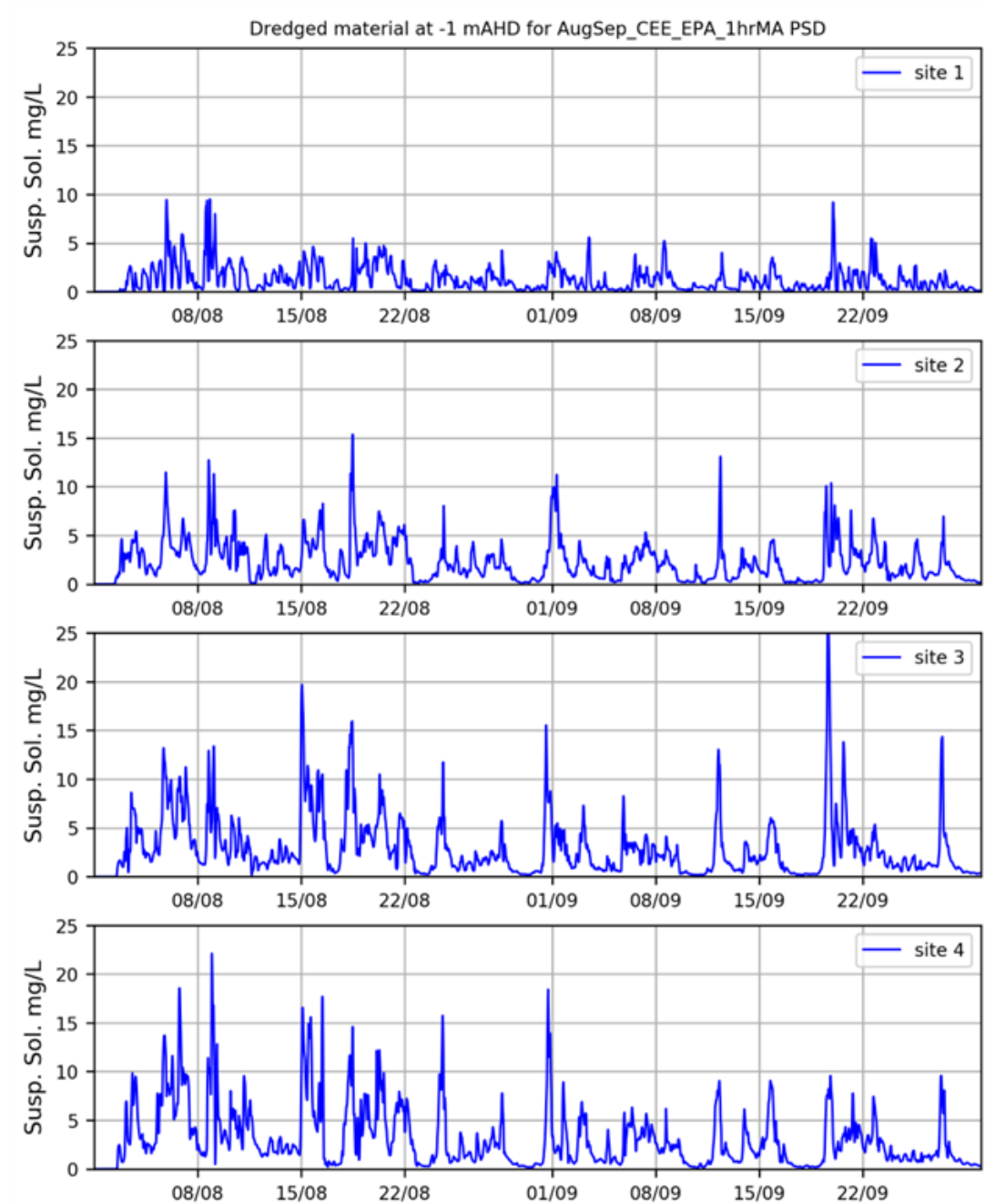


Figure 4-3 Time series of suspended solids at Sites 1 to 4 – August-September

The average suspended solids increment over the 8 weeks of dredging varied from 1.3 mg/L (1.1 NTU) and 3.2 mg/L (2.6 NTU), with a peak of 10 mg/L to 23 mg/L. These predictions show low average suspended solids and turbidity concentrations. The increase in turbidity would be visible within about 250 metres of the dredging area, however as concluded in the EES, the increased turbidity would have very little effect on water quality or light attenuation in the Ramsar site.

During the 1996 to 1997 Channel Improvement Program, turbidity measurements were undertaken and were similar to the predictions made in a sediment dispersion model produced by Lawson and Treloar (1997). Given that the predictions of the Lawson and Treloar model were accurately measured during the 1996 to 1997 Channel Improvement Program, their model parameters were used to predict the

sediment mobilisation for this project as a point of comparison to the project's sediment dispersion model. Figure 4-4 below shows the time series of suspended solids concentrations at Site 3 and Site 4, where the greatest turbidity is predicted, using Lawson and Treloar parameters.

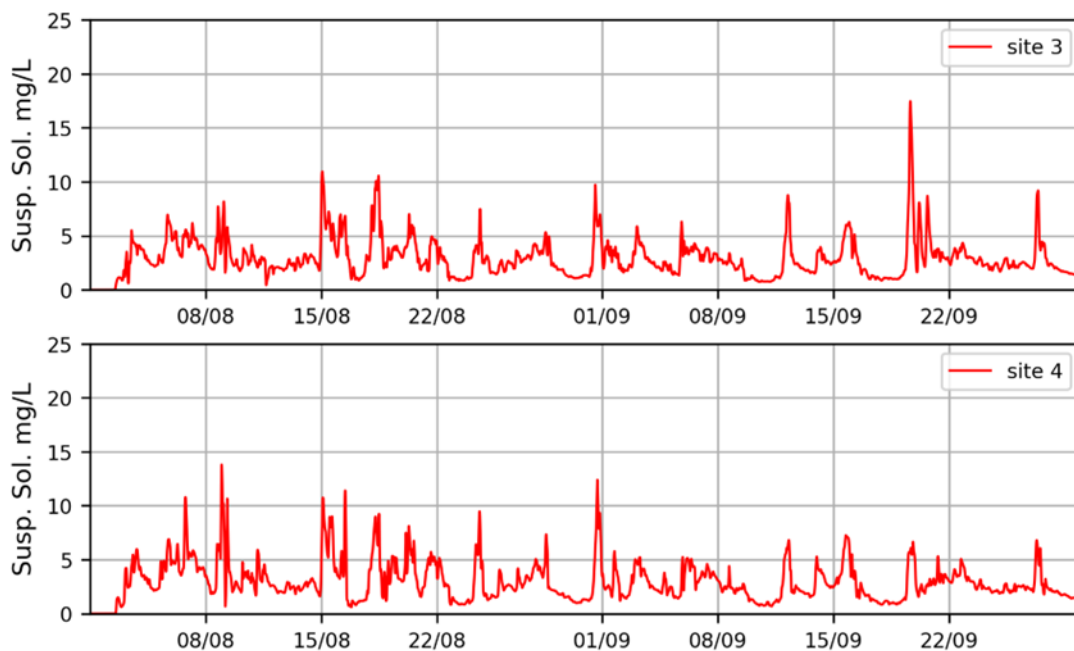


Figure 4-4 Time series of suspended solids at Sites 1 to 4 – August-September (Lawson and Treloar parameters)

At Site 3, the average suspended solids increment over the 8 weeks of dredging using the Lawson and Treloar parameters is 3.0 mg/L (2.4 NTU), which is the same as the project model predictions. At Site 4, the average suspended solids increment over the 8 weeks of dredging using the Lawson and Treloar parameters is 3.1 mg/L (1.1 NTU). This is very similar to the average suspended solids of 3.2 mg/L predicted using the regional model for this assessment. This demonstrates that there is very little difference between the project sediment dispersion model, and the model run with Lawson and Treloar parameters which were verified with measurements during the 1996 to 1997 Channel Improvement Program.

To assess the impact of suspended solids to light availability for seagrasses, a light threshold of 20% surface irradiance was adopted for the Ramsar site and a light threshold of 10% was adopted for Corio Bay based on recommendations from the IAC hearing for the initial project EES.

In accordance with the Dredging Science Node of the Western Australian Marine Science Institution (WAMSI, 2017), an appropriate time scale to monitor and detect impacts on seagrass is two weeks. As such, 14-day average suspended solids concentrations have been extracted, based on the revised sediment transport modelling, and with consideration to the four sites presented in Figure 4-2. These 14 day suspended solids concentrations are presented in the Table 1 below.

Table 4 Summary of 14-day average suspended solids concentrations (mg/L)

Suspended solids	Background	Week 1-2	Week 3-4	Week 5-6	Week 7-8	Peak
Site 1	1.8	3.6	3.2	2.8	2.9	3.6
Site 2	1.8	4.8	4.4	3.8	3.7	4.8
Site 3	1.8	5.9	4.9	4.1	4.3	5.9
Site 4	1.8	6.7	5.2	4.2	4.0	6.7

The equations provided in the Victorian Dredging Guidelines were used to convert the 14-day average suspended solids concentrations to available light. This was done at Site 3 and Site 4 where the maximum 14-day average concentrations were observed. The maximum 14-day average concentrations at Site 1 and Site 2 were less than those at Site 3 and Site 4. The following conclusions were made:

- Site 3, which is in the Ramsar site has a peak 14-day average suspended solids concentration of 5.9 mg/L. This corresponds to 22 % light availability, greater than the 20% threshold considered appropriate by the IAC.
- Site 4, which is outside the Ramsar site has a peak 14-day average suspended solids concentration of 6.7 mg/L. This corresponds to 14 % light availability, greater than the 10% threshold for Corio Bay considered appropriate by the IAC.

On this basis, it has been concluded that the dredging program would not have an unacceptable impact on seagrass in the Ramsar site and that there is a significant safety net between the IAC recommended targets and the modelled results for light availability.

Sediment accretion modelling (settling on the seabed) suggests the highest accretion of 20 millimetres (mm) in 8 weeks is confined to the area being dredged and is therefore of no significance to the Ramsar site. Lower accretion rates of 2 to 10 mm would occur in north Corio Bay over a larger area but the rate of accretion (calculated at 0.04 mm/day to 0.2 mm/day) would have negligible impact on the seabed, seagrass or infauna.

Dredging may also cause a short-term localised increase in concentrations of metals in the water column. Limited elevated concentrations of antimony, arsenic, lead, mercury and nickel are present in sediments in the dredging area above the default guideline values; however, subsequent sediment elutriate analysis to assess the potential for chemicals to desorb from sediment particles to water, indicates there is a low potential for bioavailability (and hence ecotoxicity) to marine biota. There would be a negligible increase in metal concentrations at the Ramsar site.

Similarly, higher levels of nutrients (namely nitrogen comprised of ammonia and nitrate) would be released from the pore water held within the sediment during dredging. Release of approximately 70 kg of total nitrogen (mainly ammonia) over the 8-week dredging period (representing around 0.03% of the total nitrogen in Corio Bay) has the potential to result in a localised phytoplankton (algae) bloom after dredging ceases and turbidity levels drop (as turbidity caused by dredging reduces light, and therefore lessens the risk of algal blooms).

Most juvenile fish species that migrate through estuaries have a wide tolerance of turbidity. However, fish in seagrass habitat are possibly less tolerant, although it is noted that there is elevated turbidity in the Ramsar seagrass beds about every 2 to 3 weeks, when storms stir up sediment near the shore. Fish populations present in the Ramsar site in Corio Bay may be particularly vulnerable to sedimentation during fish spawning and development. For key fish species in the Ramsar site, this stage occurs mostly during spring.

In summary, there would be temporary and localised turbidity increases and minor increases in nutrients and metals in the water column from dredging which could have a minor effect in slowing seagrass growth and productivity for a day or two. The sediment plumes associated with the dredging do not extend to Limeburners Bay; although it could result in minor turbidity increases at the Ramsar site. However, this is unlikely to significantly affect seagrass meadows or abundance and diversity of seagrass or algae. As such, dredging is unlikely to impact species reliant on seagrass habitat or change the ecological character of the Ramsar site.

Management and mitigation measures

While it is very unlikely that dredging would impact fish populations present in seagrass habitat in the Ramsar site, as a precautionary approach, the dredging would not occur during spring (September to November), when key fish species are potentially in a more vulnerable stage of development. Furthermore, if dredging does not occur in spring, early seasonal growth of *H.nigricaulis*, the most extensive seagrass in the Ramsar site, would not be impacted by potential increases in turbidity.

In addition, a temporary silt curtain would be installed enclosing the dredge to mitigate the dispersal of suspended solids from dredging and to limit the extent of the turbidity plume in Corio Bay during

dredging, the overflow period for barges associated with a small or medium-size backhoe dredge will be limited to 20 minutes while the overflow period for barges associated with a large size backhoe dredge will be limited to 14 minutes.

The findings of the of the supplementary marine environment study and the findings of the original EES marine environment and water quality impact assessment are consistent and confirm the conclusions reached in the original EES in relation to negligible to low impact from dredging.

Therefore, no mitigation measures have been added and no changes have been made to the marine ecology and water quality mitigation measures as a result of the supplementary study, refer to Table 1 of Chapter 9: *Environmental Management Framework*.

Residual impacts and monitoring

No significant residual impacts on the Ramsar site are anticipated. There would be no reduction in the area of seagrass in the Ramsar site, however the increased turbidity may have a minor effect in slowing seagrass growth for a short period outside of the Ramsar site without ecological consequences. Dredging in seasons other than spring would have the least effect on primary productivity and fishery replenishment. With the adoption of mitigation measures, residual impacts are anticipated to be a localised reduction in primary productivity of phytoplankton and the loss of infauna in the dredged area until they re-establish, which would not have a significant impact on the ecological character of the Ramsar site or have adverse effects on the food chain for waterbirds.

To confirm that turbidity and light attenuation meet the expected modelled outputs, turbidity would be monitored continuously in north Corio Bay during dredging. A minimum of three sites along the 3 m depth contour at the offshore boundary of the main seagrass beds proximate to dredging activity which may be affected by turbidity, including seagrass in the Ramsar site, would be monitored. This would inform contingency actions if turbidity levels exceeded the proposed thresholds.

There is a small possibility that favourable weather conditions at the end of dredging could instigate a small, localised phytoplankton bloom. Monitoring of plankton during dredging (commencing 8 weeks prior and continuing for 8 weeks after) is proposed to monitor for toxic algal blooms and enable appropriate notifications to be made if required. However, if a bloom did occur, this would not alter the ecological character of the Ramsar site as such blooms occur periodically due to natural events.

No changes have been made to proposed monitoring as a result of supplementary study, refer to Table 2 of Chapter 9: *Environmental Management Framework*. Operation

As described in the EES, the primary impact pathways from operation for the Ramsar site are related to discharge of seawater to the marine environment and for potential entrainment of plankton and larvae in the FSRU seawater intake. The FSRU would require the intake and discharge of seawater, which could lead to changes in water quality (chlorine and temperature) from ambient conditions in Corio Bay, however, reuse of the FSRU discharge for cooling water through the Refinery results in discharges being very similar to the existing discharges from the Refinery which have been occurring for more than 60 years.

4.1.1.2 Discharge to the marine environment from FSRU

In accordance with Recommendations 1, 3 and 4 of the Minister's Directions, further assessment of the impacts of the existing refinery discharge and future FSRU discharge was undertaken utilising the refined regional hydrodynamic model in Technical Report A: *Supplementary marine environment impact assessment*.

To assess impacts of chlorine and temperature on marine biota the guideline values were adopted as follows:

- temperature change in Corio Bay: 3°C
- temperature change for the Ramsar site: 2°C
- chlorine concentration in Corio Bay: 10 µg/L
- chlorine concentration for the Ramsar site: 4.3 µg/L

Discharge through the refinery

The refinery has discharged warmer seawater containing residual chlorine concentrations for more than 60 years. Chlorine is added to the seawater as it enters the refinery to prevent and control the accumulation of microorganisms, plant, algae or small animals in the pipes, pumps and heat exchangers. The usual mode of FSRU operation would consist of the FSRU discharging water to Corio Bay via the existing refinery. There would be no change to the amount of seawater discharged to Corio Bay in this scenario and residual chlorine concentrations would be consistent with existing refinery discharges. The only difference to existing conditions is that the temperature of the seawater discharge would be closer to ambient conditions during operation of the FSRU.

Field surveys undertaken as part of the original EES and supplementary statement showed no detectable impact on seagrass beds or marine biota from the existing discharges. Seagrass beds were found to be abundant and very healthy offshore from the existing refinery discharge points, species such as sea urchins considered to be sensitive to chlorine were found to be flourishing under the discharges, and tests on mussels from the vicinity of the plumes showed no detectable levels of residual chlorine.

To assess the impact of the existing refinery discharges on seagrass in Corio Bay, change in seagrass condition over time was assessed for the supplementary statement. Seagrass surveys were conducted during winter, spring and summer in 2023 and consisted of approximately 2,000 survey measurements.

Two survey transects were defined in the intertidal zone parallel to the coast across the existing refinery discharge points and two additional transects were defined in the subtidal zone, parallel to the coast across the discharge points. To provide a reference, the same two intertidal and two subtidal transects were defined in the Ramsar site, well away from the existing refinery discharges plumes. The survey transects at the refinery and the survey transects at the Ramsar site are presented in Figure 4-5.



Figure 4-5 Location of intertidal and subtidal transects

Based on the seagrass surveys, it was determined that there was no significant difference in seagrass cover at the existing refinery discharge points and at the Ramsar site. Seagrass cover varied between seasons and depending on the zone, however observations between the refinery discharge points and the Ramsar site were always consistent.

To supplement the modelling conducted for the initial EES, detailed temperature and chlorine measurements were collected in proximity to the existing refinery wastewater discharges from July 2023 to December 2023. This involved daily and weekly measurements at hundreds of points along and adjacent to the existing plumes, using a highly sensitive temperature probe from a vessel and drone over a range of tidal and wind conditions in winter, spring, and summer.

The existing warm water plume from the refinery travels to the north and reaches the mouth of Limeburners Bay, at around 1°C above ambient. Figure 4-6 below presents the total extent of the actual measured existing temperature plume from the refinery wastewater discharges (W1, W3, W4 and W5). This data was collected from field measurements undertaken between July 2023 and January

2024. It demonstrates that the +5°C temperature contour encompasses a small area extending for 150 metres to the north of existing discharge point W5. The +3°C temperature contour extends along the shore for 560 metres north from the W5 discharge. The +2°C contour extends a further 90 metres north but does not reach the Ramsar site. This +2°C contour would be approximately 200m from the Ramsar site boundary.

This demonstrates that the existing refinery discharges are within the design guideline value (DGV) for temperature change for the Ramsar site and that there is no impact of temperature on marine organisms in the Ramsar site from the discharges.



Figure 4-6 Envelope of extent of measured temperature plumes.

As a point of comparison to the measured temperature plumes from July to January 2024, temperature plumes were modelled using the refined regional hydrodynamic model incorporating recommendations from the IAC. The temperature plumes simulated by the model were under comparable conditions, including the same tide and wind conditions focusing on incoming to high tide with southerly winds (see Figure 4-8). This comparison illustrates that the refined regional hydrodynamic model can reproduce the observed shape, temperature difference and extent of the existing plumes along the refinery shoreline.

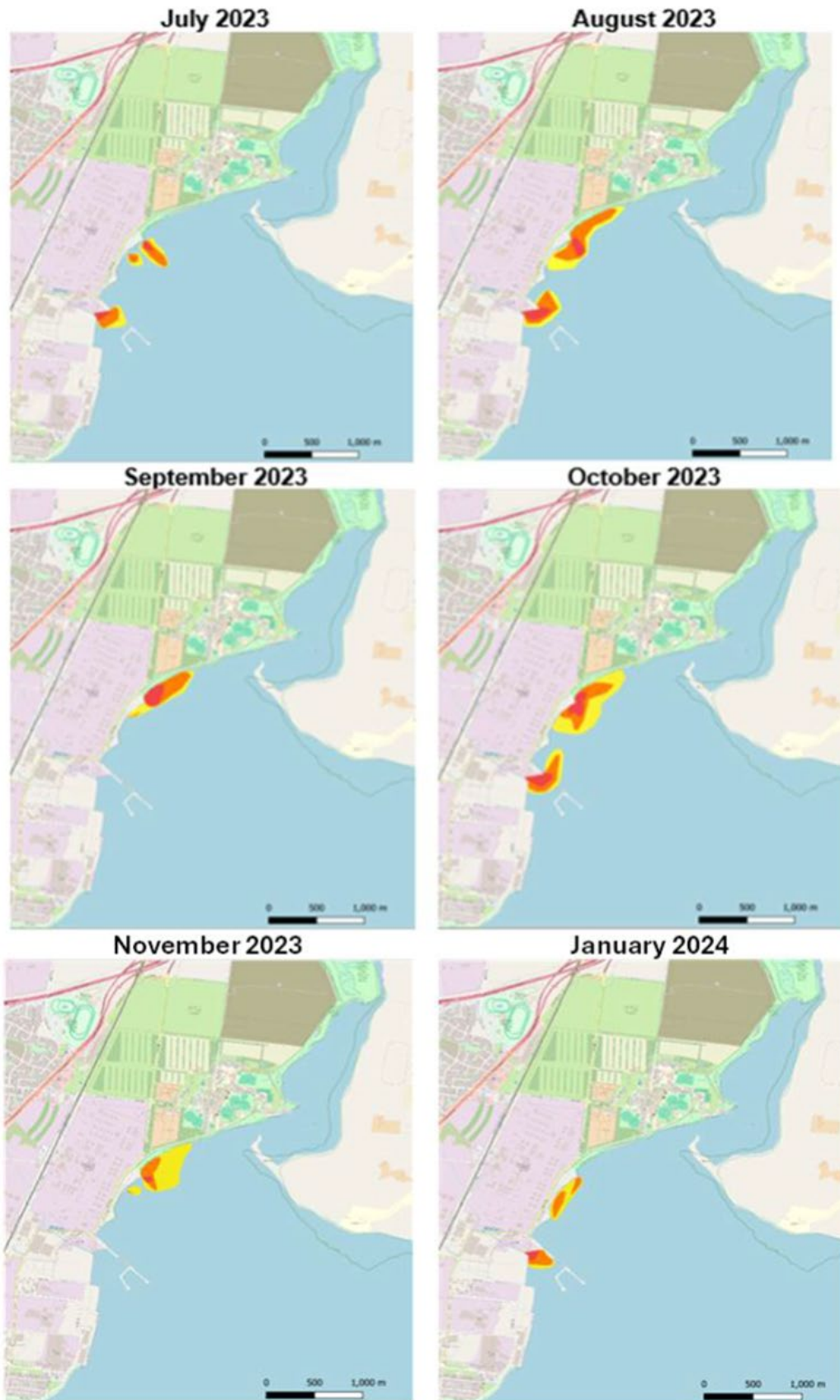


Figure 4-7 Monthly thermal plume temperature measurements between July 2023 and January 2024 (red = +5 °C, orange = + 3°C and red = +2°C)



Figure 4-8 Predicted temperature plumes using the refined regional hydrodynamic model

Table 5 below presents the average area of each of the temperature contours for the measured plumes and modelled plumes. The table shows that both the measured and modelled temperature plumes are similar in size, with the measured +2 °C and +3 °C plumes being slightly bigger in the measurements and the +5 °C contour being slightly bigger in the model.

Overall, the model is fit for the purpose of estimating the plumes from the refinery discharges which was confirmed by an independent peer review of the model.

Table 5 Average measured and modelled plume area

Plume type	+2 °C	+3 °C	+5 °C
Measured	20 hectares	12 hectares	3 hectares
Modelled	18 hectares	10 hectares	5 hectares

It is not possible to measure chlorine in seawater at low concentrations and on a boat, as the sample must be tested within 1 minute to comply with the National Association of Testing Authorities (NATA) standards. Further, chlorine in seawater reaches non-detectable levels shortly after discharge. Therefore, the method used to establish chlorine concentrations in the existing refinery plumes was to develop a correlation between temperature and residual chlorine concentration and use it to convert the measured temperature contours into equivalent chlorine contours. Using this method to establish

chlorine concentrations in the existing plumes, chlorine contours based on the 10 µg/L and 4.3 µg/L DGV for chlorine in Corio Bay and the Ramsar site were developed.

The existing chlorine discharge plumes from the refinery are presented in Figure 4-9. The chlorine measurements demonstrate that chlorine concentrations in the existing refinery plumes are less than the 4.3 µg/L DGV for the Ramsar site approximately 800 metres away from the Ramsar site boundary.

Considering these observations, there is no risk of chlorine from the existing refinery discharge plumes extending to the Ramsar site at any significant concentration.



Figure 4-9 Inferred chlorine contours in existing plumes.

Reuse of the cooled seawater from the FSRU within the refinery would reduce the existing temperature rise in the current discharges (from a discharge temperature of 8-10°C above ambient to 1-3°C above ambient) and there would be a smaller temperature plume along the shoreline than for the existing discharge as a result of using the chilled water discharge from the FSRU. The existing temperature rise associated with the refinery and the lower temperature rise associated with reuse of cooled seawater

from the FSRU represents a small change in relation to diurnal variation in temperatures experienced by biota along the shoreline, which experience diurnal variations of 10°C in the littoral zone and 1.6°C-5°C in the shallow, sublittoral zones.

It is possible that the seagrass along the north shore of Corio Bay could respond to a change back to a more natural temperature cycle. However, it would still be healthy seagrass, as shown by the condition of nearby seagrass beds. The warmer temperature discharge over more than 60 years has shown that seagrass is tolerant of temperature changes. The limiting factor for seagrass growth is more likely to be available light, sediment characteristics and predation.

The pattern and concentrations of the chlorine plume would essentially be the same as the existing situation with the refinery discharge as the same volume of seawater and concentration of residual chlorine would be discharged, with a minor effect of reduced spreading due to the lower temperature of the discharge plumes than existing.

As the proposed discharge of cooled seawater from the FSRU through the refinery does not result in a substantial change in concentration of chlorine from the existing refinery discharge plumes, the project is unlikely to impact on seagrass extent in Corio Bay or food resources for migratory shorebirds or seabirds. Therefore, discharges from the FSRU through the refinery would not have a significant impact on the ecological character of the Ramsar site.

Discharge through diffuser or closed loop operation

Alternately, discharge from the FSRU may occur through a cold-water discharge via the diffuser located on the proposed pier extension or limited discharge of warm water from closed loop operation. Both of these backup modes of operation are unlikely to be used on many days each year. If such discharge modes are utilised, there would be high dilution so the resulting plume would have a chlorine concentration of less than 3 micrograms per litre ($\mu\text{g/L}$) and a temperature rise of less than 0.5°C outside a small mixing zone. Such thermal plumes are classified as low to no risk to Limeburners Bay and the Ramsar site and would be approximately 1km from the Ramsar site boundary.

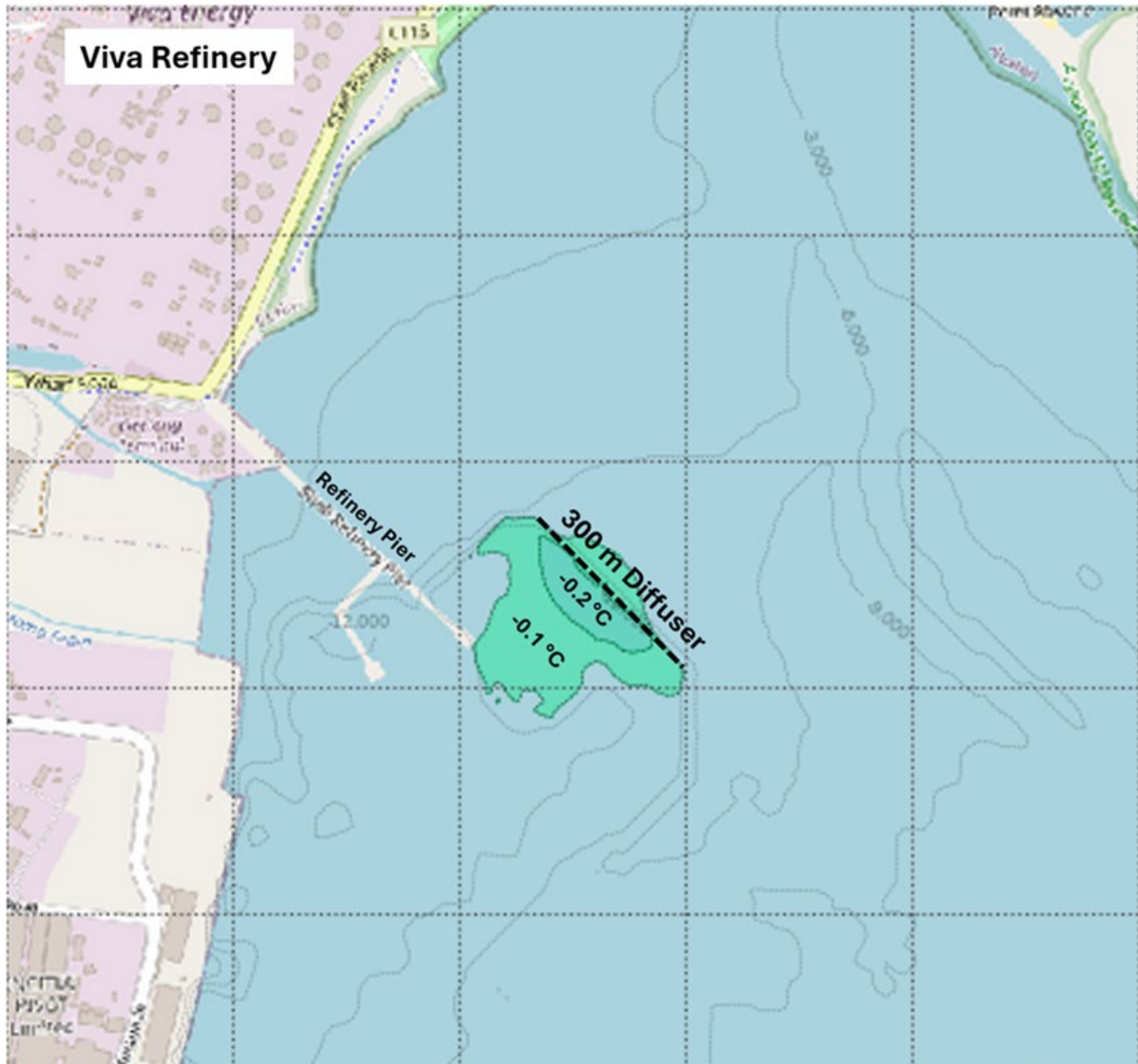


Figure 4-10 Predicted temperature plume - FSRU discharge through the diffuser



Figure 4-11 Predicted chlorine plume – FSRU discharge through the diffuser

The ecological character of the Ramsar site is unlikely to be impacted by discharges from the FSRU. Chlorine and temperature plumes would be well away from the Ramsar site boundary and have no impact on seagrass, mangroves and saltmarsh communities. Surveys of the seagrass beds under the existing plumes indicate that the refinery discharges over more than 60 years have not had a detectable adverse impact on seagrass or on the food chain associated with species found in the Ramsar site.

Management and mitigation measures

As a result of the project, there would be:

- No increase in seawater withdrawn from Corio Bay (350 ML/day whether all from the FSRU or in combination with the existing refinery intake depending on FSRU output)
- No increase in seawater discharge to Corio Bay (350 ML/day)
- No increase in chlorine discharge to Corio Bay
- Significant reduction in temperature of the plume from the refinery discharge.

For the limited occasions where the diffuser is used, the design of the proposed diffuser achieves a high initial dilution of 20:1 which ensures that the diluted discharge would have a chlorine concentration less than the chlorine guideline value and a temperature change from ambient of less than 0.5°C.

Therefore, no new mitigation measures have been added and no changes have been made to the marine ecology and water quality mitigation measures as a result of the supplementary study, refer to Table 1 of Chapter 9: Environmental Management Framework.

Residual impacts and monitoring

No residual impacts to the ecological character of the Ramsar site are anticipated as a result of discharges to the marine environment.

The flow rate, temperature and residual chlorine concentration of all major discharges would be monitored and recorded to confirm that the values are within the guideline values or if remedial action is required.

Monitoring will be undertaken to determine the effects of wastewater discharges from the FSRU (whether via the refinery or directly from the FSRU into Corio Bay) on marine biota and communities. The monitoring will include but not necessarily be limited to seagrasses, macroalgae and marine fauna (such as mussels and sea squirts). Temperature profiles (and inferred chlorine concentrations) will be recorded at the ecological monitoring sites. The monitoring will map impacts on the ecosystem including seasonal variations, using the baseline monitoring of the impacts of existing discharges from the refinery undertaken in the Supplementary Statement in accordance with the recommendations in Table 1 of the Minister's Directions.

No change to proposed monitoring as a result of the supplementary study, refer to Table 2 of Chapter 9: Environmental Management Framework.

4.1.1.3 Entrainment

Entrainment is the unwanted passage of fish or small marine organisms through a water intake. Entrainment of fish larvae or plankton that may spawn in the Ramsar site including Limeburners Bay could affect the food chain and in turn the ecological character of the Ramsar site and food availability for migratory shorebirds. In accordance with Recommendation 5 of the Minister's Directions, further assessment of the impact of entrainment was undertaken utilising the refined model. Modelling of particle movement in Corio Bay using neutrally buoyant particles as a proxy for fish larvae and plankton indicates that the potential impact of entrainment of fish larvae and plankton from the Ramsar site and Limeburners Bay is negligible.

Dispersion simulations of plankton and larvae released at the Ramsar site along north coast of Corio Bay and fish breeding areas in northern and southern Corio Bay indicated that approximately half of the plankton and larvae from the Ramsar site move out of Corio Bay into Port Phillip after seven days. Very few plankton and larvae migrate down the west coast of Corio Bay and many remain in the north of Corio Bay near the Ramsar site. After 14 and 28 days the plankton and larvae are more evenly dispersed but there are still more present in Port Phillip Bay than Corio Bay (refer to Figure 4-12).

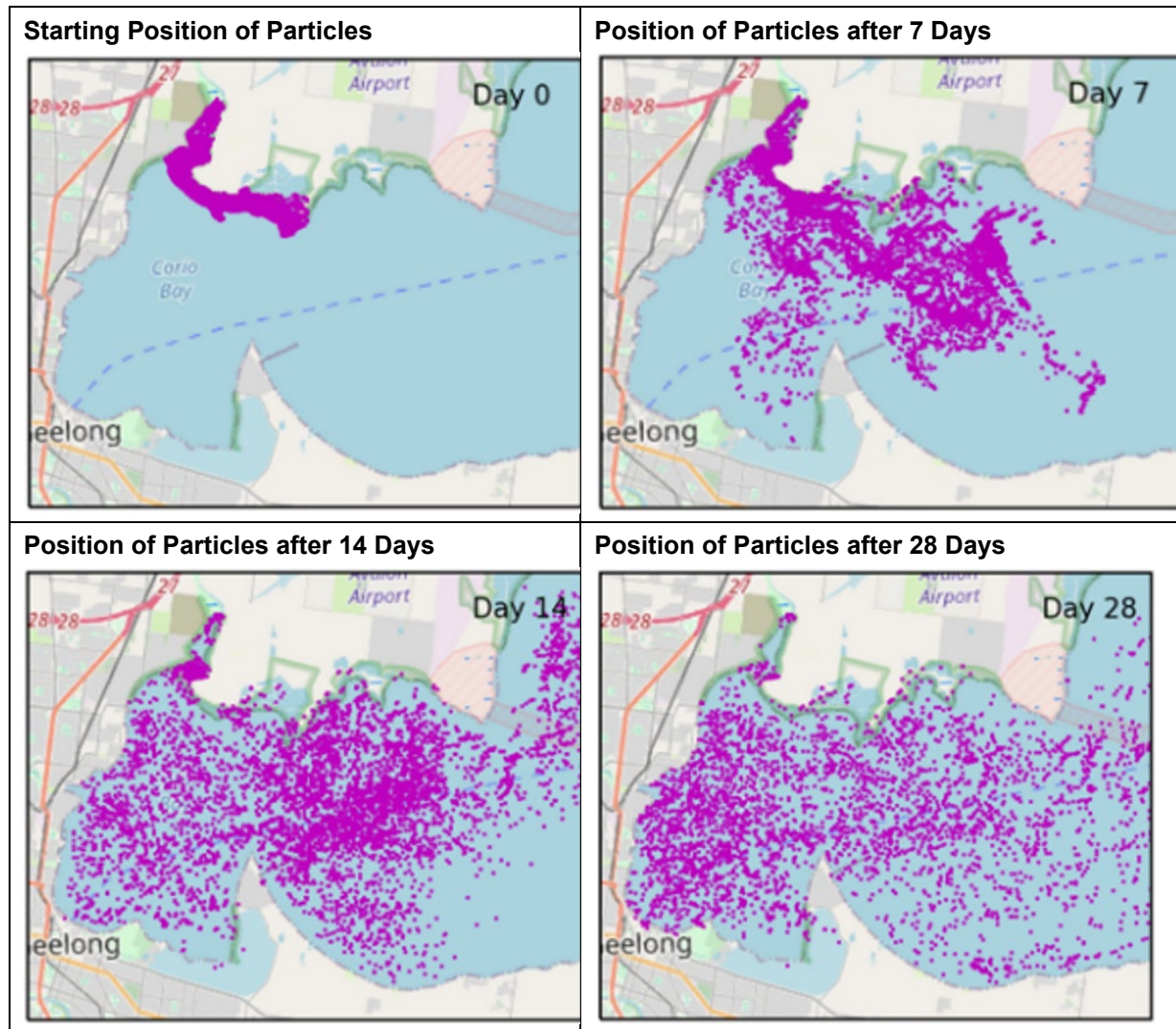


Figure 4-12 Movement of particles released from the Ramsar site

The proportion of plankton and larvae from the Ramsar site that would be entrained by the proposed FSRU intake is modelled to be very small – 0.03% in 7 days and 0.12% in 28 days. This is a very small proportion of the natural rate of reproduction of phytoplankton and zooplankton, and consistent with the modelled 0.12% entrained by the refinery inlet. This indicates that the seawater intake would have a negligible effect on plankton populations in Corio Bay. Phytoplankton mostly have a short life cycle (a day or so) and any entrained at the refinery inlet or the FSRU intake are likely to be developing locally and not from the Ramsar site. Zooplankton have a life cycle of around 14 days and the results show that entrainment rates are negligible in relation to natural factors (> 99 % loss). The majority of fish larvae from the Ramsar site including Limeburners Bay are dispersed into Port Phillip Bay and the potential entrainment after 28 days is very small in comparison with natural predation and other losses.

An additional simulation was made of entrainment for fish eggs released from all the seagrass areas in Corio Bay. The location from which particles were released is the surface to 5 m depth zone around the perimeter of Corio Bay but including the proposed dredging area for the FSRU.

Table 6 lists the percentage of fish eggs entrained in the refinery or FSRU seawater intakes over periods of 7, 14 or 28 days.

Table 6 Results of entrainment modelling

Time after Release	Ramsar Site Release		Seagrass Zone Release	
	Refinery Intake	FSRU Intake	Refinery Intake	FSRU Intake
7 days	0.03 %	0.03 %	0.07 %	0.04 %
14 days	0.07 %	0.07 %	0.14 %	0.16 %
28 days	0.12 %	0.12 %	0.25 %	0.34 %

Overall, the potential impacts of plankton and larvae entrainment from operation of the FSRU are considered to be negligible on populations and species diversity and considered to have no impact on the food chain supporting species in Corio Bay and the Ramsar site.

Management and mitigation measures

To minimise the capture of small and large fish or other free-swimming biota moving in the shipping channel near the FSRU intake, the FSRU seawater intake would adopt an intake velocity of 0.15 m/s, which would provide the same level of protection as the existing refinery intake and is consistent with the US EPA Guideline value adopted for projects of this nature. The intake on the FSRU would also have a screen with apertures less than 100 mm which would prevent large objects and seaweed from being carried into the intake. When the refinery is not operating, the FSRU intake volume will be limited to minimise entrainment during late spring/early summer, as far as reasonably practicable.

To ensure that a very low percentage of fish larvae are entrained in spring and summer, the seawater intake on the FSRU will be located so that it is at least 2 m below the water surface (to avoid entraining biota from near the surface) and at least 2 m above the seabed (to avoid entraining biota from near the seabed).

The findings of the of the supplementary marine environment study and the findings of the EES marine environment and water quality impact assessment are consistent and confirm the conclusions reached in the EES in relation to negligible to low impact from entrainment.

Therefore, no new mitigation measures have been added and no changes have been made to the marine ecology and water quality mitigation measures. Refer to Table 1 of Chapter 9: Environmental Management Framework.

Residual impacts

The current refinery seawater intake has negligible effect on phytoplankton, zooplankton and fish larvae populations in Corio Bay and the proposed FSRU intake would also have negligible impact. No residual impacts on the ecological character of the Ramsar site or food availability for migratory shorebirds are anticipated as a result of entrainment during operation of the FSRU as entrainment rates are minor in comparison to natural predation and other natural losses. The use and discharge of seawater for the project would not add or subtract any nutrients or organic carbon from the marine ecosystem.

4.1.2 Summary of impact assessment - Ramsar site

The MNES Significant impact guidelines 1.1 (DoE, 2013) provide significant impact criteria for wetlands of international importance (Ramsar sites). An action will be deemed to have the potential for a significant impact if it will result in:

- Areas of the wetland being destroyed or substantially modified
- A substantial or measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration, and frequency of ground and surface water flows to and within the wetland
- The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected

- A substantial and measurable change in the water quality of the wetland- for example a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity, or human health, or
- An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.’ (DoE, 2013, p13).

No significant residual impacts on the Ramsar site are anticipated. A summary of the impact assessment findings is outlined in Table 7.

Table 7 Significant impact assessment for the Port Phillip Bay Western Shoreline and Bellarine Peninsula Ramsar site

Significant impact criteria for wetlands of international importance	Criteria met?	Discussion
An action is likely to have a significant impact on a wetland of international importance if there is a real chance or possibility that it will:		
Areas of the wetland being destroyed or substantially modified.	No	<p>There are no works proposed within the Ramsar site.</p> <p><i>Seagrass</i> – there would be no loss of seagrass in the coastal areas adjacent to Point Wilson / Limeburners Bay section of the Ramsar site and turbidity impacts on seagrass during dredging would be localised, of short duration and sediment settlement would not be at levels where seagrass could be smothered. Turbidity monitoring would be undertaken continuously at the main seagrass beds at the boundary of the Ramsar site during dredging to identify if action is required to restrict sediment releases. The temperature and chlorine discharge modelling conducted for the original EES and Supplementary Statement indicate that the project discharge plumes do not reach the Ramsar site and do not have the potential to impact on values.</p> <p><i>Saltmarsh</i> – there would be no loss of saltmarsh from the Ramsar site.</p> <p><i>Mangroves</i> – there would be no loss of mangroves from the Ramsar site.</p>
A substantial or measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration, and frequency of ground and surface water flows to and within the wetland.	No	<p>There would be no change in hydrological inputs of the Ramsar site as there are no catchment watercourses in the project, or to the intertidal mudflat area or wetland bathymetry. Seawater intake and discharge would be as per the existing volumes from the Geelong Refinery.</p>

Significant impact criteria for wetlands of international importance	Criteria met?	Discussion
<p>The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected.</p>	<p>No</p>	<p>There would be no effects on adult fish however there would be minor changes in the proportion of entrainment of fish eggs and larvae. Entrainment, would have negligible effects on native fish species populations (see Section 4.1.2.2). Fish habitats and food sources are not adversely affected, and water quality is maintained within guidelines.</p> <p>The physical habitat for waterbirds at the Ramsar site would not be affected. There would not be an effect on food resources for waterbirds at the Ramsar site, including zooplankton and marine invertebrates. Infauna monitoring would be undertaken closer to the dredging site to detect any significant changes to infauna communities in the dredged area and the recovery of the spoil disposal area.</p> <p>There would be no loss of saltmarsh, mangroves or seagrass communities from the Ramsar site. As such significant nursery habitats for juvenile fish will not be impacted by the project.</p> <p>Dredging would be avoided during spring, which is the season for high growth of seagrass and phytoplankton, and the season when key species of fish are in larval or juvenile stages.</p> <p>Approximately 0.5 hectares of seagrass at 2 m depth would potentially be disturbed/removed during installation of the seawater transfer pipe (see Section 4.2.1.1). This loss is unlikely to seriously affect the Ramsar site or the recruitment of adult fish into the environment as the impact is localised and small in extent (0.5 ha), is located over 1 km from the Ramsar site and the loss would be temporary.</p>
<p>A substantial and measurable change in the water quality of the wetland- for example a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity, or human health.</p>	<p>No</p>	<p>Dredging would be localised, of short duration and would not reach the Ramsar site. Turbidity monitoring would be undertaken continuously at the main seagrass beds at the boundary of the Ramsar site during dredging to identify if action is required to restrict sediment releases.</p> <p>The temperature and chlorine discharge modelling conducted for the original EES and Supplementary Statement indicate that the project discharge plumes do not reach the Ramsar site and do not have the potential to impact on values.</p> <p>The connection between the marine, estuarine and freshwater components of the Ramsar site would not be impacted. There would not be a significant change in sedimentation patterns during dredging or operation of the project.</p>

Significant impact criteria for wetlands of international importance	Criteria met?	Discussion
An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	No	<p>Hygiene controls would be employed to mitigate this potential impact during operation of the FSRU, including:</p> <ul style="list-style-type: none"> • Antifoul coating to prevent the encrusting of biota on the hull; • Vessels from certain ports will be cleaned before entry; • Manage ballast water in accordance with the Australian Ballast Water Management Requirements (DAWR, 2017); • Manage vessel activities in accordance with the National System for the Prevention and Management of Marine Pest Incursions.

Consistent with technical studies undertaken for the EES, the supplementary marine and threatened and migratory bird assessments conducted for the Supplementary Statement concluded that the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site would not be impacted.

4.2 Threatened and migratory species

The assessment in the original EES Attachment IV against the significant impact criteria indicated that the project would not have a significant impact on threatened or migratory species. The pipeline study area was not considered to have habitat that is critical to the survival of threatened fauna species due to the degree of modification and past disturbance. Threatened marine species, if present in Corio Bay, would likely be habituated to the existing port environment and are unlikely to be significantly impacted by the project.

Furthermore, it was concluded that migratory shorebirds are unlikely to be impacted by construction or operation of the onshore pipeline. Marginal habitat occurs for a few of the non-threatened migratory species on the shoreline of Corio Bay adjacent to the existing refinery and adjacent to the pipeline construction footprint. Shorebirds were not observed utilising this shoreline during surveys in 2021 (EES Technical Report D: *Terrestrial ecology impact assessment*).

4.2.1 Threatened and migratory bird species

The following sections discuss the potential mechanisms through which impact on threatened and/or migratory birds could be realised with consideration of the results of the supplementary marine environment impact assessment.

The consolidated list of threatened and migratory bird species is presented in Technical Report B: *Supplementary threatened and migratory bird impact assessment* and the results of the revised regional hydrodynamic model is presented in Technical Report A: *Supplementary marine environment impact assessment*.

4.2.1.1 Impacts on food resources

Dredging activity at refinery pier would not result in the removal of seagrass and sediment mobilisation is unlikely to affect seagrass meadows or food resources (see Section 4.1.1.1). Dredging is unlikely to have any impact on the availability of food for migratory shorebirds, seabirds or other waterbirds and dredging is predicted to have very limited, short duration effects on primary production (plankton and larvae) in Corio Bay. Conducting the dredging outside of the spring season when primary production is at its peak would further reduce the potential for adverse impacts.

Approximately 0.5 hectares of seagrass would potentially be disturbed/removed during installation of the seawater transfer pipe. Seagrass mapping undertaken in supplementary statement Technical

Report A: *Supplementary marine environment impact assessment* indicates that the seagrass which would be potentially disturbed/removed would be a mixture of *H. nigricaulis* and *Halophila*. Only seagrass within the subtidal area at 2 m depth will be affected.

Loss of seagrass to install the seawater transfer pipe is unlikely to affect threatened and/or migratory shorebirds or seabirds. This is because the area of impact is localised and small in extent (0.5 ha), the seagrass to be removed is at 2m depth in the subtidal and not intertidal zone (and therefore not accessible) and the loss would be temporary.

Seagrasses would regrow from rhizomes and plants adjacent to the cleared strip and it is anticipated that at three years after pipe installation, seagrass cover would be the same as elsewhere in Corio Bay. To assist with seagrass recovery, re-planting would be undertaken along the transfer pipe alignment.

Overall, the localised and temporary loss of a small area of seagrass is unlikely to affect the food web to the extent that migratory shorebirds, seabirds or Black Swan would be impacted.

Discharge to the marine environment from the FSRU during operation is unlikely to affect seagrass or the availability of plankton or larvae as food sources within Corio Bay and at the Ramsar site (see Section 4.1.1.2). This is because:

- Discharge through the existing refinery would not change the existing chlorine plume from the refinery that does not extend to Limeburners Bay or the Ramsar site.
- The reuse of cooled seawater from the FSRU within the refinery would reduce the existing temperature difference between the current refinery discharge and Corio Bay.
- The historical refinery discharge (and therefore project discharge) has not had adverse effects on the marine ecosystem and therefore would not have adverse impacts on seagrass or the availability of food for threatened and/or migratory shorebirds and other waterbirds in Corio Bay and the Ramsar wetland.
- Direct discharge from FSRU to Corio Bay (which would be an uncommon occurrence during operation) would result in a small cold water plume that sinks to the seabed in the dredged shipping channel remote from both Limeburners Bay and the Ramsar site and seagrass beds.

Potential entrainment of fish larvae and plankton from the Ramsar site and Limeburners Bay is negligible (see Section 4.1.1.3). There would be no difference in the entrainment of fish larvae and plankton during operation of the FSRU in comparison to the existing refinery seawater intake. This predicted entrainment rate (0.12%) is negligible in comparison to natural processes such as predation and starvation.

No impacts on the ecological character of the Ramsar site or food availability for migratory shorebirds are therefore anticipated as a result of operation of the FSRU.

Management and mitigation measures

Mitigation and management measures to minimise impacts to seagrass habitat for the dredging phase of works and operation phase are described in Section 4.1.1 and 4.1.2 respectively.

Residual impacts

With the implementation of mitigation measures, no residual impacts on food resources are anticipated therefore threatened and/or migratory birds are unlikely to be impacted.

4.2.1.2 Habitat removal

Fork-tailed Swift and White-throated Needle-tail may forage over the project area or on rare occasions loaf or roost in trees. The construction footprint avoids most planted trees but will remove a maximum of 0.354 ha of planted overstorey trees. Foraging and loafing resources are available elsewhere in the landscape and these species are highly mobile. As such, they are unlikely to be affected by the project.

Swift Parrot is a highly mobile species that may use planted native trees for winter foraging on an occasional and opportunistic basis. Narrow strips of mixed native, non-indigenous trees occur along the pipeline alignment between School Road and Torresdale Road. The construction footprint avoids most planted trees and planted trees extend beyond the construction footprint for the project. Swift Parrot are

unlikely to be significantly impacted by the loss of a maximum of 0.354 ha of planted overstorey trees as foraging resources are available elsewhere in the landscape.

Rufous Fantail may occur on occasion when on passage from south-eastern Australia to spend winter in northern Australia. Foraging and loafing resources are available elsewhere in the landscape and the species is highly mobile. As such, it is unlikely to be affected by the project.

Orange-bellied Parrot may occur in the terrestrial environments of the Ramsar site. There is no habitat for Orange Bellied Parrot in the terrestrial or marine components of the project area. The small area of saltmarsh (likely planted) adjacent to the project area is avoided. Terrestrial habitat in the Ramsar site will not be impacted by the project.

Management and mitigation measures

Retention of planted eucalypt species at the edge of the construction footprint where possible (between School Road and the Corio Native Grassland Reserve) within the 'paddocks' and protection with fencing would minimise removal of potential habitat. Refer to Table 1 of Chapter 9: Environmental Management Framework for further information.

Residual impacts

The full extent of removal of planted eucalypts within the construction footprint would not be known until the detailed design has been finalised. A maximum of 0.354 ha of planted overstorey trees have the potential to be removed.

4.2.1.3 Noise and lighting impacts

Noise during construction of the pier extension and infrastructure and operation of the FSRU is unlikely to affect the foraging behaviour of migratory shorebirds or seabirds as maximum predicted noise levels are modelled to be within the range of existing ambient noise levels experienced on the foreshore near Geelong Grammar School and in the Avalon area (and therefore the Ramsar site).

Noise modelling was undertaken during the EES for construction of the refinery pier extension and operation of the FSRU and was presented in EES Technical Report I: *Noise and vibration impact assessment*. Modelled scenarios for operation of the FSRU were updated in Appendix D of Supplementary Statement Technical Report D: *Supplementary noise impact assessment* to better reflect proposed operations and noise reduction obtained through design optimisation. The modelling still considered 'worst case' noise propagating weather conditions and the FSRU closed loop operating scenario included in the original EES noise modelling.

Noise modelling presented here is therefore based on EES Technical Report I: *Noise and vibration impact assessment* for construction of the refinery pier extension and infrastructure and Supplementary Statement Technical Report D: *Supplementary noise impact assessment* for operation. The noise modelling concludes the following:

- Construction: The maximum predicted construction noise level is associated with piling and would be 49 dB at Geelong Grammar School and 46 dB in the Avalon area. Maximum predicted noise level during dredging works is 45 dB(A) at Geelong Grammar School and 43 dB(A) in the Avalon area.
- Operation: The predicted operational noise levels at Geelong Grammar School are 39 to 43 dB(A) and Avalon foreshore are 36 to 40 dB(A).

Existing noise levels on the foreshore near Geelong Grammar School range between 57 and 46 dB(A) across day, evening and nighttime periods based on the findings in Section 4.1 of Supplementary Statement Technical Report D: *Supplementary noise impact assessment*. In the Avalon foreshore area the existing ambient noise levels range between 46 and 45 dB(A).

Construction noise levels would therefore be within the range of existing ambient noise levels on the foreshore near Geelong Grammar School and in the Avalon area. Although the level at Avalon would be at the higher end of existing ambient noise levels, piling would not be undertaken at night when ambient noise levels are quietest. Construction noise will also be temporary.

Operational noise levels would be lower than ambient noise levels currently experienced on the foreshore near Geelong Grammar School and in the Avalon area. The source of noise during operation

would be regular (which means wildlife are more likely to habituate) and >1.4 km away from Limeburners Bay and >3 km from the former Avalon Saltworks.

Construction and operation would therefore be unlikely to alter noise levels in the Ramsar site above those currently being experienced. The predicted noise levels are also considerably lower than the >60 dB(A) levels at which responses have been detected in birds in the examples provided in Section 6.1.2.2 of EES Technical Report D: *Terrestrial ecology impact assessment*.

Construction of the pier extension and infrastructure and operation of the FSRU were therefore unlikely to affect the ecological character of the Ramsar site or the foraging behaviour of migratory shorebirds.

Noise from construction and operation of the FSRU is unlikely to significantly affect seabirds in Corio Bay. Seabirds are unlikely to be reliant on Corio Bay as their sole foraging resource. Most of the seabird species primarily inhabit the open oceans rather than bays and are therefore more likely to be occasional visitors to Corio Bay. Those species tend to breed in colonies on offshore islands therefore their occurrence in the marine environment associated with the project is limited to occasional foraging, which therefore reduces their potential to be impacted. Terns occur more regularly in Corio Bay may also occur in the marine component of the project area and are therefore the species with the most potential to be affected by noise.

Extensive foraging areas exist through Corio Bay and Port Phillip Bay beyond nearby sensitive receptors and seabirds are highly mobile and can therefore move away from the area if necessary. Terns currently roost on the refinery seawater intake structure next to the existing pier and are already exposed to human activity. Consequently, terns are possibly habituated to that source of disturbance.

Light associated with construction and operation of the project in the existing modified environment is unlikely to significantly affect migratory shorebirds or seabirds. Lighting requirements for safety and security during construction will be localised, temporary and in the context of an environment already subject to artificial lighting. Lighting associated with operation would be contained to the vicinity of the pier and FSRU and LNG carriers. The most prominent lighting would be on the LNG carrier associated with the bridge and this lighting faces downwards onto the foredeck. With bows facing south-east, this more prominent lighting would not be directly noticeable from Foreshore Road (Geelong Grammar School) or the Ramsar site.

As light spill will be localised and in an environment already subject to artificial lighting, seabirds, migratory shorebird habitat and ecological character of the Ramsar site are unlikely to be affected by light during construction and operation.

Management and mitigation measures

Timing the dredging and piling works outside the peak time when migratory shorebirds are present (generally late spring to late summer) would help to reduce potential risks associated with noise during construction. Monitoring of shorebirds at the Western Treatment Plant indicate that numbers of shorebirds gradually increase over spring, peak in late summer (coinciding with the timing of annual summer counts since 1981) and lowest in winter (Loyn, et al. 2014).

Although light spill would be contained within an environment already subject to artificial lighting, the effect of artificial light on migratory shorebirds is understudied and a precautionary approach should be adopted when managing potential effects from light.

The number, type and layout of lights would be designed to light only the construction or operational area with reference to the National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (May, 2023). The design would:

- Keep lights close to the ground
- Direct and shield lights to avoid light spill beyond the construction area
- Use lowest intensity lighting appropriate for the specific purpose
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths

Avoid the use of Light Emitting Diodes (LEDs) if possible

Refer to Table 1 of Chapter 9: Environmental Management Framework for further information.

Residual impacts

As threatened and migratory bird species are unlikely to be affected by construction or operation noise at their known roosting or foraging locations, no residual impacts are anticipated. No residual impacts of lighting are anticipated on threatened or migratory birds.

4.2.1.4 Additional shipping movements

Additional shipping movements are not anticipated to affect the ecological character of the Ramsar site or food availability as risk of fuel and chemical spills from the FSRU or LNG carriers is low and risk of introduction of pest species attached to the hull or in the ballast of the LNG carriers is no greater than for other international vessels that enter Port Phillip Bay.

Technical Report D: *Addendum – Peer Review* concluded that seabirds may temporarily suspend foraging while LNG carriers pass, although normal behaviour is likely to resume within the same day (Agness et al. 2009). In the context of existing ship movements into and out of the Port of Geelong, the addition of up to 45 additional ships annually (5% increase) would lead to a marginal increase in the likelihood of foraging being disrupted.

Management and mitigation measures

All vessels will be under the control of experienced and qualified captains and pilots and will only be operated in the dredged channel or for smaller vessels, within the defined operation area.

Viva Energy and Geelong Port have a well-established spill management plan. The existing plan will be updated as required and implemented. Where new and improved monitoring procedures are identified these will be implemented.

In addition, well established measures to control and minimise the introduction of marine pests in Corio Bay would be implemented, including:

- Antifoul coating to prevent the encrusting of biota on the hull.
- Vessels from certain ports will be cleaned before entry.
- Manage ballast water in accordance with the Australian Ballast Water Management Requirements (DAWR, 2017).
- Manage vessel activities in accordance with the National System for the Prevention and Management of Marine Pest Incursions.

The anti-foul coating on the FSRU will be cleaned and maintained periodically. There are established procedures to collect scrapings from the hull and prevent them from accumulating on the seabed. Only approved antifoul coatings will be used for maintenance.

Refer to Table 1 of Chapter 9: Environmental Management Framework for further information.

Residual impacts

No residual impacts from additional shipping movements are anticipated.

4.2.2 Summary of impact assessment - threatened and migratory birds

Threatened and/or migratory shorebirds and seabirds are unlikely to be impacted because:

- Dredging activity at refinery pier would not result in the removal of seagrass and sediment mobilisation is unlikely to affect seagrass meadows or food resources.
- Loss of seagrass for installation of the seawater transfer pipe is unlikely to affect threatened and/or migratory shorebirds or seabirds. This is because the area of impact is localised (0.5 ha), the seagrass to be removed is at 2m depth in the subtidal and not intertidal zone (and therefore not accessible) and the loss would be temporary.
- Discharge to the marine environment from the FSRU during operation is unlikely to affect seagrass or the availability of plankton or larvae as food sources within Corio Bay and at the Ramsar site.
- Potential entrainment of fish larvae and plankton from the Ramsar site and Limeburners Bay is negligible.

- Construction and operation activity would be unlikely to alter noise levels in the Ramsar site above those currently being experienced. The predicted noise levels are also considerably lower than the >60 dB(A) levels at which responses have been detected in birds.
- Construction of the pier extension and infrastructure and operation of the FSRU is unlikely to affect the foraging behaviour of migratory shorebirds.
- Noise from construction and operation of the FSRU is unlikely to significantly affect seabirds in Corio Bay. Seabirds are unlikely to be reliant on Corio Bay as their sole foraging resource and are highly mobile and can therefore move away from the area if necessary.
- Terns currently roost on the refinery seawater intake structure next to the existing pier and are already exposed to human activity. Consequently, terns are possibly habituated to that source of disturbance.
- Light associated with construction and operation of the project will be localised and in an existing modified environment.
- Seabirds are unlikely to be reliant on Corio Bay as their sole foraging resource. Most of the seabird species primarily inhabit the open oceans rather than bays and are therefore more likely to be occasional visitors to Corio Bay. Those that occur more regularly are highly mobile and able to access foraging resources elsewhere in the bay.
- Risk of fuel and chemical spills from the FSRU or LNG carriers is low.
- While seabirds may temporarily suspend foraging while LNG carriers pass, normal behaviour is likely to resume within the same day and the number of additional ships represents a marginal 5% increase in the number of movements into and out of the port.
- Human activity associated with the existing refinery and pier is likely to discourage regular occurrence of these seabirds and they may therefore prefer areas in the offsite environment away from the existing refinery and pier.
- Terns that may forage along the shoreline of Corio Bay are highly mobile and utilise a wide range of habitats and, as such, can seek alternative resources. The habitat is currently exposed to human activity associated with the existing refinery and pier.

Threatened and/or migratory birds of terrestrial environments are also unlikely to be impacted by the project because:

- Terrestrial birds are highly mobile and can move away from the pipeline construction area.
- Most habitat would be avoided by the construction footprint of the pipeline.
- Areas of planted native trees that aren't avoided are small in extent (0.354 ha total) and foraging, loafing and resting habitats are available beyond the construction footprint.
- Terrestrial habitats of the offsite environment are unlikely to be impacted by construction or operation of the FSRU.
- Habitat within the Ramsar site will not be impacted by the project.

Threatened and/or migratory birds are therefore unlikely to be significantly impacted by the project.

Significant impact assessment

A summary of the impact assessment findings is outlined for the significant impact criteria for threatened and migratory species contained in EPBC Act Significant Impact Guidelines 1.1 (DoE 2013) in Table 8 and Table 9. Species-specific significant impact criteria have not been developed for the threatened and/or migratory birds considered in this assessment. EPBC Act Policy Statement 3.21 *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebirds* (DoEE 2017) refers to the Significant Impact Guidelines 1.1 (DoE 2013) for criteria relating to migratory shorebirds. The *Referral guidelines for 14 birds listed as migratory species under the EPBC Act* (DoE 2015) describes important habitat for White-throated Needletail, Fork-tailed Swift and Rufous Fantail and Osprey.

A collated assessment of the significant impact criteria for threatened species has been undertaken given that the only difference between the criteria relates to whether an important population of a

vulnerable species could be impacted, rather than a population of a critically endangered or endangered species. Therefore, criteria could be assessed together, and any species-specific differences highlighted. As the impact assessment has concluded that none of the threatened or migratory species are likely to be impacted by the project, a separation of species or threat category is not considered warranted.

The original EES assessments of MNES determined that the project would not have a significant impact on threatened species and that migratory shorebirds are unlikely to be impacted by the construction or operation of the project. This conclusion remains unchanged.

Table 8 Significant impact assessment – threatened species

Significant impact criteria for threatened species	Criteria met?	Discussion
An action is likely to have a significant impact on a threatened species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population of a critically endangered or endangered species OR an important population of a vulnerable species	No	<p>The project is unlikely to lead to a long-term decrease in a population or reduce the area of occupancy of threatened bird species.</p> <p><u>Shorebirds and seabirds</u></p> <p>No threatened shorebird habitat is being removed or affected by the project.</p> <p>Construction and operation activity would be unlikely to alter noise levels in the Ramsar site above those currently being experienced and are therefore unlikely to affect foraging behaviour of threatened shorebirds.</p> <p>Dredging during construction and project related discharges would not impact the Ramsar site and would not impact the food sources of threatened shorebird or seabird species.</p> <p>Seabirds are unlikely to be reliant on Corio Bay as their sole foraging resource. Most of the threatened seabird species primarily inhabit the open oceans rather than bays and are therefore more likely to be occasional visitors to Corio Bay. Those that more regularly occur are highly mobile and able to access foraging resources elsewhere in the bay.</p>
Reduce the area of occupancy of a population of a critically endangered or endangered species OR an important population of a vulnerable species	No	<p><u>Terrestrial birds</u></p> <p>The loss of 0.354 ha of planted overstorey trees would not reduce the area of occupancy of a population or lead to a decrease in the size of the population of Swift Parrot or White-throated Needletail. These species are highly mobile and can move away from the pipeline construction area and foraging, loafing and resting habitats are available beyond the construction footprint.</p> <p>Terrestrial habitats of the offsite environment and habitat within the Ramsar site will not be impacted by the project therefore threatened species that may occur in those habitats will not be affected by the project.</p> <p>Habitat for Orange-bellied Parrot will not be removed or affected by the project.</p>

Significant impact criteria for threatened species	Criteria met?	Discussion
Fragment an existing population (or an important population of a vulnerable species) into two or more populations	No	No clearing of habitat is proposed that would result in the fragmentation of existing populations.
Adversely affect habitat critical to the survival of a species	No	<p>No habitat critical to the survival of a species would be adversely affected by the project.</p> <p><u>Shorebirds and seabirds</u></p> <p>The Ramsar site which is recognised as an internationally important habitat area for shorebirds will not be affected by the project.</p> <p>Critical habitat for Fairy Tern is centred on beaches and offshore islands for nesting and near-shore waters for foraging (DAWE 2020). The marine project component is localised and in a modified environment and is unlikely to constitute critical foraging habitat. Terns that may forage along the shoreline of Corio Bay are highly mobile and utilise a wide range of habitats and, as such, can seek alternative resources.</p> <p>Critical habitat for the seabirds is offshore islands for breeding which will not be affected by the project. Seabirds are unlikely to be reliant on Corio Bay as their sole foraging resource.</p> <p><u>Terrestrial birds</u></p> <p>Critical habitat for Swift Parrot includes areas necessary for foraging (DCCEEW 2024). Important habitat for White-throated Needletail relates to foraging habitat with large tracts of native vegetation being a key habitat requirement and tree hollows (DoE 2015). The small extent and context of the planted vegetation to be removed by the project (0.354 ha) is unlikely to represent 'habitat necessary for foraging' and is more an occasional, non-critical resource for these species.</p> <p>Habitat in the Ramsar site which may be considered critical habitat for Orange-bellied Parrot will not be removed or affected by the project.</p>
Disrupt the breeding cycle of a population	No	<p>The project is unlikely to disrupt the breeding cycle of a population of threatened bird because:</p> <ul style="list-style-type: none"> • Migratory shorebirds do not breed while in Australia. • Most of the seabird species breed on offshore islands (prion and albatross). • Australian Painted-snipe are a vagrant visitor and the project will not impact inshore wetland habitat for the species. • Fairy Tern nest on beaches and offshore islands and is unlikely to be impacted by the proposed works.

Significant impact criteria for threatened species	Criteria met?	Discussion
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	For the reasons described above the project is unlikely to modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species are likely to decline.
Result in invasive species that are harmful to a threatened species becoming established in the species' habitat	No	<p>The project is unlikely to result in invasive species becoming established in the species' habitat.</p> <p>Weeds are already established in the environment of the pipeline and the project will implement mitigations to minimise the risk of introduction or spread of weeds.</p> <p>Hygiene controls would be employed to mitigate potential for invasive species to be introduced to the marine environment through the FSRU or LPG carriers, including:</p> <ul style="list-style-type: none"> • Antifoul coating to prevent the encrusting of biota on the hull; • Vessels from certain ports will be cleaned before entry; • Manage ballast water in accordance with the Australian Ballast Water Management Requirements (DAWR, 2017); • Manage vessel activities in accordance with the National System for the Prevention and Management of Marine Pest Incursions.
Introduce disease that may cause the species to decline	No	Hygiene controls, as listed above, would be employed to mitigate this potential impact. This impact is unlikely.
Interfere substantially with the recovery of the species	No	As outlined above, the project is unlikely to adversely impact the threatened species and therefore is unlikely to interfere with the species recovery.

Table 9 Significant impact assessment for migratory species

Significant impact criteria for migratory species	Criteria met?	Discussion
<p>An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:</p>		
<p>Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for migratory species.</p>	<p>No</p>	<p><u>Shorebirds and seabirds</u> Important habitat for migratory shorebird species is defined as an area identified as internationally important (Ramsar site) or that supports at least 0.1 per cent of the East Asian – Australasian Flyway population of a single migratory shorebird species, at least 2000 migratory shorebirds or at least 15 migratory shorebird species (DoEE 2017). The Ramsar site is unlikely to be substantially modified by the project and is unlikely to be significantly impacted (refer to Table 8). Seabird foraging habitat in Corio Bay will not be substantially modified given the localised extent of the project area. Artificial structures that may be used for resting by terns are not proposed to be removed. No extensive clearing of terrestrial habitat is proposed that would result in the project substantially modifying, destroying or isolating areas of important habitat for migratory species.</p> <p><u>Terrestrial birds</u> Important habitat is defined for White-throated Needletail as large tracts of native vegetation, particularly forests, and tree hollows (DoE 2015). Fork-tailed Swift is an almost exclusively aerial species and Rufous Fantail may occur on passage through the Corio/Avalon area between areas of wet sclerophyll forest with a dense understorey which is their main habitat. Osprey occur in bays, estuaries, coral and rock reefs, terrestrial wetlands and coastal lands feeding primarily in the sea (DoE 2015). The planted vegetation to be removed by the project is unlikely to represent important habitat for these species due to the small extent (0.354 ha) and context in a modified landscape. The project will not affect the terrestrial habitats of the Ramsar site. The project will therefore not substantially modify an area of important habitat for any of these species.</p>

Significant impact criteria for migratory species	Criteria met?	Discussion
<p>Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of a migratory species.</p>	<p>No</p>	<p>The breeding cycles of migratory species would not be disrupted by the project.</p> <ul style="list-style-type: none"> • Migratory shorebirds do not breed while in Australia. • Most of the seabird species breed on offshore islands (prion and albatross). • Australian Painted-snipe are a vagrant visitor and the project will not impact inshore wetland habitat for the species. • Terns are unlikely to breed in the area as they either nest in the northern hemisphere or on offshore islands or other habitats not available in the project area or offsite environment. <p>Feeding activity is unlikely to be seriously disrupted by the project. Construction and project related discharges would not impact the Ramsar site and would not impact the food sources of migratory species. Noise and lighting are unlikely to affect migratory species.</p> <p>The migration of migratory species would not be disrupted by the project.</p> <p>Resting of migratory terns on artificial structures may be temporarily disrupted during construction. However the resting habitat is not being removed and the disruption is unlikely to be serious for the species.</p> <p>Resting habitat in the Ramsar site is unlikely to be impacted by the project.</p> <p>Noise and lighting impacts during project construction and operation are unlikely to affect migratory species. During dredging, piling and FSRU operation, noise emissions are not modelled to exceed those currently experienced in the environments of the Ramsar site.</p> <p>Lighting requirements for safety and security during construction will be localised, temporary and in the context of an environment already subject to artificial lighting. Lighting associated with operation would be contained to the vicinity of the pier and FSRU and LNG carriers.</p>
<p>Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for migratory species.</p>	<p>No</p>	<p>The project is unlikely to result in invasive species that are harmful to migratory species becoming established in the Ramsar site.</p> <p>Hygiene controls would be employed to mitigate this potential impact.</p>

5.0 Conclusion

The EES and the Supplementary Statement have determined that significant impacts to MNES are unlikely.

Dredging at Refinery Pier would have temporary and minor residual impacts on marine ecological values in Corio Bay due to short term increased turbidity, however, sediment plumes associated with the proposed dredging do not extend to the Ramsar site and Limeburners Bay. Residual impacts are anticipated to be a localised and short duration reduction in primary productivity of phytoplankton and the loss of infauna (animals living in sediment) in the dredged area until they re-establish, which would not have a significant impact on MNES. There would be no loss of seagrass in the Ramsar site or reduction in available food sources for shorebirds or seabirds.

Discharges of seawater to the marine environment during the usual open loop operating mode of the FSRU would be via the existing refinery discharge points. The discharge would be the same volume as at present, with the same residual chlorine level and a temperature closer to ambient than the current refinery discharge reducing the extent of the current temperature plume. Both the temperature plume and the chlorine plume during operation of the project do not extend to Limeburners Bay or the Ramsar site and no adverse impacts on seagrass habitat or marine biota are anticipated. Surveys of the seagrass beds and marine biota under the existing plumes indicate that the refinery discharges over the last 60 years or more have not had a detectable adverse impact on seagrass or marine biota. In fact, seagrass in the vicinity is abundant and healthy, sea urchins, which are considered to be sensitive to chlorine, are abundant in the current discharge plume, and tests on mussels from the vicinity showed no detectable residual chlorine. It is possible that the seagrass along the north shore of Corio Bay could respond to a change back to a more natural temperature cycle. However, it would still be healthy seagrass, as shown by the condition of nearby seagrass beds. The limiting factor for seagrass growth is more likely to be available light, sediment characteristics and predation.

As the discharge from the project is the same as the current refinery discharge (with an improvement in temperature), some level of confidence can be held that the current healthy condition of the marine environment would be maintained.

Noise, lighting, and increased shipping movements during construction and operation of the project are unlikely to have significant impacts on threatened or migratory birds. If present, these species are likely habituated to the existing industrial activities associated with the Port of Geelong and Refinery Pier.

Removal of small areas of planted native trees (0.354 ha total) are unlikely to significantly impact terrestrial threatened and/or migratory birds with potential to occur (Swift Parrot, White-throated Needletail or Rufous Fantail) as the species are highly mobile and foraging, loafing and resting habitat are available beyond the construction footprint. Terrestrial habitat in the Ramsar site for Orange-bellied Parrot will not be impacted by the project.

No significant residual impacts are anticipated for MNES protected under the EPBC Act with the implementation of the management and mitigation measures proposed for the project (as summarised in Chapter 9: *Environmental Management Framework*). As such, offsets in accordance with the EPBC Act Environmental Offsets Policy (DSEWPAC, 2012) are not required or proposed for the project.

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