Chapter 10

Land environment

This chapter discusses the potential impacts on the land environment associated with the construction and operation of the Viva Energy Gas Terminal Project (the project). The assets assessed include the land and water (surface water and groundwater) environments that support terrestrial ecological values.

This chapter summarises the outcomes of the following technical assessments conducted for the Environment Effects Statement (EES):

- Technical Report D: *Terrestrial ecology impact assessment* (**Section 10.1**)
- Technical Report E: *Surface water impact assessment* (**Section 10.2**)
- Technical Report F: *Groundwater impact assessment* (**Section 10.2**)
- Technical Report G: *Contamination and acid sulfate soils impact assessment* (**Section 10.2**).

The reader is referred to these technical reports for more detail on the existing environment, potential impacts and proposed mitigation measures. The marine aspects of the project which have the potential to impact terrestrial ecological values are further discussed in Chapter 8: *Marine environment* and Technical Report A: *Marine ecology and water quality impact assessment*.

Overview

The project would be located adjacent to, and on, Viva Energy's Geelong Refinery in a heavily industrialised setting. The land component of the project outside of the Geelong Refinery comprises areas dominated by exotic grassy and herbaceous species alongside areas of planted native and exotic woody vegetation. Patches of native vegetation occur within and proximal to the pipeline alignment.

The project is also sited within the marine environment of Corio Bay, which is connected to the Limeburners Bay and Avalon Beach components of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, approximately one kilometre north-east of the project. Overland flow from the project area has the potential to flow into the Ramsar site via the Hovells Creek floodplain. The Ramsar site provides habitat for waterbirds, migratory and resident shorebirds, and seabirds, some of which are threatened at the national and/or state level.

Most of the existing land uses in the project area are considered to have a relatively low potential for generating soil and groundwater contamination, with the exception of the Geelong Refinery and other adjacent industrial areas within the port and industrial area.

Terrestrial ecology

Construction activities for the project would involve the removal of 0.091 hectares (ha) of native vegetation, represented by the Western (Basalt) Plains Grassland Community which is a threatened ecological community, and may impact on a small extent of marginal foraging habitat for the nationally threatened Swift Parrot and Grey-headed Flying-fox (planted eucalypts). Golden Sun Moth may occur in mown Chilean Needle-grass adjacent to the South West Pipeline (SWP) tie-in point at Lara City Gate. Construction activities would not result in a significant impact to these ecological values, and mitigation measures such as establishing No-Go Zones (NGZs) to protect vegetation and avoiding large scale excavations in proximity to trees would be implemented.

Terrestrial ecological values of the Ramsar site, in particular, migratory shorebirds and other waterbirds, would not be directly impacted by the project as there is no infrastructure to be located in or near the wetland. The floating storage and regasification unit (FSRU) would be located some 1.3 kilometres from the Ramsar site. Noise and light spill have been evaluated and found to have no adverse impacts on Ramsar values.

Assessment of potential indirect impacts on terrestrial ecological values in Corio Bay and the Ramsar site also requires consideration of potential marine impacts. In particular, the potential for the project to impact on the food chain (plankton, larvae, fish etc.) of migratory shorebirds and other waterbirds required detailed evaluation. Marine investigations conducted for the EES indicate that the marine discharge, and entrainment of plankton and larvae in the FSRU water intake, would not adversely impact on species forming part of the food chain for migratory shorebirds and other waterbirds. Turbidity associated with project dredging was found to be localised to the dredged area and would not impact on the Ramsar site or to elements of the food chain for terrestrial species, for example, seagrass meadows in Corio Bay.

Land and water values

Given the short construction timeframe and short length of the underground pipeline, it is unlikely that temporary construction works would impact on land, surface water or groundwater environmental values.

The single waterway crossing (a minor, constructed watercourse) required for the construction of the underground pipeline would be trenched and reinstated with minimal short-term impact. It is highly unlikely that the project's operation would have surface water impacts on nearby sensitive receptors with the proposed use of existing runoff

water management systems in place at the refinery. Residual impacts on surface water associated with construction and operation of the project would be minor.

There is very limited potential for groundwater to be intersected during construction based on the proposed project infrastructure and the results of field investigations to establish groundwater depth. Groundwater levels or flow are not expected to be impacted during operation.

Construction activities have the potential to disturb small amounts of contaminated soils, groundwater and/or acid sulfate soils (naturally occurring sediments that can produce acid when disturbed) which could result in the mobilisation of contaminants and adversely impact the environmental values of soil, groundwater and/or groundwater users. Existing contamination was found to be limited in extent, and predominantly located within the boundaries of the Geelong Refinery. Due to the contained nature of the contamination, disturbance of contaminated soils and groundwater during the project's construction and operation has limited potential to impact on human health and the environment with the implementation of industry standard management measures. Residual impacts associated with the disturbance of contaminated material would be minor.

EES evaluation objective

The scoping requirements provided by the Minister for Planning for the project set out the specific environmental matters to be investigated and documented in the EES, which informed the scope of the EES technical studies.

The following evaluation objectives below are relevant to the land environment chapter

The associated technical reports prepared in support of the EES provide more detailed information on the investigations and impact assessments conducted in response to the EES scoping requirements.

Evaluation objective	Chapter section
Biodiversity – To avoid, minimise or offset potential adverse effects on native flora and fauna and their habitats, especially listed threatened or migratory species and listed threatened communities as well as on the marine environment, including intertidal and marine species and habitat values.	**Section 10.1** *Terrestrial ecology*
Water and catchment values - To minimise adverse effects on water (in particular wetland, estuarine, intertidal and marine) quality and movement, and the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.	**Section 10.2** *Land and water values*
Waste - To minimise generation of wastes by or resulting from the project during construction and operation, including dredging and accounting for direct and indirect greenhouse gas emissions.	**Section 10.2** *Land and water values*

10.1 Terrestrial ecology

This section summarises the potential impacts of the project on terrestrial ecology detailed in Technical Report D: *Terrestrial ecology impact assessment*.

10.1.1 Methodology

The following approach was adopted for the terrestrial ecology impact assessment:

- Establishing the study area
- Reviewing relevant legislation and policy at Commonwealth, state and local levels
- Undertaking a desktop review of relevant databases including:
  - Environment Protection and Biodiversity Conservation (EPBC) Act Protected Matters Search Tool (PMST)
  - Victorian Biodiversity Atlas (VBA)
  - NatureKit
- Reviewing previous assessments
- Undertaking field programs to identify native vegetation within the study area, inform a threatened species preferred habitat assessment, survey grassy habitat along the pipeline alignment, survey native grassland or threatened species at the Corio Native Grassland Reserve and to survey shorebirds in the study area
- Assessing terrestrial biodiversity impacts during construction and operation of the project
- Developing mitigation measures in response to identified impacts
- Evaluating the residual environmental impacts once mitigation has been implemented.

10.1.2 Study area

- The study area for the terrestrial ecology impact assessment was made up of 'onshore' and 'offshore' components.
- The 'onshore' study area included the area within a 50 metre (m) buffer of the proposed pipeline route between Refinery Pier and the SWP tie-in point to the Victorian gas network at Lara City Gate. This also included the Corio Native Grassland Reserve and an area referred to as 'the paddocks' along the western side of the pipeline, adjacent to the north of the existing Geelong Refinery.
- 'Offshore' areas considered as part of the assessment included 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 wetland of international significance for migratory shorebirds (Ramsar site) and because potential marine impacts associated with discharges from the project could impact on terrestrial ecology values at the Ramsar site, for example, impacts on the food chain for migratory shorebirds and other waterbirds.

The terrestrial ecology impact assessment study area, including offshore locations, is presented in **Figure 10-1**.

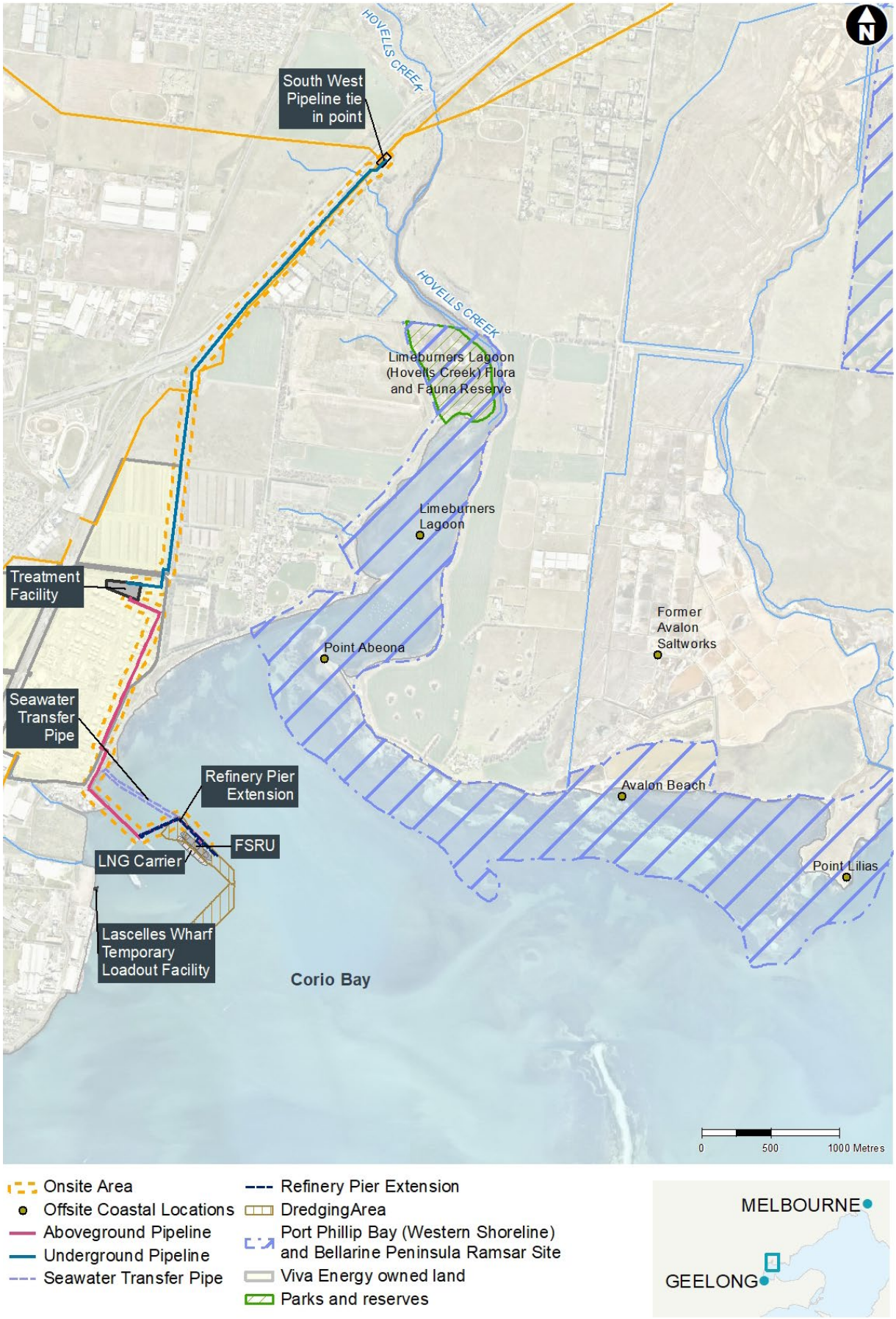

Figure 10-1 Terrestrial ecology study area

10.1.3 Existing conditions

The existing conditions assessment provides baseline conditions to enable an assessment of the potential impacts to terrestrial ecology from the project.

Existing conditions were assessed based on the location of the study area and with consideration to a review of relevant legislation, database searches, previous assessments and field programs.

Onshore conditions

The extent of native and exotic vegetation was assessed along the pipeline alignment to inform the existing conditions assessment. Exotic vegetation refers to vegetation that is not indigenous or native to the study area. Quadrats 2 metres by 2 metres in size were spaced 150 metres apart along the proposed pipeline route. Within each quadrat, elements measured included dominant species and their coverage, the presence of any native grass species and their coverage and the presence of any favourable habitat (such as cracking clays or rock for Striped Legless Lizard).

The quadrat assessment highlighted that most grassy species along the pipeline alignment were exotic and that the proportion of native species to exotic species was low. Some instances where native vegetation dominated included in 'the paddocks' on the western side of Shell Parade, north of School Road, adjacent to the study area. These included small patches of Wallaby Grass and Plains Grassland. This native vegetation is considered endangered under the Flora and Fauna Guarantee Act 1988 (FFG Act). Wallaby Grass and Plains Grassland are discussed further in latter sections (state significant biodiversity values). On the eastern side of Shell Parade adjacent to Bell Road and within the Corio Native Grassland Reserve, patches of Native Temperate Grasslands of the Victorian Volcanic Plain (NTGVVP) threatened ecological community (according to the EPBC Act) were identified outside of the 50-metre pipeline buffer. This is discussed further in latter sections (threatened ecological communities).

Between Refinery Pier and Foreshore Road, close to the shoreline, a narrow strip of Coastal Saltmarsh with Shrubby Glasswort, Austral Seablite and Rounded Noon-flower was identified. This native vegetation is listed as a threatened community under the EPBC Act and is considered vulnerable under the FFG Act. It is unclear whether the Coastal Saltmarsh is naturally occurring or has been established through revegetation of the shoreline. The Coastal Saltmarsh is discussed further in latter sections (threatened ecological communities and state significant biodiversity values).

Offshore conditions

Limeburners Bay

Limeburners Bay is located on the northern shore of Corio Bay and is a broad, sandy estuarine inlet which is characterised by open, shallow water at the mouth of Hovells Creek (refer to **Figure 10-1**). The shorelines and sandy spits are important feeding and roosting habitats for birds. The bay is home to more than 40 bird species. Large beds of seagrass are supported by the shallow waters of the inlet. Seagrass meadows are recognised for their critical function as nursery habitat for fish and important feeding habitat for birds.

As part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site, Limeburners Bay is recognised as a wetland of international importance.

The foreshore reserve and bay are in a Public Conservation and Resource Zone and are covered by an Environmental Significance Overlay (ESO2) under the Greater Geelong Planning Scheme. ESO2 identifies high value wetlands and associated habitat protection areas. A terrestrial area on the eastern side of Limeburners Bay is Rural Conservation Zone and is covered by an Environmental Significance Overlay (ESO1). ESO1 identifies areas with a number of significant flora and fauna habitats and areas of geological and natural interest.

Corio Bay

Corio Bay is one of several internal bays on the western shoreline of Port Phillip with the entrance defined by Point Lillias and Point Henry (refer to **Figure 10-1**). The foreshore extending north from the refinery intake located 150 metres north of Refinery Pier is within the Port Phillip Bay Coastal Reserve and forms part of ESO2 of the Greater Geelong Planning Scheme.

The foreshore vegetation ranges from mown exotic grasses to small pockets of Coastal Saltmarsh and planted native trees and shrub. The sub-tidal environment, below the low tide line, is known to support a variety of marine life including fish, marine mammals and seabirds. Sea floor habitats range from muddy to sandy substrates which support burrowing invertebrates. The sea surface and water column between the sea surface and floor are foraging habitats for seabirds and marine mammals.

Figure 10-2 Native vegetation proximate to the proposed pipeline alignment

Avalon Beach

Avalon Beach is located within the Avalon Coastal Reserve which is part of the Port Phillip Bay (Western Shoreline) Ramsar site (refer to **Figure 10-1**). Avalon Beach is located 5km east of the proposed project, however the marine environment of Corio Bay connects the project area to the environs of the Avalon Coastal Reserve.

Matters of National Environmental Significance

Review of the EPBC Act Protected Matters Search Tool (PMST) identified a number of Matters of National Environmental Significance (MNES) that may occur, or for which suitable habitat may occur, within the study area.

Matters of national environmental significance are protected under national environment law (EPBC Act) and include (but are not limited to) threatened species and communities, migratory species and Ramsar wetlands of international importance. A summary of the MNES located within 5km of the study area is presented in **Table 10-1**.

The list of threatened flora and fauna generated by the PMST search within a 5km radius of the proposed pipeline has been combined with the results of the Victorian Biodiversity Atlas (VBA) records for the same area. For many of the species identified by the PMST search, a large number have not previously been recorded within 5km of the proposed pipeline according to the most recent VBA records.

Wetlands of International Significance (Ramsar sites), migratory shorebirds, threatened ecological communities and threatened species relevant to the study area are discussed in further sections.

Table 10-1 MNES within 5km of the study area

MNES	Number of occurrences
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Significance (Ramsar Sites)	Port Phillip Bay (Western Shoreline) and Bellarine Peninsula (1.3km north-east of Refinery Pier)
Listed threatened ecological communities	Five threatened ecological communities • Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Critically Endangered) • Natural Temperate Grassland of the Victorian Volcanic Plain (Critically Endangered) • Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (Critically Endangered) • Subtropical and Temperate Coastal Saltmarsh (Vulnerable) • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered)
Listed threatened species	66 listed threatened species made up of • 45 listed fauna species • 21 listed flora species
Listed migratory species	60
Commonwealth Marine Areas	None

Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site

Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is recognised as being of international importance for migratory shorebirds. The Ramsar site covers 22,650 hectares and is comprised of six distinct areas, including Limeburners Bay and Avalon Coastal Reserve (**Figure 10-3**).

The project is located near to the Point Wilson / Limeburners Bay area of the Ramsar site (**Figure 10-1**). At its closest, the pipeline study area is approximately 800 metres to the west of the Ramsar site at the southernmost end near the refinery. This distance increases to approximately 1.8km towards the centre of the study area and decreases again to approximately 1km at the northernmost end of the study area at Lara City Gate. The FSRU would be 1.3km from the Ramsar site. In addition, the northernmost end of the alignment is approximately 300 metres west of Hovells Creek reserve. Hovells Creek drains into Limeburners Lagoon, a part of Limeburners Bay.

In order for a wetland to be considered a Ramsar wetland, it is assessed against nine criteria under the Ramsar Convention. The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site meets six of the nine criteria, including the following which relate to migratory shorebirds:

- Regularly supports 20,000 or more waterbirds
- Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

As such, the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is considered to be an important habitat for migratory shorebirds.

Ramsar wetlands are recognised as a MNES under the EPBC Act and any action that has, will have, or is likely to have a significant impact on the ecological character of a Ramsar Wetland must be referred to the Commonwealth Minister and be subject to an environmental assessment and approval process. An action will be deemed to have the potential for a significant impact if it may 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.

Values critical to the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site include geomorphology/ ecological connectivity, hydrology, seagrass, rocky reefs and social and cultural values. The Point Wilson / Limeburners Bay area of the Ramsar site supports specific values. These 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 which helps stabilise soft sediments and seagrass beds, which are an important food resource and component of the ecological character of the Ramsar site.

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.

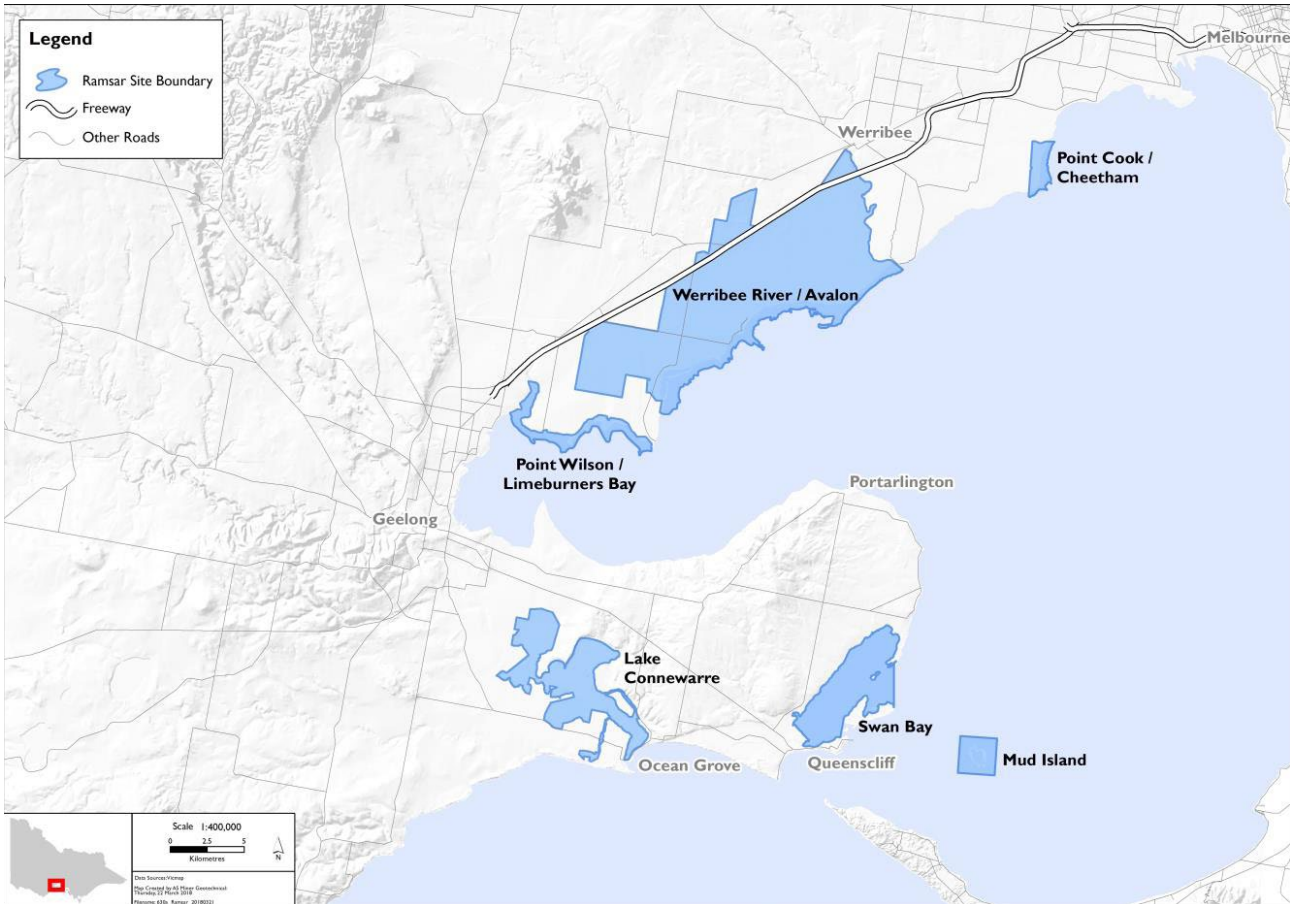

Figure 10-3 Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site

Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve

Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve, within Limeburners Bay, is part of the Port Philip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The reserve contains an extensive amount of Coastal Saltmarsh which is considered vulnerable in Victoria and is considered a threatened ecological community under the EPBC Act.

The low-lying floodplain of Hovells Creek supports the Chaffy Saw-Sedge, a tussock grass which provides habitat for the Altona Skipper Butterfly. While skipper butterflies occur in other parts of Port Phillip Bay, Altona skipper butterflies are geographically isolated from other populations and are considered under the FFG Act as endangered.

Limeburners Bay is a valuable fish breeding ground for many of the commercial fish species in Port Phillip Bay. 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 migratory shorebirds.

Migratory shorebirds

Shorebirds (also known as waders) include plovers, lapwings, stone-curlews, sandpipers, 'shanks', tattlers, curlews, godwits, snipes, pranticole, oystercatchers, stilts, avocets and jacana. Shorebirds are so named as they commonly feed by wading in shallow water along the shoreline of lakes, rivers and the sea. Shorebirds use intertidal areas (between high and low waterline) to forage and supratidal areas (above high waterline) to roost.

There are 54 shorebird species that occur regularly in Australia. This includes 17 resident shorebird species and 37 other species which migrate to Australia from their breeding grounds in the northern hemisphere and New Zealand.

The 37 migratory shorebirds that regularly visit Australia are listed in the EPBC Act and are subject to a number of international agreements, such as the Ramsar Convention of Wetlands. Australia's obligation under these international agreements and conventions is to ensure adverse effects to listed migratory species and their habitats in Australia do not occur.

Threats to shorebirds include habitat loss, habitat modification and pollution, anthropogenic disturbance, altered hydrological regimes, harvesting of prey including fish, and climate variability and change.

During the field surveys undertaken, shorebirds were not observed on the shoreline of Corio Bay adjacent to the proposed project. In comparison, Limeburners Bay and Avalon Beach supported an abundance of aquatic birds including several species listed as migratory under the EPBC Act.

Habitat requirements

Water depth is the habitat attribute of greatest importance to shorebirds. Shorebirds use habitats within a narrow range of water depths. Birds with longer legs, beaks and necks can forage in deeper water than smaller birds. Abundance and diversity of waterbirds are reportedly greatest at water depths of 10-20 centimetres (cm) and ponds with an overall depth of 30-40cm provide the greatest habitat diversity.

Small waders have higher energy demands and need to feed for longer durations than large birds. Large waders are better able to exploit mudflats more distant from shore that are only available for short periods at low tide. Small migratory bird species are more susceptible to the effects of disturbance due to their need to feed for longer to meet their energetic demands, and their size limiting the distance from shore that they can forage.

Food chain

The marine food chain is dependent on marine plants and algae which include macroalgae and seagrass. These are known as 'primary producers' in a food chain which is a system of interdependent food chains. Plants, animals and non-living parts within an ecosystem are connected to each other such that if one part of the food chain is impacted, every part is affected to differing degrees.

Aquatic plants living in Corio Bay are phytoplankton, seagrasses, macroalgae and microphytobenthos. Seagrass meadows occur around the perimeter of Corio Bay (except in the port areas) based on distribution mapping in 1972 and 2001. Seagrass meadows function as a nursery area for fish, provide important habitat for a diversity of animals and provide a valuable source of food to migratory shorebirds. Algae and invertebrates growing on the leaves of seagrass (epiphytes) are a major food source for fish, shellfish and crustaceans.

Aquatic invertebrate assemblages are essential for maintaining the ecological character of the Ramsar site. They are a critical food source for a range of vertebrate fauna (waterbirds and fish). Common invertebrates found in marine environments such as Corio Bay include infauna (bivalves, shrimp, crustaceans, polychaetes, bivalve molluscs and gastropods) and epifauna (grazing molluscs, crabs, amphipods, shrimp, seapen, gastropods, brachiopods, sea stars and urchins).

Water column biota are those which inhabit the water column from the shoreline and seafloor. They include organisms which drift passively in the water column (phytoplankton, zooplankton and jellyfish) and larger, more mobile fish and marine mammals. Diatoms are the dominant phytoplankton in Corio Bay. Plankton abundance and species richness is evenly distributed over Corio Bay can be highly variable increasing rapidly in favourable conditions and decreasing rapidly in unfavourable conditions.

Fish provide a critical food source for numerous waterbird species and marine mammals (including dolphins and seals). The presence and diversity of fish is strongly influenced by the availability of habitats, particularly intertidal mudflats, seagrass and deeper channels. Fish species which live in the Corio Bay water column include snapper, which a highly valued fishing species. Species known to utilise mudflat habitats such as those in Corio Bay include flathead, flounder and mullet.

Fish species associated with seagrass and areas of unvegetated sediment habitats within Corio Bay include King George Whiting (another valued commercial and recreation fishing species) and leatherjackets.

Several fish which occur or may occur in Corio Bay are of conservation significance under the EPBC Act and include pipefish and seahorses, school shark, Australian mudfish and Australian Grayling.

Threatened ecological communities

Of the five threatened ecological communities listed in **Table 10-1**, the two communities described below were identified in association with the project, but in areas outside the pipeline alignment.

Natural Temperate Grassland of the Victorian Volcanic Plain

Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP) was not identified within the study area (up to 50 metres from the proposed pipeline) but occurs adjacent to the study area. Native species observed included Wallaby grasses, Spear grasses, Fireweed and Bindweed.

Subtropical and Temperate Coastal Saltmarsh

Subtropical and Temperate Coastal Saltmarsh (STCS) occurs along the shoreline of the foreshore reserve near Refinery Pier within the 50-metre buffer of the proposed pipeline. In addition, the community occurs offshore in Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve and is indirectly connected to the marine component of the project via Corio Bay. STCS is also listed as vulnerable under the FFG Act.

Threatened species

An assessment of the likelihood of threatened flora and fauna species occurring in the project study area is presented in Technical Report D: Terrestrial ecology impact assessment. Threatened species listed under the EPBC Act that received a 'possible' or greater likelihood of occurring within study area are discussed below.

Flora

Two EPBC Act-listed threatened flora species identified by the PMST and/or VBA were assigned a 'possible' likelihood of occurrence based on past records and potential grassland habitat within, or adjacent to, the study area. These species were:

- Spiny Rice-flower, a small shrub endemic to the grasslands of Victoria (critically endangered).
- Large-headed Fireweed, a perennial daisy also known as Large-fruit Fireweed or Large-fruit Groundsel (critically endangered).

Field assessments indicated that both of these species are unlikely to occur in the study area. Two historical records of Spiny Rice-flower were identified by the VBA within 5km of the study area. One of those records is from the south-east corner of the Corio Native Grassland Reserve from 2013. A targeted search of the exclusion plot at the location of the VBA record did not detect the species. One historical record of the Large-headed Fireweed was identified by the VBA within 5km of the study area from 1998. The location of the past record is in an area that had been recently cropped and it is unlikely the species still occurs at that location.

Fauna

Four EPBC Act-listed threatened fauna species were assigned a 'possible' likelihood of occurrence based on past records, potential habitat within the pipeline study area and/or identified as a species of interest in the scoping requirements for the EES:

- Swift Parrot (critically endangered)
- Grey-headed Flying-fox (vulnerable)
- Golden Sun Moth (vulnerable)
- Striped Legless Lizard (vulnerable).

It is noted that Golden Sun Moth was listed as critically endangered under the EPBC Act until 7 December 2021 when a downgrade in status to vulnerable came into effect.

Three EPBC Act listed threatened migratory shorebirds are also identified as being of interest in the scoping requirements and are therefore also considered below:

- Eastern Curlew (critically endangered)
- Curlew Sandpiper (critically endangered)
- Red Knot (endangered).

Swift Parrot may occasionally forage in the small, planted eucalypts of the study area while moving through to central Victoria. A number of records of Swift Parrot are known from the Greater Geelong region. A review of VBA records shows past observations to be clustered outside of the study area and in areas that provide more extensive foraging resources. Examples of such areas include the You Yangs Regional Park, Brisbane Ranges National Park and coastal towns such as Anglesea and Ocean Grove. Whilst records have been observed proximal to the project area within the grounds of Geelong Grammar School (1998) and Avalon Foreshore (2005), given the general lack of foraging resources provided in the study area they would only be anticipated to use the area on an opportunistic and occasional basis.

Grey-headed Flying-fox may forage in young, planted eucalypts within the study area but are unlikely to utilise this vegetation as their primary food resource. A colony occurs in Eastern Park, Geelong which is approximately 8km south of the study area. This colony is thought to be an offshoot of the colony initially located in the Melbourne Botanic Gardens with the majority of bats moving to Yarra Bend. A review of VBA records shows, that whilst the colony is located in central Geelong, the majority of observations of the species outside central Geelong are clustered in peri urban areas, in particular proximal to Colac and the Otways. No records are located within the study area and as per Swift Parrot any use of the area by the species would be anticipated to be on opportunistic and occasional basis.

Golden Sun Moth may occur within part of the study area at the Corio Native Grassland Reserve and public open space at Lara City Gate. No records of Golden Sun Moth are recorded on the VBA within 5km of the study area. The closest historic record is

located approximately 8km to the north of the study area and dates from 2009. Most of the study area is not suitable for Golden Sun Moth. The ground within the roadsides has been historically disturbed via past earthworks (installation of pipelines and services) along the route on which the proposed new pipeline is aligned. Significant compaction has occurred since, and regular on-going maintenance and management from weed control and slashing/mowing has further reduced the habitat value.

Corio Native Grassland Reserve had the potential to provide habitat for Golden Sun Moth, however, the grassland had significant biomass dominated by Phalaris which is not a known food source for Golden Sun Moth. An area to the south of the Lara City Gate was noted to provide the most suitable habitat of anywhere along the alignment. The area mapped in **Figure 10-4** had a 25% or greater cover of Chilean Needle-grass (a known food source). In proximity to the South West Pipeline connection point, the ground appeared to have been previously disturbed to construct the compound and to plant trees. Slashing of that area creates an ideal open structure for the moth, however, the planted trees shade the area and provide vantage points for birds which increase the predation risk to Golden Sun Moth. In addition, the area is not connected to other areas of suitable habitat beyond the area of public open space.

In the absence of a targeted survey, while it is considered that the area south of Lara City Gate is unlikely to support a population of the Golden Sun Moth, presence of the species has been assumed at this location as a precautionary approach.

Striped Legless Lizard is unlikely to occur within the study area. There are no nearby records of Striped Legless Lizard on the VBA. The closest historical record of the species on the VBA is from approximately 7km north of the study area and dating from 1992. The study area has been historically disturbed through the laying of pipework, underground utilities and construction of roads or is currently disturbed through slashing and mowing activities, or both. Corio Native Grassland Reserve is dominated by dense swards of Canary-grass and Chilean Needle-grass. The absence of surface rocks, dry, cracking soils and inter tussock spaces means the study area within Corio Native Grassland Reserve is unlikely to support Striped Legless Lizard. Unlike Golden Sun Moth, Striped Legless Lizard is unlikely to occur in the public open space surrounding Lara City Gate. The area is routinely mowed and lacks rocks and soil cracks which means the area provides very little refuge from predators. Dominance by exotic grasses suggests extensive modification in the past and may never have been suitable as habitat.

No suitable habitat for the migratory shorebird species of Eastern Curlew, Curlew Sandpiper or Red Knot occurs along the pipeline corridor. 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. Curlew Sandpiper and Red Knot have both been observed in Limeburners Bay. Those observations were of a single individual in February 2014 and February 2016 (both species). Curlew Sandpiper (single individual) was observed at Avalon Beach during the shorebird survey in February 2021.

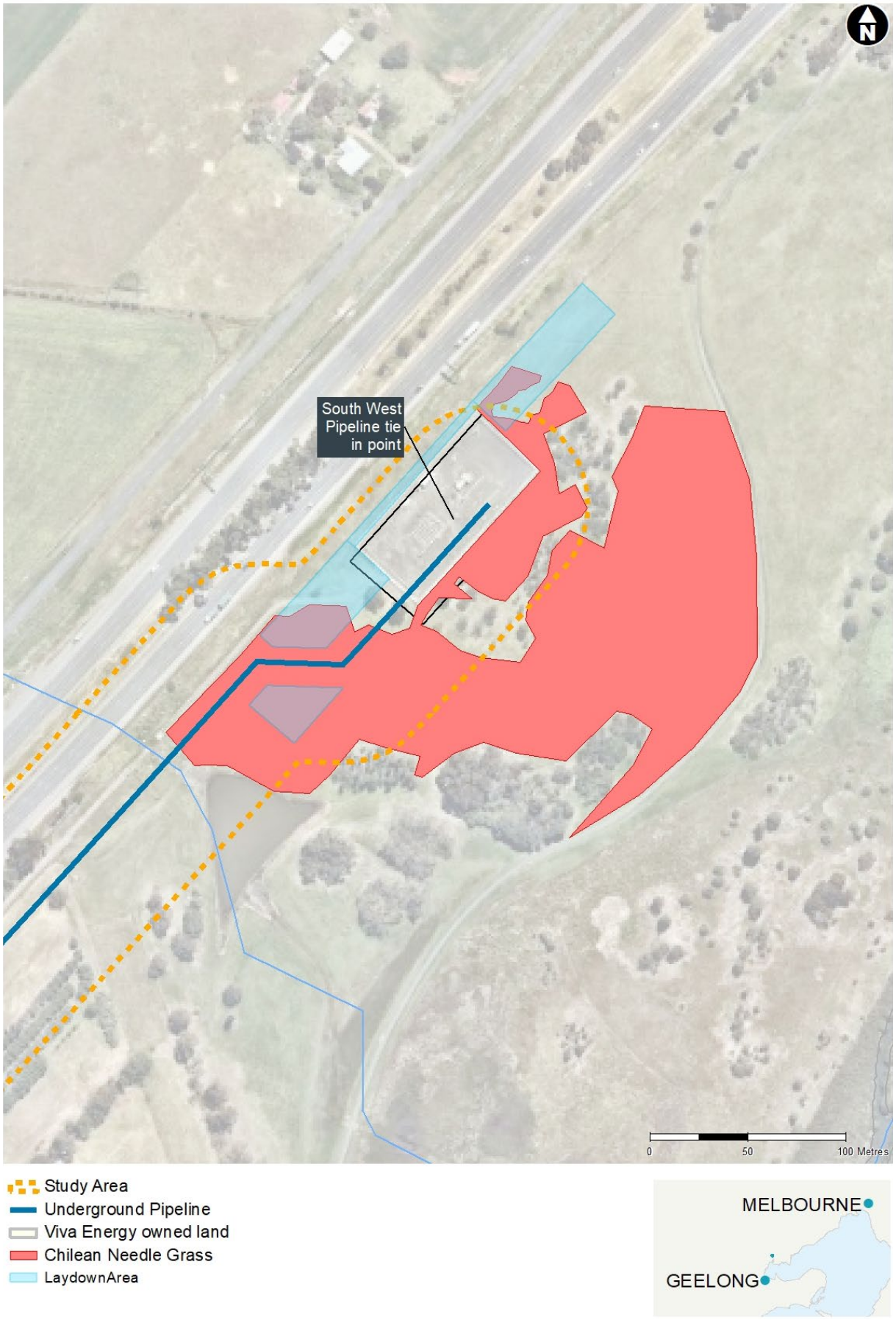

Figure 10-4 Occurrence of Chilean Needle grass around Lara City Gate

State significant biodiversity values

Under Victorian planning schemes, native vegetation is defined as plants that are indigenous to Victoria, including trees, shrubs, herbs, and grasses. Native vegetation in Victoria is classified into Ecological Vegetation Classes (EVCs) based on floristic, structural, and ecological features. Each EVC has been assigned a 'benchmark' condition for each of Victoria's bioregions. The EVC benchmark is used for comparison when assessing vegetation quality through a Vegetation Quality Assessment (VQA).

Table 10-2 below presents the modelled EVCs and their Biodiversity Conservation Status (BCS) within 5km of the study area.

Native vegetation within the study area

Most of the study area is dominated by exotic vegetation. Where native vegetation is present, it consists primarily of Heavier Soils Plains Grassland (EVC 132) dominated by Wallaby grasses and Spear grasses with occasional Fireweed and Bindweed. This is mostly present adjacent to the study area. In addition, Coastal Saltmarsh (EVC 9) is present within the study area in the foreshore reserve towards Refinery Pier. Native vegetation proximate to the study area is presented in **Figure 10-2**.

In total 4.153 hectares of native vegetation was identified in the study area; 4.05 hectares of Plains Grassland and 0.1 hectares of Coastal Saltmarsh. Of this, 0.091 hectares falls within the construction footprint and is considered in relation to the impact assessment (refer to **Section 10.1.4**).

Across the broader study area, some patches of native vegetation were identified within the Corio Native Grassland Reserve.

One patch of Plains Grassland also met the threshold to be classified as the EPBC Act listed NTGVVP, which was identified beyond the 50-metre buffer of the pipeline on the eastern side of Shell Parade within the Corio Native Grassland Reserve and would not be impacted by the project. The 0.091 hectares of Plains Grassland that fall within the construction footprint occur within 'the paddocks' and within the Princes Highway road reserve (see **Figure 10-2**).

Corio Native Grassland Reserve

The area now known as the Corio Native Grassland Reserve was previously intended to be a residential subdivision referred to as the New Corio Estate (NCE). In 2013, Greater Geelong City Council adopted Amendment C243 to incorporate changes to the Environment Significance Overlay (ESO) of the planning scheme to reflect the presence of significant native vegetation more accurately on vacant land in the north of Geelong. Amendment C243 also incorporated the Geelong Ring Road Employment Precinct Native Vegetation Precinct Plan into the Greater Geelong Planning Scheme. This plan aims to ensure native vegetation protection.

Table 10-2 EVCs modelled within 5km of study area derived from NatureKit

EVC No.	EVC Name	Status
9	Coastal Saltmarsh	Vulnerable
55	Plains Grassy Woodland	Endangered
68	Creekline Grassy Woodland	Endangered
125	Plains Grassy Wetland	Endangered
132	Plains Grassland	Endangered
140	Mangrove Shrubland	Vulnerable
163	Coastal Tussock Grassland	Vulnerable
175	Grassy Woodland	Endangered
302	Coastal Saltmarsh/Mangrove Shrubland Mosaic	Endangered
647	Plains Sedgy Wetland	Endangered
691	Aquatic Herbland/Plains Sedgy Wetland Mosaic	Endangered

State threatened species and communities

The Victorian FFG Act identifies threatened species and communities that require management to minimise threats to those species and communities.

In addition to the EPBC Act listed threatened species which are also listed as threatened under the FFG Act, the VBA identified records of 4 FFG Act listed flora species and 24 FFG Act listed fauna species (all birds) within a 5km radius of the study area. Marginal habitat for these species occurs along the foreshore, the swale drain on Macgregor Court (south) or around the artificial dam near Lara City Gate, otherwise there is no suitable habitat for these species associated with the project. Some species observed during surveys suggest that the Black Falcon and White-bellied Sea-eagle hunt over the study area.

Heavier Soils Plains Grassland (EVC 132) is considered endangered and a threatened ecological community under the FFG Act.

Existing threats to biodiversity values

Threats to biodiversity include removal of native vegetation, habitat fragmentation, predation of native wildlife by Red Fox and cats, browsing of native vegetation by European Rabbit and invasion of native vegetation and habitat by weeds and pathogens. These threatening processes are recognised under the EPBC Act and FFG Act as they may threaten the survival of native species or ecological communities.

As is the case for areas in semi-urban settings, the environment of the pipeline study area has already experienced, or is currently subject to, these threatening processes.

Six weed species listed under the *Catchment and Land Protection* (CaLP) Act 1994 or identified as Weeds of National Significance (WoNS) were observed in the study area. European Rabbit were observed within the study area but not in large numbers. In an environment dominated by weeds, the presence of rabbits is unlikely to represent a major threat to biodiversity. European Hare and Red Fox may also occur in the study area at times. Cats are likely to occur given the presence of residences in the area.

Two pathogens were recognised as threats to biodiversity in the study area: Chytrid Fungus and Cinnamon Fungus. Chytrid Fungus is now established in most climatically suitable areas in Australia and is likely to already be present in the dam near Lara City Gate. Chytrid Fungus typically lives in water or wet soil and infects frogs when their skin contacts water containing spores. If present, the disease may be affecting non-threatened frogs which occur in the dam. Currently, there are no proven ways to control the disease once present.

Cinnamon Fungus is unlikely to be present in the environment of the study area. Cinnamon Fungus is an introduced water mould that attacks the root systems of susceptible native plants. Vegetation in the study area does not contain susceptible plant species or ecological communities. As such, Cinnamon Fungus is not an existing threat to the ecosystems of the study area or the animals that depend on the habitat.

10.1.4 Construction impact assessment

Construction impacts have been considered in two distinct components to cover the potential impacts associated with:

- Construction of the onshore pipeline alignment
- Offshore environments associated with the marine-based construction components of the project.

Potential impacts associated with construction of the onshore pipeline from Refinery Pier to the SWP tie-in point at Lara include native vegetation removal, impacts to threatened ecological communities and threatened species, the injury or death of wildlife, the disturbance of wildlife and exacerbation of threatening processes.

Potential impacts associated with the marine based construction components of the project are described in Technical Report A: *Marine ecology and water quality impact assessment*. Potential marine construction impacts are only considered in this section where they have potential to impact on terrestrial ecology. For example, dredging for a period of 8 weeks and construction of the new pier arm may influence the ecological character of the Ramsar site and the food chain of migratory shorebirds primarily through sediment mobilisation affecting seagrass productivity and noise and lighting causing disturbance.

Pipeline (onshore)

Onshore pipeline construction activities would include:

- Construction of the 3km aboveground pipeline along the existing pipe track from Refinery Pier, under Shell Parade and within the refinery itself to an existing laydown area where the treatment facility would be located at the northern end of the refinery
- Construction of the 4km underground pipeline from the treatment facility in the refinery to the SWP tie-in point at Lara City Gate. A 15–20m wide construction right of way (ROW) would be established, clearly identified and fenced off where required to protect retained ecological values. Once the construction ROW was established, vegetation would be removed and a trench excavated to a maximum depth of 2m and a maximum width of 1m for the pipeline to be placed. Following the placement of the pipeline, the construction ROW would be rehabilitated to its pre-existing condition as far as practicable.

Native vegetation

Native vegetation is protected under the EPBC and FFG Acts where it meets the criteria for a listed threatened ecological community and is considered to provide habitat for listed threatened species or protected flora. Of the 0.928 hectares of native vegetation within 50 metres of the proposed pipeline alignment, 0.091 hectares of Plains Grassland was identified within the proposed construction footprint and may be removed during construction. Given that this is not a significant amount of Plains Grassland, if up to 0.091 hectares were to be removed during construction, this would be considered a minor impact.

Native vegetation has the potential to be impacted by a range of construction activities such as vehicle parking and equipment and plant storage, and stockpiling of soils and construction materials, if not appropriately managed. Other potential risks to retained vegetation include introduction and/or spread of weeds due to movements of machinery, light vehicles, personnel and materials, surface water runoff (erosion and sedimentation) and hazardous material spills (contamination).

No-Go Zones (NGZs) would be established and clearly demarcated to protect retained areas of the vegetation (see MM-TE01 to MM-TE04). Other measures would include:

- Undertake all earthworks in a manner that minimises soil erosion and adhere to the Construction Techniques for Sediment Pollution Control (EPA, 1991)
- Use indigenous plants of local provenance in revegetation works, as agreed with landholders.

Threatened ecological communities

Nationally significant threatened ecological communities (TECs) are listed as vulnerable, endangered, or critically endangered depending on the extent of the community remaining in Australia, threats to their decline and the potential for extinction. They are listed under Commonwealth law to prevent further decline and assist in recovery efforts to ensure the long-term survival of the community. State significant TECs include flora and fauna communities listed as 'threatened' under the FFG Act.

No EPBC Act listed ecological community would be impacted by construction of the project. NTGVVP does not occur within the study area and would not be impacted. A narrow strip of Subtropical and Temperate Coastal Saltmarsh occurs within the study area, however, would not be impacted by the construction of the project and as a threatened ecological community listed in the vulnerable category, it is not considered a Matter of National Environmental Significance for assessment purposes.

Western (Basalt) Plains Grassland (FFG Act listed) occurs within the study area and the construction of the project may result in up to 0.091 hectares of Plains Grassland being removed. Given that this is not a significant amount, the removal of Plains Grassland would be considered a minor impact. A permit to remove this FFG listed community from public land would be required under the FFG Act.

NGZs will be defined as areas where works are not permitted to protect sites of known significant ecological values including the area of Coastal Saltmarsh within the foreshore reserve and areas of the Corio Native Grassland Reserve, with particular emphasis on the area adjacent to mapped NTGVVP on the eastern side of Shell Parade (see MM-TE02) (refer to **Figure 10-2**).

Threatened species

Nationally threatened species are listed under the EPBC Act. Field assessments indicated that no nationally threatened flora species are likely to occur within the study area and therefore are unlikely to be impacted by the construction of the project.

Swift Parrot and Grey-headed Flying-fox may occasionally use the planted eucalypts within the study area (in the refinery buffer area) to forage or rest despite the canopy of trees not being mature. The construction footprint avoids most planted trees and those that may be lost are an occasional and marginal resource that extend beyond the construction footprint. These species are unlikely to be significantly impacted by the loss of a maximum of 0.354 ha of planted overstorey trees.

Migratory shorebirds are unlikely to be impacted by construction 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. This marginal habitat would not be removed. Shorebirds were not observed utilising this shoreline during field surveys in 2021, and suitable alternate habitat is present for shorebirds to forage during construction works.

State significant flora and fauna species are those which are listed as threatened under the FFG Act and not the EPBC Act. Most state significant species recorded within 5km of the pipeline are unlikely to occur within the study area and therefore would not be impacted by the construction of the project.

Golden Sun Moth may occur in mown Chilean Needle-grass adjacent to the SWP tie-in point at Lara City Gate. Construction of the pipeline at the tie-in point would remove 0.512 hectares of modified exotic grassland containing a cover of at least 25% Chilean Needle-grass from within the construction footprint (refer to **Figure 10-5**). Of this, 0.48 hectares is considered to be potential habitat for Golden Sun Moth. The planned construction area would be the more heavily disturbed portion of the area which aligns with existing pipeline easements and areas disturbed during the original installation of Lara City Gate. As discussed in **Section 10.1.3**, this area is considered to be low quality habitat for the species and construction in this area would have a localised impact in a broader area that would be unlikely to have a significant impact on the Golden Sun Moth, if present.

Mitigation and management measures would include the retention of as many as possible of the planted eucalypt species at the edge of the construction footprint (MM-TE07) and use of protection fencing to minimise the removal of marginal Swift Parrot and Grey-headed Flying-fox habitat (MM-TE02). Measures to further minimise impacts on Golden Sun Moth at Lara City Gate include:

- Fencing the construction footprint to contain disturbance of the ground to within the works area
- Where appropriate, using trenching techniques that minimise disturbance to planted eucalypts
- Minimising the footprint and prioritising placement in areas with little to no Chilean Needle-grass.

Protected flora

Protected flora are native plants offered protection under the FFG Act. Protected flora was not identified in the study area. The construction of the project would not be expected to impact protected flora.

Measures to minimise the loss of native vegetation, detailed within this Section, would also minimise the loss of flora (see MM-TE01 to MM-TE07).

Fauna injury or death

Vegetation within the study area provides habitat for non-threatened fauna, particularly arboreal mammals (possums), microbats, birds, reptiles and frogs. Construction activities may remove up to 0.091 hectares of Plains Grassland, up to 0.512 hectares of non-native modified grassland and up to 0.354 hectares of planted eucalyptus habitat for those non-threatened species. Individuals could be displaced, injured, or killed, particularly during site clearance if vegetation and habitat is removed. Displaced animals are vulnerable to collision with vehicles and susceptible to predation. The displacement, injury, or death of non-threatened fauna is an animal welfare concern.

Measures would be implemented to reduce potential impacts on fauna during construction. These include measures to reduce the risk of fauna becoming entrapped in trenches and engaging appropriately qualified wildlife spotters when habitat is removed (see MM-TE08 and MM-TE13). Details of the type of measures and location where the measures must be implemented would be determined as part of developing a Construction Environment Management Plan (CEMP).

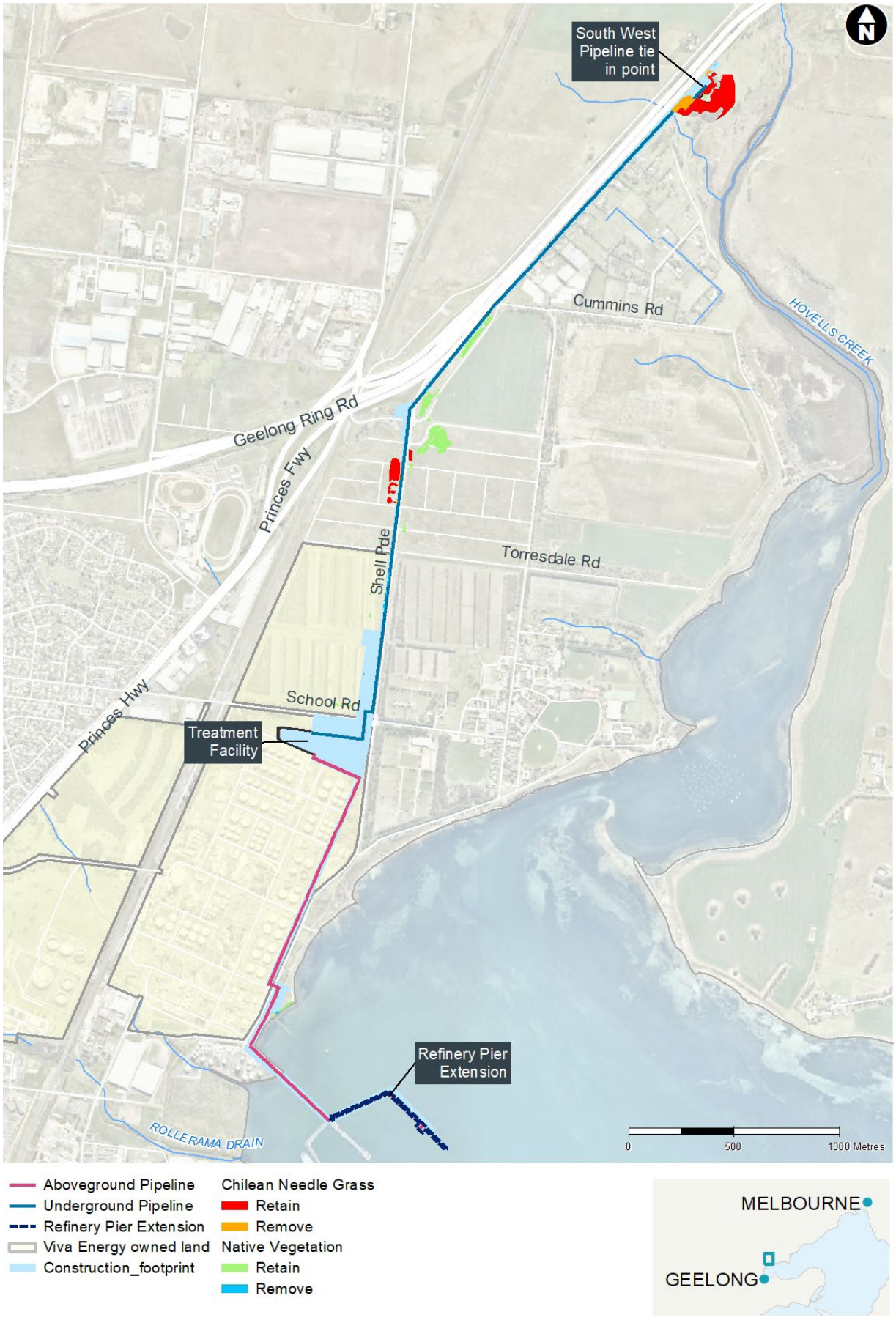

Figure 10-5 Native vegetation and Chilean Needle-grass for removal and retention

Disturbance

Wildlife can be disturbed by artificial lighting, noise associated with construction activities and visible movement of personnel. Potential impacts associated with noise and lighting during construction of the pipeline relate to non-threatened wildlife. Disturbance of shorebirds from the shoreline of Corio Bay adjacent to the pipeline during construction is unlikely as shorebirds are not regular visitors to the area (see **Section 10.1.3**).

Where practical, night works near treed areas should be avoided. If lighting is required during construction for night works or for security purposes, the number, type and layout of lights would be designed to light only the construction area with reference to the National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (MM-TE10 and MM-TE111). 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 LEDs if possible.

Threatening processes

Threatening processes are processes that may threaten the survival, abundance, or ongoing existence of a native species or ecological communities. Existing threats to biodiversity in the study area are summarised in **Section 10.1.3**.

The project would be unlikely to encourage the occurrence of predators (cats and foxes) or rabbits above current levels in the environment. The project would be unlikely to lead to the introduction or spread of pathogens, as Cinnamon Fungus does not occur in ecosystems such as those in the study area and Chytrid Fungus is likely to already be present in the dam adjacent to the construction footprint. The project would have the potential to exacerbate the invasion of native vegetation by environmental weeds as the study area is dominated by weeds which may be spread during construction works.

Measures to prevent and manage the introduction and spread of weeds or pathogens would include (MM-TE14 to MM-TE17):

- Implement hygiene measures to ensure opportunities for the introduction and spread of weeds (importation of seeds and other vegetative material to the site) and pathogens are limited
- Treat high risk weeds from construction areas prior to works commencing
- Manage any outbreak of noxious and/or Weeds of National Environmental Significance (WoNS) within construction areas that occurs due to construction activity and prevent spread into adjacent land
- Manage and control spread of noxious weeds as per the responsibilities outlined in the CaLP Act.

Offshore environment

Offshore construction activities most relevant to potential terrestrial ecological impacts would include:

- Localised dredging of approximately 490,000m^3 of seabed sediments within the new berth and swing basin. Dredging within the new berth would be undertaken to a depth of 13.1m and the swing basin would be dredged to a depth of 12.7m. Dredged material would be deposited at an existing dredged material ground in Port Phillip Bay to the east of Point Wilson.
- Construction of the new pier arm and berthing infrastructure. Steel piles would be driven into the seabed by cranes mounted on floating barges. Transport of materials and installation of pier infrastructure would also be undertaken from the water using barges.

While these construction activities are occurring in the marine environment, they are considered in the terrestrial ecology impact assessment insofar as they have the potential to impact on terrestrial ecology. In particular, potential impacts on the food chain for migratory shorebirds and other waterbirds could occur, as could disturbance of terrestrial species as a result of construction noise and lighting.

Sediment mobilisation

Sediment mobilisation through dredging would lead to increased turbidity in the water column, the release of nutrients and contaminants, and sedimentation as suspended solids settle on the seabed. The effects of dredging on suspended solids/turbidity, light availability, sediment accretion, mobilisation of contaminants and nutrients (nitrogen) are assessed in Technical Report A: *Marine ecology and water quality impact assessment*. Suspended solids can influence the productivity and distribution of seagrass through increased light attenuation (reduced light transmission) of the water column and smothering as the sediment settles on the seabed.

A reduction in density or extent of seagrass could have implications for the food chain for migratory shorebirds (see **Section 10.1.3**).

The area impacted by dredging is 12ha from a total area of 3,500ha of seabed in Corio Bay. Infauna in this area would be lost until they re-establish themselves. The ability for infauna to re-establish has been demonstrated by sampling in nearby existing channels that have been dredged in recent years (see Chapter 8: *Marine environment*).

During dredging, there would be increased turbidity (elevated suspended solids) and increased nutrients around the dredging area. Small quantities of contaminants may be released and the settling of sediments on the seabed would occur once dredging ceases.

Increased turbidity may inhibit light availability and therefore growth of seagrasses and seaweeds (phytoplankton) during that time. An increase in turbidity and light attenuation would occur in an area influenced by dredging and a temporary loss of productivity of seagrass is expected in that area. Seagrass recovery would begin shortly after the completion of dredging.

Modelling of sediment accumulation described in Technical Report A: *Marine ecology and water quality impact assessment* suggested that the rate of accretion (i.e., how much sediment would accumulate on the seabed) would be 0.04 millimetres per day (mm/day) to 0.2mm/day. This is considered to be a minor amount of accumulation and would have negligible impact on the seabed, seagrass or infauna. Further, modelling indicated that the sediment plumes resulting from the dredging would not extend into Limeburners Bay. The Ramsar site and central Corio Bay would have only a minor increase in turbidity, similar to that recorded in the 1996-1997 Corio Bay Channel Improvement Program.

The dredging activity would therefore be unlikely to affect seagrass meadows or shorebird food resources. As such, dredging would be unlikely to change the ecological character of the Ramsar site or affect the availability of food for migratory shorebirds or other waterbirds.

Technical Report A: *Marine ecology and water quality impact assessment* makes recommendations on mitigations for the dredging works. Those recommendations include timing of dredging to occur during the more dormant period of seagrasses (i.e., not in the spring active growth period) and installation of a silt curtain to reduce the opportunity for sediment to reach the intertidal zone of the western shoreline of Corio Bay, adjacent to the refinery.

No additional management and mitigation measures are recommended as turbid water would be unlikely to affect the ecological character of the Ramsar site and potential impacts on seagrass and seaweeds would be localised and of short duration (8 weeks), therefore unlikely to affect the availability of food for migratory shorebirds or other waterbirds. To confirm the predicted turbidity effects during dredging, turbidity and light attenuation would be monitored at 6 sites to provide real time feedback such that actions to reduce overflow from construction barges can be undertaken (refer to Chapter 8: *Marine environment for further information*).

Noise

Dredging and the construction of new piles would be sources of noise with potential to directly affect terrestrial species. Noise can also increase predator vigilance which reduces foraging efficiency and therefore food intake. This may be a particular concern to migratory shorebirds who need to maximise their energy consumption and stores before they undertake a long flight back to their breeding grounds.

As outlined in Technical Report I: *Noise and vibration impact assessment*, the maximum predicted noise level at the nearest sensitive receptors (Geelong Grammar School approximately 1,400m away and the Avalon area, approximately 1,800m away) during dredging works would be up to 45 dB(A) and 43 dB(A), respectively. Ambient noise levels on the foreshore near Geelong Grammar School and at Avalon Coastal Reserve are approximately up to 50 dB(A) and 39 dB(A). This suggests that noise emissions from dredging activities would be unlikely to alter noise levels in the Ramsar site above those currently being experienced. Noise emissions from the construction of the Refinery Pier extension would be 49 dB(A) and 46 dB(A) at Geelong Grammar School and the Avalon area, respectively. This suggests that the pier extension work would be marginally above ambient noise levels at the Avalon area and would be audible above other existing environmental sounds.

A recent study for a similar project measured existing noise levels within the primary foraging habitats of shorebirds and waterbirds and adjacent to roost areas (AECOM/Biosis, 2020). Maximum sound levels were measured between 64 dB(A) and 75 dB(A) with no apparent impact to these birds (AECOM/Biosis, 2020). This supports another study which assessed road traffic noise on Australian wetlands birds, including migratory birds, and found no detectable correlation between the highest noise measurement of 62 dB(A) and wetland site occupancy (Phoenix Environmental Sciences, 2011).

Further studies conducted on the effects of aircraft noise on birds at Avalon, Victoria (Weston et al, 1995) found that the likelihood of a response resulting in birds taking flight increased when the noise levels from fixed-wing aircraft or helicopters exceeded 80dB(A), however, some birds were found to exhibit a response at noise levels down to 60 dB(A). No significant effect of jet overflights at levels of 55-110 dB(A) were reported on wading birds (Black et al, 1984). Crested terns in Australia showed escape behaviour following exposure to pre-recorded aircraft noise at levels of 85 dB(A) (Brown, 1990).

Considering these studies, the predicted increase in noise levels in the Avalon Area from 39dB(A) to 46 dB(A) would be lower than the >60 dB(A) levels at which responses have been detected in birds in the examples provided above. On the basis that predicted construction noise is well below levels which are known to affect birdlife, construction noise from the project would be unlikely to affect the ecological character of the Ramsar site or the foraging behaviour of migratory shorebirds and no mitigation measures have been recommended. The proposed noise monitoring and mitigation measures can be found in Chapter 14: *Environmental Management Framework.*

Construction lighting

Potential light spill during construction is considered in Technical Report J: *Landscape and visual impact assessment*. Potential impacts of light spill on the marine environment are addressed in Technical Report A: *Marine ecology and water quality impact assessment*.

The project would be constructed in a highly modified environment port and industrial setting and therefore species utilising habitats in proximity to the facility would likely be adapted to the existing light pollution of the landscape.

Shorebirds, particularly migratory species, were not recorded on the shoreline of Corio Bay adjacent to the refinery during 2021 field surveys. The shoreline in the vicinity of the existing pier is unlikely to be providing a nocturnal roost for shorebirds as it is already subject to noise and light from the refinery and visitation to the area by people. This would suggest that any additional light associated with construction of the project in the existing modified environment would be unlikely to affect migratory shorebirds.

If lighting is required during construction for night works or for security purposes, the number, type and layout of lights would be designed to light only the construction area with reference to the National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (MM-TE10 and MM-TE11).

Sediment deposition at disposal ground

Dredged material is planned to be deposited at an existing dredged material ground in Port Phillip Bay, east of Point Wilson subject to approval. The potential impacts of sediment deposition at the disposal ground have been assessed in Technical Report A: *Marine ecology and water quality impact assessment*.

Technical Report A: *Marine ecology and water quality impact assessment* determined that the deposition of sediment in the spoil disposal area would not alter the sediment characteristics at the disposal area. The same infauna community that currently occurs on the existing sediment surface would develop on the new sediment surface at the disposal ground, once dredged material has settled. Therefore, no impacts would be anticipated to the Ramsar site or to migratory shorebirds as a result of the material deposited at the existing disposal ground or on the food chain supporting these species.

10.1.5 Operation impact assessment

Operation of the project is anticipated to continue for 20 years and would involve:

- Receipt of up to 45 liquefied natural gas (LNG) carriers each year at the FSRU moored at Refinery Pier
- Regasification of LNG (conversion back to a gaseous state) onboard the FSRU using seawater as a heat source
- Injection of nitrogen and odorant into the gas prior to distribution via the Victorian Transmission System (VTS) at the northern end of the refinery
- Monitoring and maintenance of the pipeline easement.

Potential terrestrial ecology impacts associated with the operation of the FSRU would primarily relate to the discharge of seawater to the marine environment, operational noise and lighting, entrainment of plankton and larvae (food source) in the FSRU intake and increased shipping movements affecting terrestrial species or the food chain.

Discharge to the marine environment

Potential impacts associated with discharge of water used for regasification of the LNG from the FSRU would relate to changes in temperature and chlorine levels in the waters of Corio Bay. Changes in temperature and chlorine levels could affect seagrass extent and food sources for migratory shorebirds and other waterbirds.

The project involves recycling of water used in the regasification of LNG in the FSRU through the refinery as cooling water, resulting in a discharge which is very similar to that discharged from the refinery for more than 60 years. The project discharge through the refinery will have the same low levels of residual chlorine as the current refinery discharge and a water temperature closer to ambient in Corio Bay than the current discharge. The marine investigations showed that the existing refinery chlorine concentrations along the shoreline adjacent to the four current discharge points would not be altered by the discharge of recycled FSRU regasification water via the refinery as the chlorine dosing for the refinery would remain the same. The existing plume does not extend to Limeburners Bay or the Ramsar site and would not do so once the project was operational.

Reuse of cooled seawater from the FSRU within the refinery would reduce the existing temperature difference between the current refinery discharge and Corio Bay. Currently, water is discharged to Corio Bay approximately 8 to 10°C above ambient seawater temperature. Cooled seawater to be discharged from the FSRU into the refinery would be approximately 1 to 3°C above ambient seawater temperature once it is discharged to Corio Bay, improving the temperature difference by approximately 7°C.

The existing Geelong refinery has been discharging warm water and low levels of chlorine into Corio Bay for over 60 years providing an ideal opportunity for the EES technical studies to assess the impacts of this discharge as a baseline for assessing potential project impacts. The studies found a healthy marine ecosystem offshore from the refinery discharge indicating that historical discharges have not have adverse effects on the marine environment. On this basis, there is strong empirical evidence (current healthy marine ecosystem) to suggest that the project discharge will not have adverse impacts on seagrass or on the food chain supporting terrestrial shorebirds and other waterbirds in Corio Bay and the Ramsar wetland. The FSRU water intake was found to have little to no impact on the availability of plankton and larvae as food sources within Corio Bay and at the Ramsar site (refer to Chapter 8: *Marine environment* and Technical Report A: *Marine ecology and water quality impact assessment*).

As outlined in Chapter 4: *Project description*, there may be times when the cooled water discharge from the FSRU needs to be discharged directly into Corio Bay. This could occur when the refinery is partially shut down for maintenance or if the refinery was decommissioned at some point in the future. During the operational life of the refinery, direct discharges to the Bay would be an uncommon occurrence. Direct discharges of the cooled water from the FSRU would be via a long diffuser located on the Refinery Pier extension. The EES studies included modelling of this discharge which results in a small cold water plume in the vicinity of the FSRU due to the high level of mixing achieved via the diffuser. The plume sinks to the seabed in the dredged shipping channel and is remote from both Limeburners Bay and the Ramsar site and is not anticipated to have any adverse impacts on seagrass beds (which are not present in the vicinity) or on food chain species.

On the basis that the studies conducted show that project operation would not have adverse impacts on Limeburners Bay, the Ramsar site, seagrass meadows and food chain species, no management and mitigation measures related to terrestrial ecology have been recommended. Further information on impacts to the marine food chain and proposed monitoring of marine discharges is provided in Chapter 8: *Marine environment* and Technical Report A: *Marine ecology and water quality impact assessment*.

Operation noise and lighting

Noise and lighting can affect wildlife behaviour as summarised in **Section 10.1.4**. Operation of the project would not involve a significant change to noise or introduction of lighting into the terrestrial environment.

The predicted operation noise considers a 'worst case' scenario where noisier conditions have been assumed. This would be highly unlikely to occur as it would require the FSRU to be operating in closed loop (noisiest) mode simultaneously with the LNG carrier mooring with four tugs, nitrogen injection at the treatment facility and nitrogen unloading at the treatment facility at night. The resulting operation noise from the FSRU would be lower than noise levels currently experienced on the foreshore near Geelong Grammar School, and slightly higher than current levels at Avalon Beach but lower than the >60 dB(A) levels known to affect birds from previous studies. The source of noise during operation would be regular but at levels below that of concern to terrestrial species. Berthing of the LNG carrier generates a slightly higher noise level that will occur up to 45 times per year (or less than once per week).

The FSRU would have permanent lighting. Although light spill during operation would be contained to 50 metres within an environment already subject to artificial lighting, the effect of artificial light on migratory shorebirds is understudied and therefore a precautionary approach would be adopted when managing potential effects from light. If lighting is required during operation for night works or for security purposes, the number, type and layout of lights would be designed to light only the area required with reference to the *National Light Pollution Guidelines for Wildlife* including marine turtles, seabirds and migratory shorebirds (MM-TE10).

Entrainment

Entrainment is the unwanted passage of sea life such as plankton, larvae and small fish through a water intake. Entrainment into the FSRU water intake of fish larvae or plankton which may spawn in the Ramsar site, including Limeburners Bay, or move around Corio Bay into these areas, could affect the food chain and in turn the ecological character of the Ramsar site and food availability for migratory shorebirds and other waterbirds.

The potential impact of entrainment of plankton and larvae was assessed based on 12 months of sampling in Corio Bay, and subsequent modelling of the movement of plankton and larvae in Corio Bay and Port Phillip Bay. It was concluded that the potential impact of entrainment of larvae and plankton from the Ramsar site and Limeburners Bay is negligible. The estimated amount of plankton entrained by the FSRU compared with all plankton in Corio Bay was less than 0.1% of the total which is minor in relation to natural mortality rates which are around 99%. The majority of fish larvae from the Ramsar site, including Limeburners Bay, disperse into Port Phillip Bay and move in a clockwise pattern. The potential entrainment of fish larvae after 28 days is less than 0.5% which is minor in comparison to natural predation and mortality rates.

In terms of potential entrainment of plankton and larvae in and around the Ramsar site, modelling indicated that many larvae and plankton would remain in the north of Corio Bay near the Ramsar site as opposed to migrating down the west coast of Corio Bay, towards the FSRU intake. After longer time periods, larvae and plankton would be more evenly dispersed throughout the Bay, however, more would move into Port Phillip Bay than Corio Bay. The very low level of entrainment into the FSRU overall, and the fact that plankton and larvae in and around the Ramsar site are not entrained by the FSRU based on water circulation patterns in Corio Bay, suggests that project operation would not impact the ecological character of the Ramsar site and food availability for migratory shorebirds and other waterbirds. Given the negligible impact, no mitigation measures have been recommended (refer to Technical Report A: *Marine ecology and water quality impact assessment*).

Additional shipping movements

Potential impacts associated with the movement of up to 45 additional ships each year (<one per week) are considered in Technical Report A: *Marine ecology and water quality impact assessment* and Technical Report N: *Safety, hazard and risk assessment*. The Port of Geelong currently has over 600 ships arriving and departing each year. As with any vessel operating in Corio Bay and Port Phillip Bay, potential impacts would include vessel to vessel collision, vessel grounding, intentional damage and the release of dangerous goods and hazardous substances.

Based on the outcomes of the studies outlined above, the overall likelihood of potential impacts associated with any of these events is considered low. LNG carriers have multiple layers of effective protection to prevent spills and losses of containment and carry very little oil when compared with many other vessels as they are powered by LNG. The safety measures that provide the layers of protection include:

- Double hull design and construction
- Storage tanks set back from the inner hull by insulating material
- Sophisticated ship controls ensuring effective manoeuvrability
- Use of four tug vessels during transit in the shipping channel
- Experienced pilot on board the vessel
- Limited vessel speed
- Port operations control managing vessels within the shipping channel – ships are only able to move with the Harbour Master's authorisation.

Based on these measures, there would be an unlikely impact to the Ramsar site and Limeburners Bay from an additional 45 ships entering the port each year and no further mitigation measures have been considered.

Discharge to the terrestrial environment from gas pipeline or treatment facility

Hazards associated with operation of the gas pipeline and treatment facility have been addressed in Technical Report N: *Safety, hazard and risk assessment*.

The main potential risk associated with the treatment facility located in the refinery would be the loss of containment of liquid nitrogen and odorant. The main potential risk associated with the gas pipeline would be a pipeline rupture. The potential for these risks to impact on the Ramsar site and migratory shorebirds and other waterbirds is considered to be highly unlikely due to separation distances and the fact that any releases would be gaseous in nature rather than substances such as oil which can have significant impacts after spills.

In the unlikely event of a release or rupture, Limeburners Bay and the Ramsar site are more than 1km from the gas pipeline and are therefore unlikely to be affected based on the impact zone radius presented in Technical Report N: *Safety, hazard and risk assessment*. Toxic exposure from the odorant at the treatment facility would not extend beyond the treatment facility boundary. As such, no further mitigation measures have been considered.

10.1.6 Residual impacts

As the pipeline route has been sited to avoid impacting native vegetation where possible, and assuming adoption of the recommended management and mitigation measures, it is anticipated that the project would have minor residual impacts on terrestrial ecological values during construction.

If all native vegetation is removed from within the construction footprint, a total maximum loss of 0.104 hectares of native vegetation has the potential to be removed. However, taking into consideration vegetation that will be avoided by horizontal directional drilling (HDD), this results in a total likely maximum loss of 0.091 hectares of native vegetation (subject to the finalisation of the design), including Western (Basalt) Plains Grassland (FFG Act listed). Offsets for the removal of this vegetation would be secured once the full extent of vegetation clearance is confirmed.

Residual impacts would include the loss of 0.48 hectares of potential habitat for Golden Sun Moth, which is unlikely to result in a significant impact, and the loss of a maximum of 0.354 hectares of planted eucalypts trees which are a marginal and widespread foraging resource for Swift Parrot and Grey-headed Flying-fox.

During operation of the project, no significant residual impacts on terrestrial ecology, migratory shorebirds or other waterbirds or the ecological character of the Ramsar site are anticipated.

10.2 Land and water values

This section summarises the potential impacts of the project on surface water, groundwater and soil as detailed in:

- Technical Report E: *Surface water impact assessment*
- Technical Report F: *Groundwater impact assessment*
- Technical Report G: *Contamination and acid sulfate soils impact assessment*.

10.2.1 Methodology

To determine potential impacts on land and water values from the project, the following approach was adopted for the surface water, groundwater and contamination and acid sulfate soils impact assessments:

- Establishing the study area and its existing environmental setting
- Conducting a desktop assessment to understand the existing conditions of surface water, local hydrology, groundwater and contamination across the project area based on relevant datasets and literature
- Conducting a review of the project design and proposed activities in the context of existing environmental conditions to understand temporal

and spatial distribution of project components and activities in relation to sensitive receptors
- Undertaking a groundwater field program to confirm areas where groundwater could be intersected by the project, involving the installation and gauging/sampling of five groundwater monitoring wells
- Undertaking a contamination field program to identify the presence of contamination and acid sulfate soils through the advancement of 22 soil bores and 13 environmental test pits throughout the study area
- Assessment of potential surface water, groundwater and contamination impacts during construction and operation of the project
- Development of mitigation measures in response to identified impacts focused on implementation of the mitigation hierarchy
- Evaluation of the residual environmental impacts once mitigation has been implemented.

10.2.2 Study areas

Surface water

The study area for the surface water impact assessment includes the project area, along with waterbodies and watercourses within the surrounding area. The surface water impact assessment considered the potential impacts of project activities within this area with a focus on the land-based components of the project, including the aboveground pipeline, the treatment facility and the underground pipeline.

Groundwater and contamination

The groundwater and contamination and acid sulfate soils impact assessments considered intrusive works and infrastructure in the onshore section of the project area where there was potential to intersect contaminated soil and groundwater, as well as surrounding areas where groundwater levels and flows could be impacted.

The depth of assessment for most of the groundwater and contamination and acid sulfate soils study area was limited to the upper 5 to 10 metres of the subsurface due to the shallow nature of proposed pipeline trenching and below ground infrastructure. A depth of 20 to 25 metres was considered along the proposed horizontal direction drilling (HDD) sections.

The groundwater study area was defined by the following three project components where there was a potential for groundwater to be intersected together with a 200-metre buffer:

- The culvert beneath Shell Parade in the south of the refinery
- The treatment facility
- The underground pipeline.

The groundwater study area is shown in **Figure 10-6**.

The contamination and acid sulfate soils study area was defined by the following three project components together with a 200-metre buffer:

- The aboveground pipeline alignment (onshore) within the Refinery Pier foreshore pipeline compound and Geelong Refinery, from east of Shell Parade to the treatment facility
- The treatment facility
- The underground pipeline between the treatment facility and the SWP tie-in point.

For the purposes of the contamination and acid sulfate soils assessment, the study area was divided into two zones, as follows:

- Zone 1 - the portion of the study area within the Geelong Refinery boundary and including the Refinery Pier foreshore pipeline compound east of Shell Parade
- Zone 2 - the portion of the study area north of the Geelong Refinery boundary along the proposed underground pipeline alignment.

The contamination and acid sulfate soils study area is shown in **Figure 10-7**.

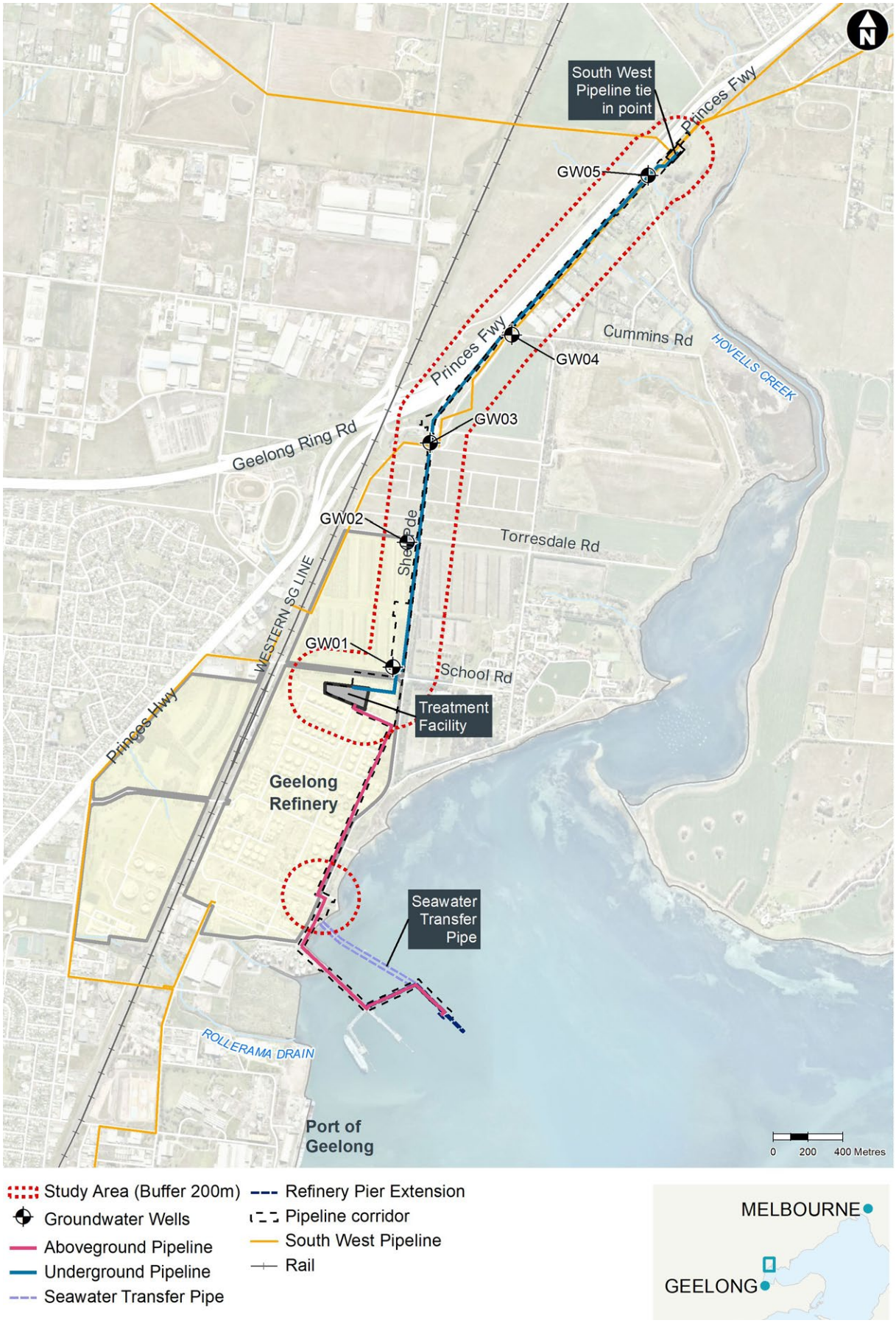

Figure 10-6 Groundwater study area

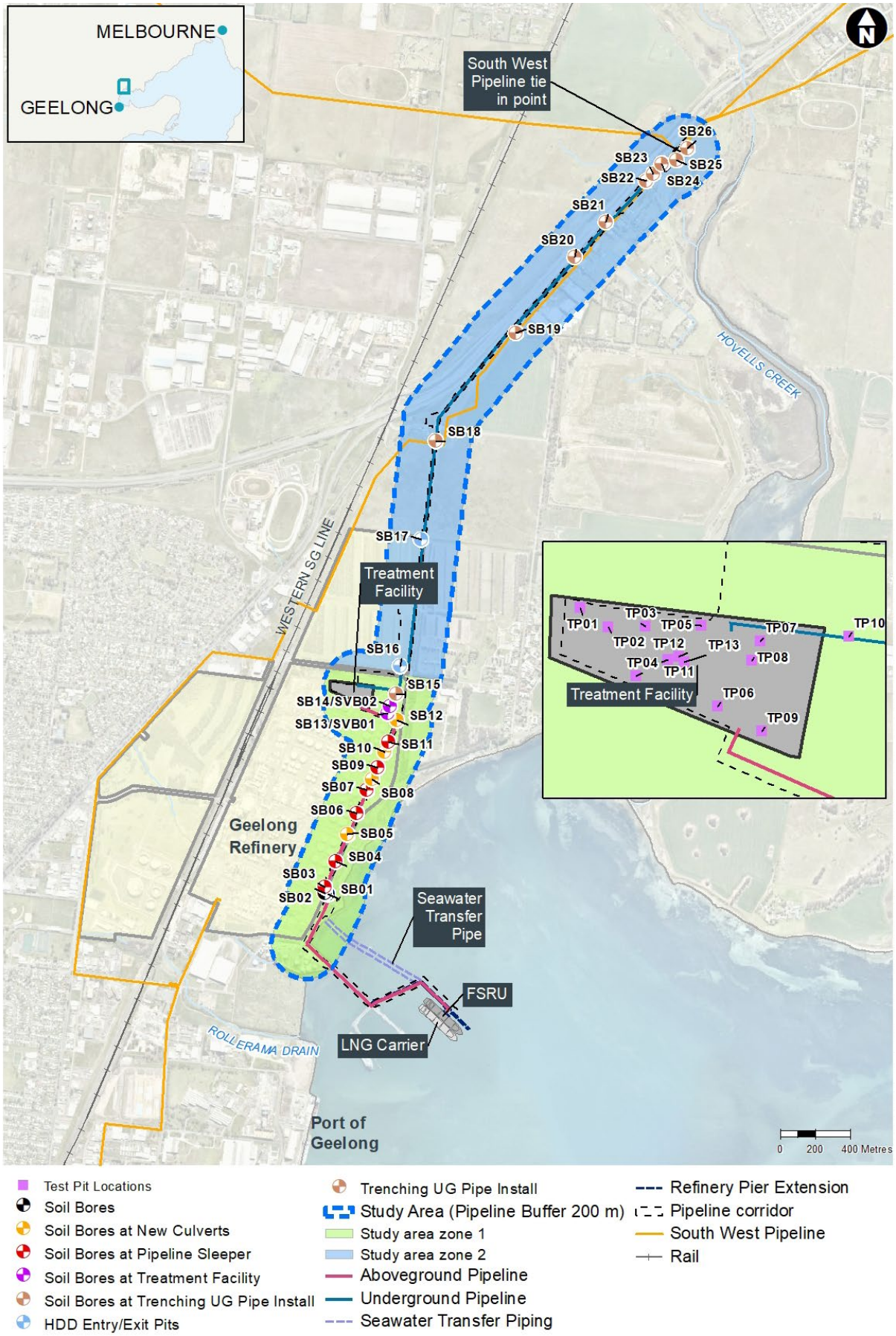

Figure 10-7 Contamination and acid sulfate soils study area

10.2.3 Existing conditions

This section provides an overview of the regional and local surface water catchment, hydrogeological setting, existing land uses and contaminated sites, and environmental values of land and water.

Regional catchment overview

The project is located within the Corangamite catchment region compromising approximately 13,340 square kilometres along the Victorian south-western coast from Geelong to Peterborough. Within the Corangamite region, the project is located within the Moorabool River basin and the Hovells Creek sub-catchment. The Moorabool River is located approximately 6.5 kilometres to the south-east of the project and Hovells Creek is located approximately 300 metres to the east of the proposed tie-in point to the SWP at Lara. Hovells Creek is considered to be a high value and priority waterway due to its environmental condition and social amenity value.

There is a component of one internationally significant Ramsar wetland located outside the project area; the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. This Ramsar site is comprised of six distinct areas. The Point Wilson/Limeburners Bay section of the Ramsar site is located along the northern shoreline of Corio Bay approximately one kilometre to the north-east of the FSRU site, as shown in **Figure 10-8**. The project area does not intersect with the Ramsar site; however, the location is considered in the context of the assessment due to the potential for overland flow from the broader catchment. The ecological values of the Ramsar site are discussed in **Section 10.1.3**.

The Index of Wetland Condition (IWC) shows that water quality in Port Phillip Bay, including Limeburners Lagoon at Hovells Creek, is in overall good condition but can vary, particularly after heavy rain. This is also dependent upon the quality of water from rivers and catchments upstream entering the Bay.

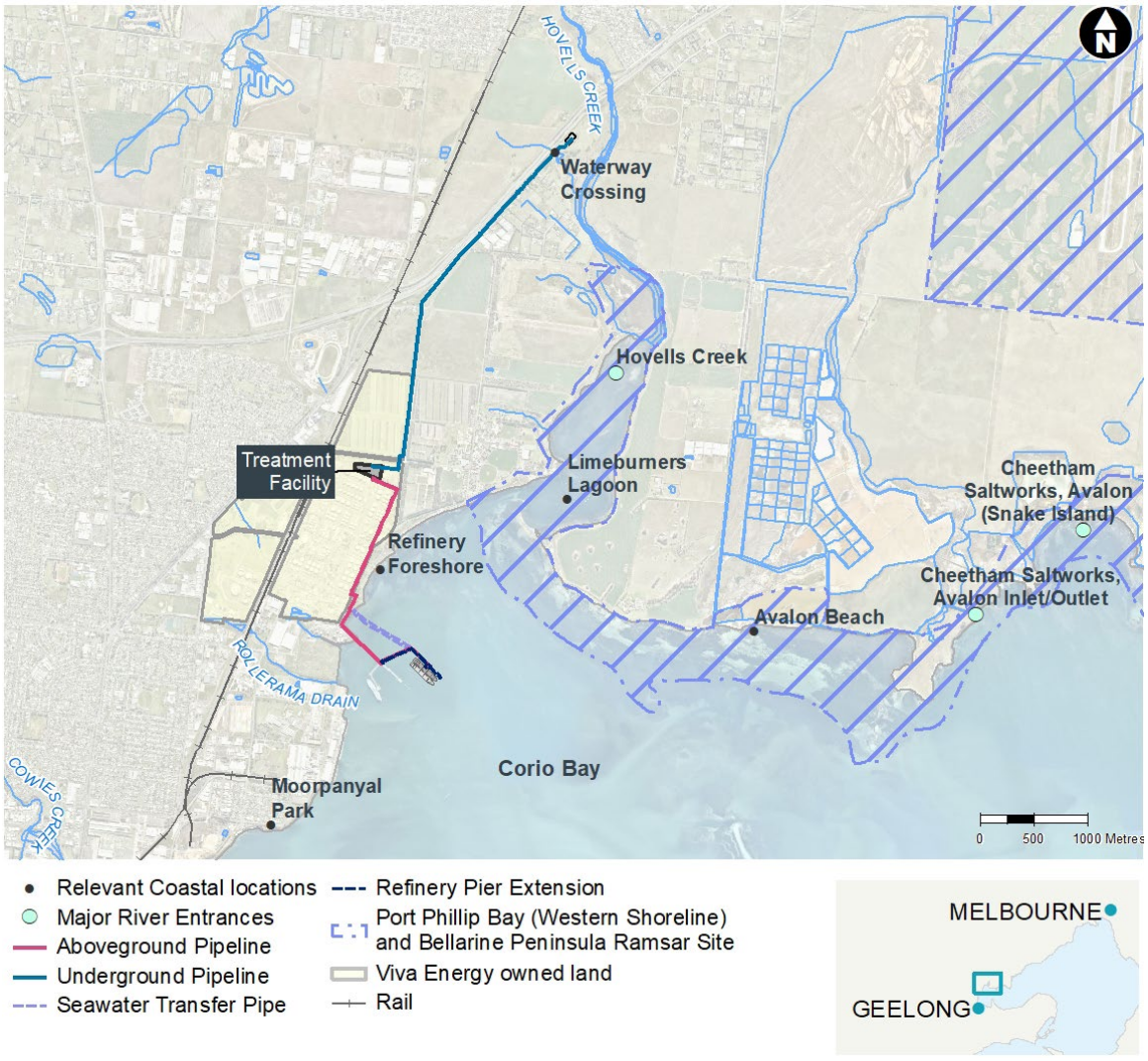

Figure 10-8 The Point Wilson/Limeburners Bay section of the Ramsar site

Surface water in the study area

The project is not located within a floodplain and does not intersect any low-lying or flat areas that are subject to flooding. A 1% Annual Exceedance Probability (AEP) flood extent and historic flood overlays are present downstream of the southern boundary of the project. A flood with a 1% AEP has a one in a hundred chance of being exceeded in any year and would have an acceptable 'risk' for planning purposes. However, none of the project components, including the aboveground and underground pipelines and treatment facility, intersect with any flood overlays. Floodwaters from surrounding areas drain to the Hovells Creek floodplain, which flows into the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site and Corio Bay.

There is one unnamed minor watercourse located within the project area. The underground pipeline would cross this ephemeral, artificially constructed watercourse located within the Hovells Creek Reserve prior to reaching the tie-in point to the SWP at the northern end of the pipeline, as shown in **Figure 10-9**.

Annual Exceedance Probability

Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any year, with the probability expressed as a percentage. For example, 1% AEP refers to a 1% chance of a flood event occurring.

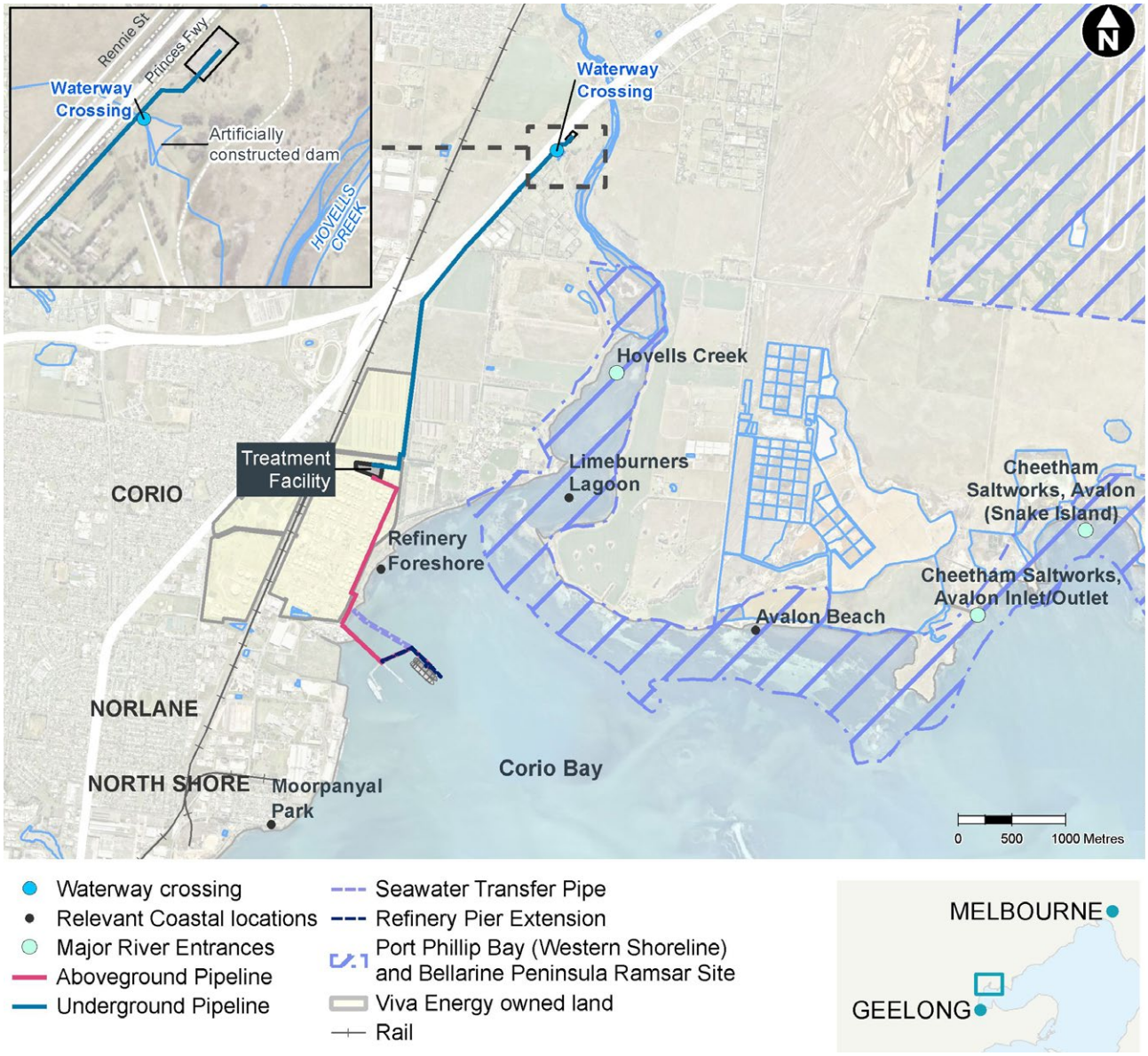

Figure 10-9 Proposed waterway crossing

The minor watercourse is an artificial rock lined channel and is approximately 5 metres wide. The watercourse flows from the north-west beneath Rennie Street and the Princes Freeway before draining into an artificially constructed dam shown in **Figure 10-10**. The dam is a low point in the landscape which fills up after heavy rainfall events. At the edge of the dam, the hill slopes down to Hovells Creek where overflow from the dam flows into the creek after significant rainfall events.

The Westernport-Altona-Geelong (WAG) crude oil pipeline, the black oil pipeline (BOPL) and the APA Brooklyn–Corio Gas Pipeline all currently run under this minor watercourse.

What is an ephemeral watercourse?

Ephemeral watercourses lack a consistent surface water flow for the majority of the year and have no baseflow. They generally only contain water for a brief period following a rain event.

Figure 10-10 Dam which the ephemeral watercourse flows into, prior to entering Hovells Creek

Hydrogeological setting

The Tertiary age Black Rock Sandstone (now known as the Sandringham Sandstone) geological unit outcrops at the surface south of the treatment facility and at the Shell Parade culvert. Further north, the Sandringham Sandstone is overlain by the Upper Tertiary/Quaternary age Newer Volcanic Group basalt flows, scoria and pyroclastics. At the northern extent of the study area, beneath the SWP tie-in point, the Newer Volcanic Group is overlain by Quaternary age Darley Gravel comprising gravels, sands and silts. The geology of the study area is shown in **Figure 10-11**.

The study area lies at the onshore edge of the groundwater basin known as the Port Phillip Basin. The northern margin is bounded by outcropping pre-Tertiary basement bedrock (which forms the Southern Uplands), the Rowsley Fault marks the western margin, and the Selwyn Fault is on the eastern margin of the basin.

The shallow aquifers (body of rock and/or sediment that holds groundwater) of the Port Phillip Basin of relevance to the project are outlined in **Table 10-3**.

The UTAM is the water table aquifer found in the southern portion of the project area where it reaches the surface. Further north, the UTAM is overlain by the UTB aquifer. Depending on the groundwater elevation, the water table will be hosted by the unconfined UTB aquifer or the underlying UTAM. At the northern extent of the study area, the QA would locally form the water table aquifer.

Based on regional groundwater mapping, depths to groundwater are between 5 to 10 metres below ground surface (mbgs) within the study area, and in some areas increasing to 15 to 20mbgs beneath the higher topography in the east.

The groundwater table is often observed to be a subdued version of the ground surface. As such, shallower groundwater would be anticipated beneath the south and north of the study area (in lower lying areas close to the coast and in the Hovells Creek area) and greater in depth beneath the central portion of the underground pipeline alignment. Regional groundwater will flow towards the east and southeast beneath the study area, from higher ground towards Corio Bay.

Table 10-3 Hydrostratigraphy of the study area

Aquifer	Hydrogeological Groundwater Unit (HGU)	Depth (mbgs)	Thickness (m)	Study area section
Quaternary Alluvium (QA)	Various fluvial/lacustrine/alluvial/ colluvial sediments	0	Up to 5	Shell Parade culvert and northern extent of underground pipeline
Upper Tertiary/ Quaternary Basalt (UTB)	Newer Volcanics basalt flows, scoria and pyroclastics	0 to 5	0 to 30	Treatment facility and underground pipeline
Upper Tertiary Aquifer (Marine) (UTAM)	Sandringham Sandstone	0 - 30	0 - 20	All (except northern portion of underground pipeline)

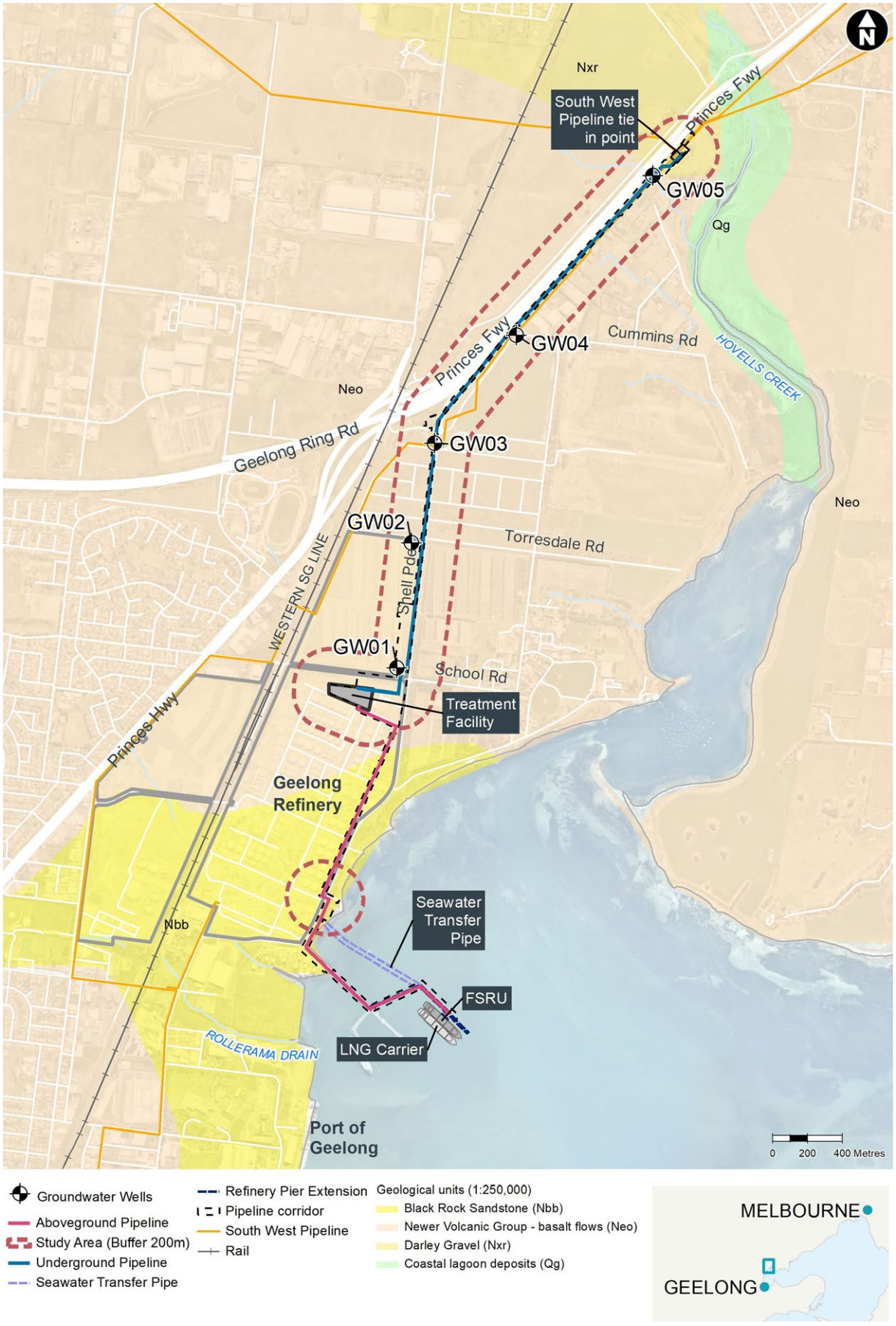

Figure 10-11 Geology of the study area

Groundwater levels in the study area

Groundwater levels are measured at monitoring wells in the vicinity of the proposed Shell Parade culvert, the proposed treatment facility site and the southern portion of the proposed underground pipeline alignment as part of the refinery's ongoing groundwater monitoring program. Five additional groundwater monitoring bores were installed along the underground pipeline route as part of the groundwater impact assessment.

Establishing depths to groundwater is important to assess whether any proposed project infrastructure is likely to intercept that groundwater, what the potential impacts may be and to enable mitigation measures to be developed if required. Groundwater levels at the culvert, treatment facility and along the underground pipeline are shown in **Figure 10-12**, however it is noted that groundwater levels may vary across the different seasons and following large rainfall events.

Shell Parade culvert sub-area

Depths to groundwater near the proposed Shell Parade culvert are between 3 and 4mbgs based on data from the nearest monitoring wells (see **Figure 10-12**). This is one to 2 metres below the anticipated depth of proposed pipeline trenching across Shell Parade.

Groundwater elevations are higher in monitoring wells closer to Shell Parade and lower to the east beneath the foreshore area. The inferred groundwater flow direction in this area is consistent with the anticipated broader regional groundwater flow direction being east to southeast towards Corio Bay.

Treatment facility sub-area

Based on the nearest monitoring wells, depths to groundwater near the proposed treatment facility within the refinery site are typically between 4 and 6mbgs (see **Figure 10-12**). Groundwater elevations are typically higher in monitoring wells to the west and lower to the east consistent with the regional groundwater flow towards Corio Bay.

Underground pipeline sub-area

Depths to groundwater between the proposed treatment facility and School Road are approximately 4.5 to 5.5mbgs (GW01). The depth to groundwater increases to more than 8.5mbgs further north along the pipeline route between Torresdale Road and Cummins Road (at GW02, GW03 and GW04). The bore logs and groundwater levels indicate that the Newer Volcanic basalts are unsaturated (at GW03 and GW04) and that the regional water table occurs within the underlying sediments. Groundwater is shallower near the SWP tie-in facility (at GW05) with a depth of 2.86mbgs due to its location in a lower lying part of the landscape, close to the unnamed watercourse and dam (**see Figure 10-12**).

The depth to groundwater through this area (from GW01 to GW05) is consistent with the groundwater table being a subdued version of topography with greater depths to groundwater beneath topographic highs and shallower depths to groundwater beneath lower lying topography.

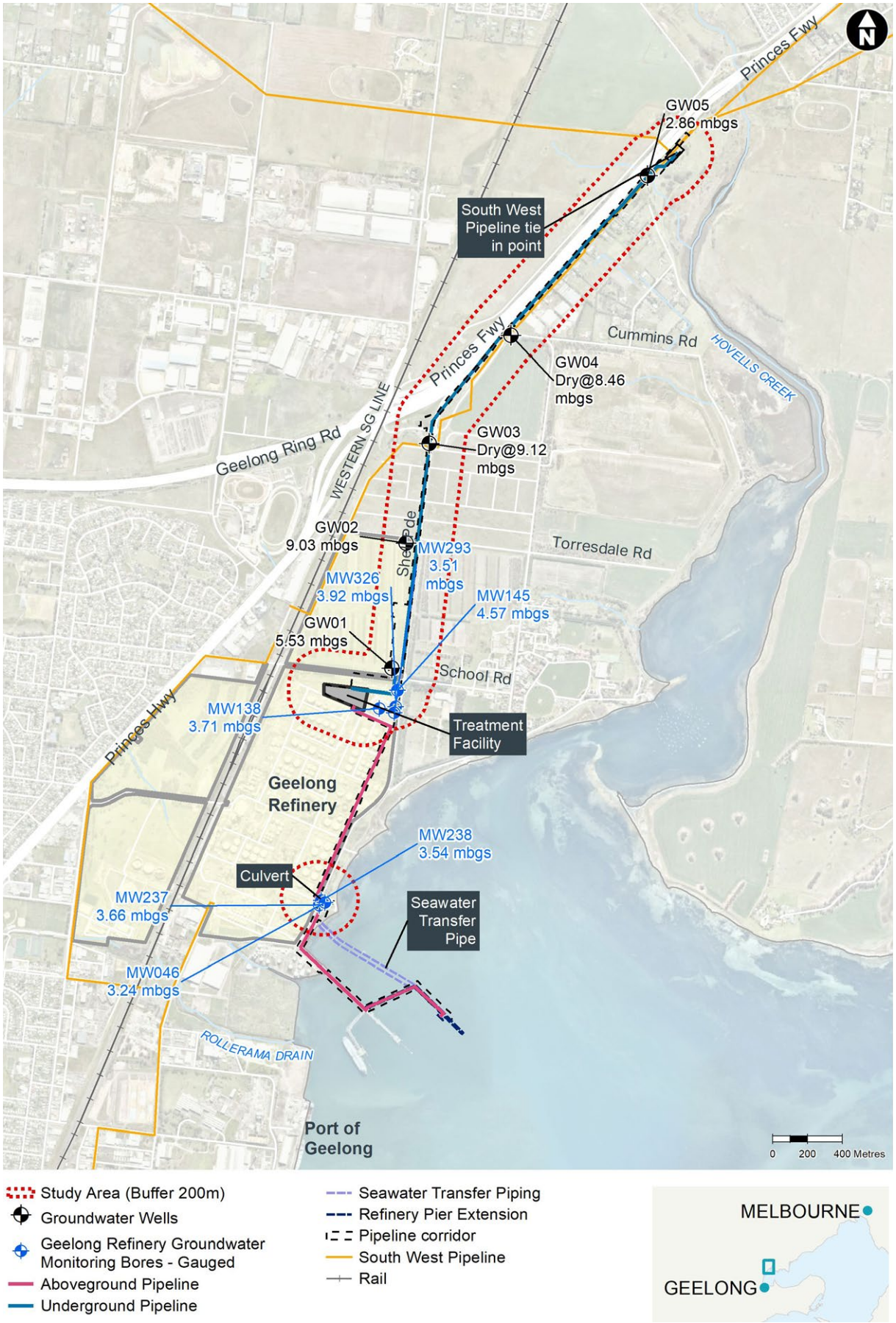

Figure 10-12 Groundwater levels in the study area

Groundwater users

A summary of the groundwater bores within the study area is shown in **Table 10-4**.

A summary of the consumptive use bore, and three potentially consumptive use bores is provided below (from north to south):

- One of the unknown bores (104976) is approximately 113 metres from the proposed pipeline alignment, with the bore depth range unknown.
- The second unknown groundwater bore (WRK982178) is approximately 9 metres from the pipeline alignment and has a total depth of 25 metres.
- The consumptive use bore (115471) is located 126 metres from the proposed pipeline alignment and is registered for domestic use. It is recorded as being screened from 27 to 35mbgs and is well below the proposed depth of project construction activities and infrastructure.
- The third unknown groundwater bore (WRK984684) is approximately 160 metres north west of the pipeline alignment and has a total depth of 25 metres.

Groundwater dependent ecosystems

There are no potential aquatic groundwater dependent ecosystems (GDEs) mapped within the study area and no terrestrial GDEs within the underground pipeline corridor and treatment facility areas. There are high potential terrestrial GDEs, meaning there is a high likelihood these ecosystems interact with groundwater, mapped within the Shell Parade culvert area. These are described as coastal saltmarsh/mangrove shrubland mosaic and are located on the area of foreshore reserve between Shell Parade and Corio Bay.

Groundwater dependent ecosystems (GDEs)

Groundwater plays an important role in sustaining aquatic and terrestrial ecosystems. Potential groundwater dependent ecosystems (GDEs) are aquatic or terrestrial ecosystems that have been identified as likely to be at least partly dependent on groundwater. They are referred to as 'potential' due the uncertainty in using desktop methods to identify ecosystems as being groundwater dependent.

Groundwater-surface water interaction

The unnamed minor watercourse and artificially constructed dam discussed above are not mapped as potential GDEs and are believed to be fed by surface water. Hovells Creek is identified as being a high potential GDE, however it is located outside of the study area, approximately 300 metres south-east of the proposed underground pipeline.

Table 10-4 Licenced uses for registered bores within the study area

Licensed use category	Licensed uses	Number of bores	Bore depth range (m)	Distance from pipeline route (m)
Water Measurement Information System (WMIS) Database				
Consumptive	Domestic	1	35	125
Monitoring/ Observation	Groundwater investigation, observation	17*	5.2 – 13	70 – 200
Unknown	Not known use	3^	25	10 – 170

** - all associated with the Geelong Refinery monitoring network*
^ - two unknown use bores are listed as being 'not used'.

Figure 10-13 Groundwater dependent ecosystems

Existing land uses and contaminated sites

The existing land uses within the study area consist of the Geelong Refinery, commercial and industrial facilities, residential, agricultural land, vacant land and roads. These land uses are considered to have a relatively low potential for generating soil and groundwater contamination, with the exception of the Geelong Refinery and other adjacent industrial areas.

The Environment Protection Authority (EPA) Victoria Priority Sites Register lists sites that have been issued with a formal Clean Up Notice (CUN) or Pollution Abatement Notice (PAN) under the former *Environment Protection Act 1970*. At these sites, EPA Victoria considers that the condition of the site is not compatible with the current approved use without active management to reduce risks to human health and the environment.

A search of the EPA Priority Sites Register indicates that, as of 19 July 2021, there are three current priority sites located within proximity of the study area, one of which is the Geelong Refinery. The other two sites are the former Corio landfill, located approximately 200 metres to the east of the study area, and an accidental spill/leak on the Princes Highway in Lara.

Soil and groundwater contamination at the Geelong Refinery has been investigated extensively and is actively monitored and managed by Viva Energy in accordance with regulatory requirements.

Both the Geelong Refinery and the former Corio landfill have been the subject of several Environmental Audits conducted in accordance with the former *Environment Protection Act 1970*.

As of 19 July 2021, there are four prescribed permission activities located within one kilometre of the study area including the Geelong Refinery and Terminals Pty Ltd, and the former Corio landfill and Ford manufacturing plant located outside of the study area, both of which are former licensed activities. Prescribed development and operating activities are those with potential high risk of harm to human health and the environment, and are subject to a development licence and operating licence under the *Environment Protection Act 2017*.

Prescribed permission activities are required to apply for an EPA development licence and operating licence under the Environment Protection Regulations 2021 unless exempt. The licence covers operation of the site and sets operating conditions, waste discharge limits and waste acceptance conditions, as appropriate. With the exception of the Geelong Refinery, it is considered unlikely that the former or currently licensed premises would have any impact on land or groundwater quality within the study area. Construction and operation of the proposed project within the Geelong Refinery where there is potential for interaction with contaminated soil and groundwater would be managed in accordance with regulatory requirements and the existing site contamination management practices in place at the site.

EPA Victoria Priority Sites

EPA Victoria issues CUNs and PANs for a broad range of sites, not only focusing on industrial and commercial sites, but also existing and former landfills and sites where EPA Victoria suspects that contamination has occurred. Sites are removed from the Priority Sites Register once all conditions of a Notice have been complied with and the site has been cleaned up to EPA Victoria's satisfaction.

Contamination within the study area

Based on an initial desktop assessment, it was concluded that Zone 1 (area within Geelong Refinery boundary) has a high potential for contamination based on historic land use, storage and processing of bulk fuels, and Zone 2 (area north of the Geelong Refinery along proposed pipeline alignment) has a low potential for contamination based on a history of agricultural and open space land uses. A broadly spaced and targeted intrusive field investigation was undertaken in the study area, with a total of 22 soil bores and 13 test pits advanced along the length of the investigation area. Thirteen soil bores were completed in Zone 1 and 11 in Zone 2. Five of the soil bores in Zone 2 were extended to groundwater and groundwater wells were installed.

The field investigation found soil contamination is present within Zone 1 at depths of approximately 1.5m and greater at the Geelong Refinery site which is associated with contaminated groundwater plumes known to exist beneath the refinery. Contamination at the refinery is well documented and has been under active monitoring and management by Viva Energy in consultation with regulatory authorities. The concentration of hydrocarbon compounds such as benzene and Total Recoverable Hydrocarbons (TRH) reported in Zone 1 exceeded both human health and ecological screening criteria within the boundary of the refinery which means this soil would require management in accordance with existing procedures at the refinery. Within the refinery, contaminated soils are temporarily stored and classified on site, prior to being disposed of offsite at locations authorised to receive the waste, in accordance with the *Environment Protection Act 2017*, Environment Protection Regulations 2021 and supporting legislation.

In Zone 2 to the north of the refinery, the sampled soil within the proposed underground pipeline alignment is generally not contaminated. This is consistent with historic land use and the low potential for contamination identified during the desktop assessment. **Figure 10-14** shows the locations where contamination levels exceeded the screening criteria for contaminants of concern and these concentrations are summarised in **Table 10-5** below.

Table 10-5 Contaminant concentrations above screening criteria

Zone	Location ID	Depth	Analyte	Concentration	Relevant Screening Criteria
Soil					
1	SB02	0.1-0.2 m bgs	PFOS	3.1 mg/kg	2 mg/kg[1]
1	SB04	SB04	Arsenic	122 mg/kg	100 mg/kg[2]
1	SB04	0.2-0.3 m bgs	PFHxS	2.4 mg/kg	1 mg/kg[1]
1	SB04	0.2-0.3 m bgs	PFOA	1.4 mg/kg	1 mg/kg[1]
1	SB07	0.2-0.3 m bgs	PFOS	3.4 mg/kg	2 mg/kg[1]
1	SB09	1.5-1.6 m bgs	C6-C10 Fraction (minus BTEX) (F1)	531 mg/kg	370 mg/kg[3]
1	SB09	1.5-1.6 m bgs	>C10-C16 Fraction	600 mg/kg	170 mg/kg[4]
1	SB09	1.5-1.6 m bgs	>C10-C16 (minus Naphthalene)(F2)	600 mg/kg	170 mg/kg[4]
1	SB09	1.5-1.6 m bgs	>C16-C34 Fraction	500 mg/kg	300 mg/kg[5]
1	SB09	1.5-1.6 m bgs	Benzene	12.6 mg/kg	3 mg/kg[3]
1	SB11	1.5-1-6 m bgs	C6-C10 Fraction (minus BTEX) (F1)	232 mg/kg	180 mg/kg[5]
1	TP02	0-0.1 m bgs	>C16-C34 Fraction	520 mg/kg	300 mg/kg
1	TP04	0-0.1 m bgs	PFHxS	1.9 mg/kg	1 mg/kg[1]
1	TP04	0-0.1 m bgs	PFOS	4 mg/kg	2 mg/kg[1]
1	TP04	0-0.1 m bgs	PFOA	1.1 mg/kg	1 mg/kg[1]
1	TP04	0.5-0.6 m bgs	PFOA	1.7 mg/kg	1 mg/kg[1]
1	TP11	0-0.1 m bgs	PFOS	2.2 mg/kg	2 mg/kg[1]
1	TP12	0-0.1 m bgs	PFOS	8.5 mg/kg	2 mg/kg[1]
1	TP12	0.5-0.8 m bgs	PFHxS	1.3 mg/kg	1 mg/kg[1]
1	TP12	0.5-0.8 m bgs	PFOA	1.7 mg/kg	1 mg/kg[1]
1	TP13	0-0.1 m bgs	PFOS	3.8 mg/kg	2 mg/kg[1]
1	SB23	0-0.1 m bgs	PFOS	3.2 mg/kg	2 mg/kg[1]

Zone	Location ID	Depth	Analyte	Concentration	Relevant Screening Criteria
Groundwater					
1	MW139	-	Benzene	707 µg/L	700 µg/L[6]
1	MW238	-	Benzene	174 µg/L	10 µg/L[7]
2	GW05	-	PFOS	0.19 µg/L	0.00023 µg/L[8]

Note: 'm bgs' - metres below ground surface, 'PFOS' - perfluorooctanesulfonic acid, 'PFHxS' - Perfluorohexanesulfonic acid, 'PFOA' - Perfluorooctanoic acid, 'BTEX' – Benzene, Toluene, Ethylbenzene, Xylene, 'mg/kg' – miligrams per kilogram, 'µg/L' – micrograms per litre.1 – EPA Publication 1669.4, 2 – NEPM 2013 Table 1B(5) Generic EILs for Urban Residential, 3 - NEPM 2013 Table 1B(3) Commercial/industrial Soil HSL for Vapour Intrusion, Sand, 4 - NEPM 2013 Table 1B(6) Commercial/industrial Coarse Soil, 5 - NEPM 2013 Table 1B(6) Urban Residential Coarse Soil, 6 – NHMRC 2008 Guidelines for Managing Risks in Recreational Waters, 7- ANZG (2018) Marine water 95%, 8- PFAS NEMP 2020

Trace concentrations of per-and polyfluoroalkyl substances (PFAS) were encountered in Zone 1 and Zone 2 but were reported below sensitive human health and ecological exposure investigation levels on site.

Groundwater contamination was also found to be limited largely to Zone 1. Contamination in groundwater beneath the refinery consisted of Light Non Aqueous Phase Liquid (LNAPL) i.e. petroleum product floating on top of groundwater, Total Recoverable Hydrocarbons (TRH) and benzene.

In Zone 2, groundwater is generally not contaminated although phosphorous and nitrate were detected, potentially representing regional fertiliser use, probably associated with agriculture. Phosphorous exceeded long term irrigation investigation levels but not short term use investigation levels. Long term irrigation investigation levels represent the maximum concentration of phosphorous in irrigation water which can be tolerated for 100 years of irrigation and short term irrigation levels represent the maximum concentration of phosphorous in irrigation water which can be tolerated for a shorter period of time such as 20 years. This means that phosphorous levels are acceptable for short term irrigation. The concentration of nitrate is not likely to preclude use or irrigation of encountered groundwater.

PFAS was encountered in groundwater from one well (GW05) in Zone 2 at concentration orders of magnitude above Water Dependent Ecosystems investigation levels. Given that the location of the PFAS contamination is over 3 kilometres to the north of the refinery, it is not considered to be related to the Geelong Refinery operation and the source is unknown.Acid sulfate soils occur naturally within coastal sediments.A desktop geomorphological investigation showed Zone 1 has potential geological indicators of acid sulfate soils. The geology of Zone 2 showed low indicators of acid sulfate soils, with potential indicators in the unnamed water way near the tie-in point, however, a targeted investigation for acid sulfate soils in this area did not find any evidence of PASS or actual acid sulfate soils.

Based on data collected as part of the field investigation, it was determined that net acidity concentrations in soil are generally below the adopted action criteria for acid sulfate soils management across the study area. The localised presence of potential acid sulfate soils (PASS) was reported at shallow depths within lithology classified as clayey sands, exceeding the action criteria at one location in the central area of Zone 1, along the refinery pipe trench parallel with Shell Parade (SB07). Acid sulfate soils were not encountered in Zone 2 during the field investigation.

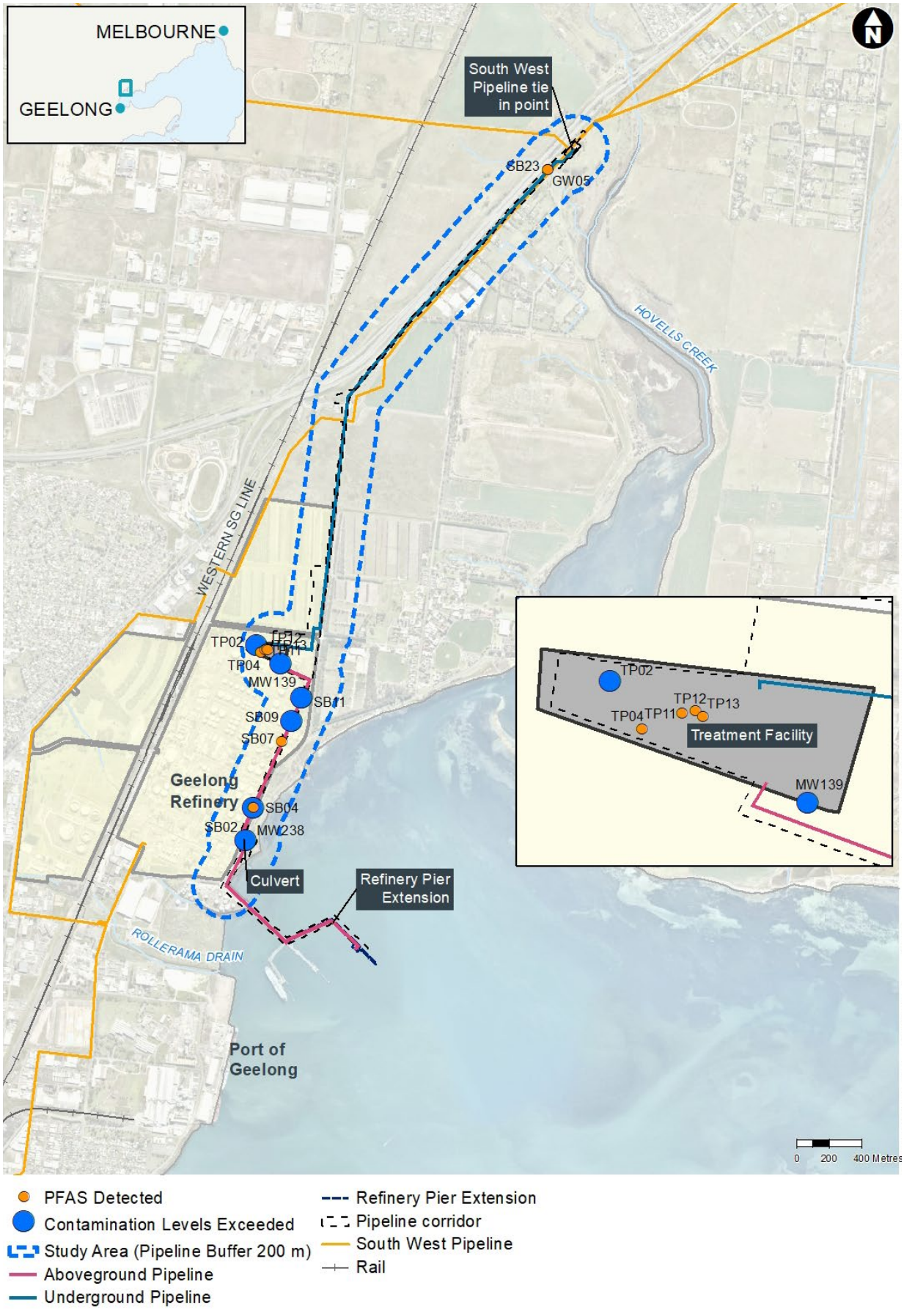

Figure 10-14 Locations where contamination levels exceeded criteria within the study area

Environmental values

Under the Environment Reference Standard (ERS) of the *Environment Protection Act 2017* (Vic), environmental values have been identified for water and the land environment to be achieved and maintained.

Surface water

The environmental values associated with waterways in the vicinity of the project area are summarised in **Table 10-6**.

Table 10-6 Environmental values of surface water

Waterways in the vicinity of the project area	Environmental values
Water Measurement Information System (WMIS) Database	
Hovells Creek and its tributaries	Water dependent ecosystems and species: (Slightly to moderately modified) • Agriculture and irrigation • Traditional Owner cultural values • Water based recreation • Human consumption of aquatic foods
Estuaries and inlets – Limeburners Lagoon	Water dependent ecosystems and species: (Slightly modified) • Water based recreation • Traditional Owner cultural values • Human consumption of aquatic foods

Groundwater

The ERS classifies groundwater into segments based on background salinity levels measured as total dissolved solids (TDS). Within each segment, a number of environmental values are identified and need to be maintained and protected.

TDS was estimated from electrical conductivity samples collected on 28 July 2021 during the groundwater field program and it was determined that the background salinity ranges from 915 milligrams per litre (mg/L) to 3,785mg/L. For the purposes of this groundwater impact assessment, and for identifying groundwater users to be protected, the groundwater salinity has been conservatively assessed as being Segment B, with the associated environmental values summarised in **Table 10-7**.

Table 10-7 Environmental values of groundwater

Environmental values	Segment (TDS mg/L)						
	A1 (0-600)	A2 (601-1200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures;	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

Land environment

Land use categories and their associated environmental values have been identified in the ERS and include parks and reserves, agriculture, sensitive use, recreation/open space, commercial and industrial. As these land uses are all present within the study area, all environmental values for the land environment were considered in assessing the potential contamination and acid sulfate soils impacts. These environmental values are summarised in **Table 10-8**.

The indicators and objectives for each environmental value are outlined the ERS.

Table 10-8 Environmental values of land

Environmental value		Land Use						
		Parks& Reserves	Agricultural	Sensitive Use - High Density	Sensitive Use - Other	Recreation/ Open Space	Commercial	Industrial
Land dependent Ecosystems	*Natural Ecosystems*	✓						
	Modified Ecosystems	✓	✓		✓	✓		
	Highly Modified Ecosystems		✓	✓	✓	✓	✓	✓
Human Health		✓	✓	✓	✓	✓	✓	✓
Buildings and Structures		✓	✓	✓	✓	✓	✓	✓
Aesthetics		✓		✓	✓	✓	✓	
Production of food, flora and fibre		✓	✓		✓			

10.2.4 Surface water impact assessment

The surface water impact assessment examined the potential of the project to affect nearby sensitive water receptors, such as Hovells Creek and Limeburners Lagoon.

Construction impacts

Construction activities have the potential to impact local and downstream sensitive receiving waterbodies and watercourses through the mobilisation of sediment, disposal of collected water and pollution incidents (for example, spills) if not managed properly.

Managing trench dewatering

Following a rainfall event during construction of the project, it may be necessary to pump surface water out of open trenches or excavated areas where it has accumulated from direct rainfall or from surface water runoff. If water collected from trenches is not managed appropriately, there is potential for water with high sediment content or pollutants to enter nearby sensitive receptors, such as Hovells Creek and Limeburners Lagoon.

Wherever possible, water collected from excavated areas would be recycled or reused for construction activities such as dust suppression. Where this is not possible, widely accepted and effective sediment control measures would be implemented to manage potential sedimentation impacts from dewatering, including treating collected water if turbidity exceeds EPA requirements, discharging the water to low gradient areas and not discharging directly into or within 50 metres of any watercourse. Where required, sediment control devices to remove suspended soils and dissipate flow would be used (see mitigation measure MM-SW01).

Trench water may also contain other contaminants and would be tested and discharged or disposed of in accordance with EPA surface water management and contamination protocols which would be incorporated into the Construction Environmental Management Plan (CEMP) for the project. Disposal of contaminated trench water is addressed in **Section 10.2.6**.

Runoff from disturbed areas

Construction works would result in disturbed areas from as excavation of the underground pipeline trench and the treatment facility site, and temporary stockpiling of spoil material. Runoff from excavated trenches, disturbed surfaces, HDD sites and stockpiled material has the potential to increase sediment loads and turbidity in receiving waterbodies without correct management. If increased sediment loads reach nearby waterways and enter the Ramsar site downstream, this may impact on waterway health and aquatic vegetation; however, this is unlikely to occur due to appropriate management measures that would be implemented during construction.

To manage runoff from disturbed areas, temporary flow diversion banks would be placed upstream of the spoil material and an overflow spillway would be constructed to allow runoff from external catchments to pass over the spoil material at a controlled location without causing erosion and potential sedimentation of receiving waterbodies. Sediment control devices such as bunding or silt fences would be set around stockpiled material, earthworks and disturbed areas to minimise loss of sediment to the receiving environment (see mitigation measure MM-SW02).

To avoid HDD drilling muds from entering waterbodies, earth bunds/or and drainage channels would be placed around the upper edges of drill sites and work areas to divert natural runoff around and away from the site and prevent mixing with drilling compound runoff. Sump pits would also be constructed at the bottom of the drill sites to capture runoff from the drilling compound (see mitigation measure MM-CO06). HDD drilling mud is further described in **Section 10.2.6**.

Watercourse trenching

Only one minor, artificially constructed watercourse would be crossed by the underground pipeline and is proposed to be constructed by open trenching. This watercourse, which is highly modified and drains into an artificially constructed dam, has been trenched for several pipelines previously. However, as the watercourse is in close proximity to Hovells Creek and can potentially drain into the creek if the dam overtops during a significant rainfall event, there is the potential for sediments to be transported downstream into Hovells Creek. Generally, open trenching is considered an acceptable construction method for waterways that are heavily degraded and/or do not have the potential to convey significant volumes of water during rainfall events meaning the likelihood of sediment mobilisation from construction works during these events is low. As the watercourse does not convey significant volumes of water, it is anticipated that trenching could be undertaken with appropriate mitigation measures to avoid potential impacts.

Where practicable, to avoid potential sedimentation impacts, the watercourse crossing would be constructed during no flow conditions and reinstated as soon as possible. Weather forecasts would also be monitored to avoid having the watercourse trench open when high rainfall events are expected. All obstructions to flow, if there is any flow, would be removed as soon as practicable after the pipe is laid and backfilled (see mitigation measure MM-SW03).

Spills

There may be potential for spills to occur during construction, including fuels or other liquid pollutants, associated mostly with refuelling and other small quantities of liquids used during construction activities (see **Section 10.2.6**). The primary concern with this potential impact is the possibility of hazardous materials flowing overland and reaching Hovells Creek and the Limeburners Bay component of the Ramsar site.

To avoid potential spills occurring, the storage of fuels and chemicals on site would be minimised. Fuels and chemicals would not be stored close to waterways or areas within proximity to the wetland. If a spill were to occur, spill kits would be available at locations where machinery/plant equipment is operating, as well as at refuelling points and fuel and chemical storage locations. Refuelling of vehicles and machinery would be undertaken in a designated refuelling area with auto shut off valves and would not occur within 50 metres of a receiving watercourse (see mitigation measure see MM-CO08).

Operation impacts

Operation activities have the potential to impact local and downstream sensitive receiving waterbodies and watercourses through the mobilisation of increased potentially contaminated runoff from the facility and pollution incidents (e.g. spills) if not managed properly.

Runoff water quality

The treatment facility is proposed to be located on the existing refinery site and would result in a small increase in impervious area, which may increase local runoff within the refinery site. The primary issue associated with potentially contaminated stormwater running off from industrial sites is the possibility of this runoff reaching nearby waterways and impacting on sensitive receptors. However, runoff from the project is not expected to be detrimental to receiving waterways and nearby sensitive receptors due to the small volume generated and the fact that runoff would be treated and managed in accordance with the refinery's existing runoff water system. In a wet weather event, controlled discharge facilities (CDF) at the refinery provide storage for the 'first flush' of rainwater, which is considered to be the most contaminated runoff water. Once the CDF basins are full, subsequent runoff water is allowed to discharge directly into Corio Bay in accordance with EPA licence requirements (see mitigation measure MM-SW08).

Spills to waterways

There is a potential for spills of fuels or other hazardous substances during the operational phase of the project, particularly associated with the treatment facility (as further described in **Section 10.2.6**). However, due to the absence of watercourses in the area surrounding the treatment facility and well-established spill management practices used in the refinery, it is unlikely that receiving waterbodies would be impacted by a spill.

Residual impacts

Residual impacts on surface water associated with construction and operation of the project are considered to be minor with the implementation of industry standard mitigation measures and by utilising existing management practices currently in place at the refinery.

Given the short construction timeframe and short length of the underground pipeline (approximately 4 kilometres), it is unlikely that temporary construction works would impact on surface water and nearby sensitive receptors with standard mitigation measures in place. Potential impacts associated with site dewatering, runoff from disturbed areas and potential spills can be effectively avoided and minimised with the implementation of mitigation measures outlined in EPA Publication 275 *Construction Techniques for Sediment Pollution Control* and EPA Publication 1834 *Civil construction, building and demolition guideline*. The single waterway crossing required for the project would be trenched and reinstated with minimal short-term impact.

It is highly unlikely that the project's operation would have surface water impacts on nearby sensitive receptors, including Hovells Creek and the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. Runoff water management systems in place at the existing refinery would ensure runoff from a rain event at the treatment facility is captured and managed effectively so as to not impact on any of these areas.

10.2.5 Groundwater impact assessment

The groundwater impact assessment examined the potential of the project to affect groundwater environmental values and groundwater users from changes in groundwater levels or flow.

Construction impacts

Construction activities have the potential to temporarily affect groundwater levels and flow if shallow groundwater is intersected during pipeline trenching and HDD works and the installation of foundations or piles at the treatment facility.

Trench dewatering reducing groundwater levels

Groundwater is unlikely to be intersected by the proposed pipeline trenching activities, which would typically be no more than 2 metres in depth between the treatment facility and SWP tie-in point. This includes at the unnamed watercourse and dam near the SWP tie-in point where the depth to groundwater is shallower than along the rest of the pipeline (2.86mbgs).

Trenching across Shell Parade is not expected to intersect groundwater based on an anticipated 2-metre-deep trench and culvert. Thrust boring is also being considered as an alternative construction methodology at this location, which is anticipated to be less than 3 metres deep and is not expected to intersect groundwater in this area.

Should groundwater be intersected during trenching, it is likely to be along a limited portion of the trench. The duration of dewatering, if required, would likely occur for less than one day (typically occurring immediately prior to laying of the pipe). Furthermore, the clay and sandy clay encountered in the area with the shallowest groundwater near the SWP tie-in point indicates low hydraulic conductivity (that is, groundwater does not pass through the soil easily). Reductions in groundwater levels in the unlikely event of dewatering being required would therefore be small in magnitude, extent and duration.

Overall, the need for groundwater dewatering to facilitate pipeline installation is not anticipated due to the unlikely intersection of groundwater. Any potential impacts to groundwater levels, environmental values and groundwater users from dewatering would be negligible.

The disposal of trench water (likely consisting of surface water runoff, as opposed to groundwater) is addressed in **Section 10.2.6**. Groundwater extraction/dewatering is not required as part of the HDD process. The potential impacts from HDD drilling water disposal are discussed in **Section 10.2.6**.

Registered bores are destroyed or inaccessible

There is potential for groundwater bores within, or near, the underground pipeline construction ROW to be damaged, destroyed or to become inaccessible during construction. One consumptive use bore and three unknown use bores were identified as part of the desktop assessment in proximity to the underground pipeline route.

Following detailed design, the location of registered and unregistered bores would be visually confirmed on site relative to the pipeline and construction ROW. Prior to construction, the potential for damage or loss of access to existing bores would be established in consultation with the landholder/bore owner (see mitigation measure MM-GW01).

Operation impacts

Once constructed, the project has the potential to change groundwater levels or impede flows during operation due to the underground pipeline and the presence of foundations or piles at the treatment facility. This could potentially result in impacts such as the reduction of groundwater levels at GDEs or bores (down-hydraulic gradient) and raising saline/brackish groundwater into the soil zone (up-hydraulic gradient).

Trenched sections of the pipeline affect groundwater levels or flows

As the trenched section of the underground pipeline is not expected to intersect groundwater, the potential for alteration of groundwater levels or flow due to preferential flow along the trench, or groundwater flow being impeded by the trench and pipeline, is not anticipated to occur once pipeline construction is complete.

If groundwater was intersected, it would be along localised sections of the pipeline only, for example at the lower lying area near the unnamed minor watercourse and dam. Excavated and/or imported trench backfill would be placed and compacted such that the permeability is similar to the surrounding unexcavated material, reducing the likelihood of preferential flow. Therefore, the magnitude of any impacts on groundwater flow would be limited in extent.

HDD sections of the pipeline affect groundwater levels or flow

The anticipated depth of HDD sections is up to 25 metres, which results in the potential for this activity to intersect groundwater.

The potential for HDD installed sections of pipeline to impede groundwater flow and adversely impact groundwater uses or groundwater users during the operational life of the project is very unlikely. The small dimensions of the underground pipeline relative to the regional groundwater flow system means that groundwater would readily flow over or under the pipeline with negligible change in hydraulic gradient across it. The magnitude and extent of any impacts on groundwater levels and flow, and hence groundwater environmental values and groundwater users, would be negligible.

It has been assumed that the project will engage a qualified person (as per AS/NZS2885.1) in the development of a construction management plan for the HDD crossings (as per AS/NZS2885.1 and APGA Code of Environmental Practice). The construction management plan would consider the site specific geological and hydrogeological conditions to be managed during construction.

Impeded groundwater flow due to foundations or piles

The potential magnitude of changes to the groundwater regime at the treatment plant site depends on the extent to which the aquifer perpendicular to groundwater flow may be impeded by the foundation/piles. While detailed design of the foundations or piles is yet to be confirmed, it is anticipated that they would be to a depth of only 1.5 mbgs. These would not intersect groundwater given the depth to groundwater in this area is typically 3.4 to 4 mbgs. Should the final design foundations be deeper and intersect groundwater, the geological profile and absence of groundwater users within 200 metres means that the potential for adverse impacts is considered very unlikely.

Although changes to groundwater levels and flow (if any) would be permanent following re-equilibration of the groundwater system, the magnitude and extent of any impacts would be negligible.

Potential impacts on groundwater quality from foundations or piles in addressed in **Section 10.2.6 Contaminated groundwater.**

Residual impacts

Residual impacts on groundwater associated with construction and operation of the project are considered to be negligible.

As groundwater is unlikely to be intersected by shallow trenching during pipeline construction, residual impacts on groundwater levels or flow are not anticipated to occur. The residual impacts of groundwater bores being lost, damaged or becoming inaccessible during construction are considered negligible with the recommended mitigation measure of 'ground truthing' bore locations and liaison with the landholder/bore owner during construction.

Groundwater levels or flow are not expected to be impacted by the underground pipeline during operation. Residual impacts from trenched sections and HDD/thrust-bore sections of the underground pipeline would be negligible in extent and magnitude, especially considering the small dimensions of the underground pipeline relative to the regional groundwater flow system. The magnitude and extent of any residual impacts on groundwater levels and flow associated with foundations or piles beneath structures within the treatment facility are also considered to be negligible, given that foundations or piles are not anticipated to intersect groundwater.

10.2.6 Contamination and acid sulfate soils impact assessment

The contamination and acid sulfate soils impact assessment examined the potential of the project to adversely affect human health and the environment (groundwater and land environmental values).

Construction impacts

Construction activities have the potential to disturb contaminated soils, groundwater and/or acid sulfate soils during trenching and HDD works and the installation of foundations or piles at the treatment facility. This could result in the mobilisation of contaminants and adversely impact the environmental values of soil, groundwater and/or groundwater users.

Contaminated soils

The results of the desktop assessment and field investigation indicate that contaminated soils are expected to be encountered during construction of the project within the boundaries of the Geelong Refinery (Zone 1) but are unlikely to be encountered along the underground pipeline alignment (Zone 2). The assessment of soil on the refinery site identified some exceedances of the investigation levels adopted for human health, however, these soils are all within restricted access areas. Due to the contaminated material being restricted to the controlled refinery site, and the absence of a source of contamination in publicly accessible areas, the potential impact on human health is considered low. The refinery has well established practices for management of contaminated materials associated with works within the site.

The concentration of petroleum hydrocarbons in Zone 1 exceeded ecological screening levels and have the potential to impact on ecological values in the area during excavation. All excavated soils in Zone 1 would be carefully managed to avoid spreading contamination and discharging to waterways and Corio Bay. In accordance with EPA Publication 1828.2 (2021) and with consideration of the general environmental duty (GED) to reduce the risk of harm, where possible, soils may be returned to the excavated area after laying the pipe and support infrastructure in a similar order to excavation (i.e. deepest soil is placed back at the greatest depth) (see mitigation measure MM-CO01). While contamination was not encountered in Zone 2 except for minor traces of PFAS, similar practices would be adopted during construction to avoid potential runoff carrying contaminants entering nearby waterways.

Based on the sample results, the soils within Zone 1 and Zone 2 are generally suitable for reuse on site (e.g. for backfilling of development excavations). However, if off-site disposal is required then further sampling and analysis would be required to determine the acceptability for off-site disposal.

Reuse of excavated soil to backfill the proposed pipeline trench or excavations related to the treatment facility would be managed in accordance with the Environment Protection Regulations, the ERS, EPA Victoria Publication 1669.4: *Interim position statement on PFAS* and would need to consider the GED. If soils are to be disposed offsite or be subject to uncontrolled use at a different location, a lawful place would need to be established in accordance with the *Environment Protection Act 2017*, EPA Victoria Publication 1828.2: *Waste disposal categories – characteristics and thresholds*, and a designation application will be submitted to EPA Victoria for approval prior to disposal of any PFAS-impacted soils (see mitigation measure MM-CO01).

Based on the results from the field investigation, and the controlled nature of the refinery in regard to public access, the disturbance of contaminated soils during the project has limited potential to impact on human health and the environment with the implementation of industry standard management measures.

Contaminated groundwater

There is potential for contaminated groundwater to be encountered during construction of the onshore works, especially in Zone 1 (Geelong Refinery area) due to the long history of oil refining operations. Inappropriate management and disposal of contaminated/acidic/brackish groundwater could result in changes to soil and surface water chemistry which could impact on protected environmental values.

Groundwater is contaminated with hydrocarbons in Zone 1 and with PFAS unrelated to refinery operations at the northern end of the underground pipeline in Zone 2 where groundwater is noted to be shallowest at 2.65m mbgs (GW05). Due to the shallow groundwater depth, trenching in the area around GW05 has the greatest potential to intersect groundwater although it is still not anticipated to occur (refer to **Section 10.2.5**).

While the need for dewatering during pipeline installation is not anticipated as groundwater is anticipated to be below the typical 2m pipeline excavation depth, if dewatering is required (e.g. after rain events), trench dewatering would only be undertaken prior to installing the pipeline. If groundwater is intersected and trench dewatering required, the water would not be discharged to waterways and would require appropriate management and disposal based on the expected groundwater conditions in the relevant area. Trench water would be analysed to confirm contaminant status and would only be discharged to land in accordance with EPA requirements and subject to approval from the relevant regulators. Any dewatered trench water disposed of in this way would not be expected to enter the surface water system, but instead would seep through the ground and re-enter the groundwater system. Any potentially contaminated groundwater, (including PFAS-impacted trench water), will be disposed of appropriately in accordance with EPA guidelines (see mitigation measure MM-CO02). PFAS-impacted trench water would require offsite treatment should it be abstracted during pipeline construction.

Due to the low probability of encountering groundwater during construction, the potential for inappropriate handling, storage and disposal of contaminated groundwater to impact on human health and/or the environment is considered to be minor.

Contaminant migration

As outlined in **Section 10.2.5**, trenching for the underground pipeline is not expected to intersect groundwater. Any unexpected intersection of groundwater would be along limited portions of the trench, result in limited depths of intersection, and would not require significant dewatering (see mitigation measures MM-CO03). Therefore, potential impacts on environmental values from increased contamination migration as a result of the trench dewatering is considered to be minor.

Unexpected finds

Encountering unknown contamination (including asbestos) during any construction project is possible. Unknown contamination may be identified by visual or olfactory observations (such as staining or strong odours), the presence of asbestos and/or other anthropogenic material. However, based on the site history and field investigation results, it is unlikely that project construction works would encounter unknown contamination that will result in long-term and irreversible impacts to human health and the environment.

It is noted that the sampling density undertaken for the field investigation was not designed to meet EPA Victoria Publication IWRG702: *Soil Sampling requirements* and was designed to assess the potential for contamination over the wider study area. As such, there is the potential that localised contamination may be present at other locations and may be encountered during project construction works. If encountered, localised contamination would be managed in accordance with regulatory requirements and within Zone 1, the existing practices in operation at the refinery.

Contamination is conservatively assumed to be present throughout Zone 1 and therefore any contamination encountered in this zone during construction would be managed in accordance with existing refinery site management protocols and regulatory requirements.

In the event that unknown contamination is encountered in Zone 2 during construction, ground disturbance works at the location of contamination would cease, and an assessment of the site contamination would be undertaken, and appropriate remedial action implemented if required (see mitigation measure MM-CO04). Any unknown contamination identified in soil would be managed and disposed of in accordance with relevant EPA guidance (see mitigation measure MM-CO01).

Acid sulfate soils

The primary concerns with acid sulfate soils (ASS) relate to the potential for acidic water to impact soil quality and vegetation, enter waterways (via surface water runoff from acid sulfate soils stockpile materials), leach into groundwater and impact human health via direct contact, ingestion or recreation. Based on the preliminary data, potential acid sulfate soils (PASS) have been noted in shallow clayey sands at a single location, in Zone 1. However, the data is not sufficient to completely rule-off the presence of acid sulfate soils at other locations within Zone 1. No indicators or detection of acid sulfate soils was identified in Zone 2.

Soils in Zone 1 would be managed in accordance strategies developed and implemented within the CEMP to manage potential ASS risks (see mitigation measure MM-CO05). Such strategies include (but are not limited to):

- Avoiding construction works during wet months unless conditions are such that land degradation and surface water management problems can be avoided, or appropriate mitigation measures implemented
- Minimising the duration of stockpiling
- Including a procedure for managing the unexpected discovery of ASS/PASS
- Capturing and managing run-off that has the potential to be impacted by stockpile material
- Developing and implementing a monitoring program as part of the CEMP to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils.

This strategy would be developed considering the Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999, EPA Victoria Publication IWRG655.1: Acid Sulfate Soil and Rock, Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010) and National Acid Sulfate Soils Guidance (series of documents) 2018.

With the implementation of mitigation to manage acid sulfate soils, the potential impact on human health and/or the environment would be negligible.

PASS activation from dewatering activities

Oxidation of previously submerged soils from trench dewatering could lead to generation of acidic waters that can affect human health via direct and secondary contact, surface water and/or groundwater quality. As dewatering is not expected to be required during project construction, it is unlikely that activation of potential acid sulfate soils will occur. The management of PASS during any dewatering will be incorporated into the CEMP (see mitigation measure MM-CO05).

Drilling mud disposal

HDD crossings of up to 25 metres deep are being considered for construction at some locations along the underground pipeline such as beneath School Road, Shell Parade (at the Bell Road roundabout) and Macgregor Court.

Drilling mud is used as a coolant to wash in-situ material (cuttings) from the drilled hole and to seal and line the hole to facilitate insertion of the pipe. The primary clay used for drilling mud is bentonite, a non-toxic, naturally occurring mineral clay, which is added to fresh water to produce a 'mud'. Drilling mud will be managed using industry best practice per the Australian Pipelines and Gas Association (APGA) Code of Environmental Practice – Onshore Pipelines. Disposal of drill cuttings and drilling mud will be undertaken in accordance with the EP Regulations 2021 and Schedule 5 of the Regulations to classify drilling mud for appropriate disposal. However, if an HDD encounters groundwater and mixing occurs, the drilling muds may become contaminated. On that basis, all drilling muds will be tested to confirm the suitability of disposal (see mitigation measure MM-CO06).

With the implementation of industry standard practices for the management of drilling mud disposal, any potential impacts on human health and/or the environment would be minor.

Hydrotest water

Prior to commissioning, the pipeline would be subject to a strength and leak test, known as hydrostatic pressure testing (or hydrotesting). This involves filling a section of the pipeline with water and monitoring its pressure to detect potential leaks. Approximately 2 megalitres (ML) of water will be required for the pipeline hydrotest(s) which would be sourced directly from the refinery freshwater supply. Oxygen scavenger and biocide may be added to the hydrotest water as required to minimise the risk of corrosion and bacterial growth.

Following completion of the testing, if the test water is not able to be reused or recycled within the refinery, the water will be disposed of by an appropriately licensed waste contractor in accordance with the *Environment Protection Act 2017* and Environment Protection Regulations 2021. As per AS2885.5: *Pipelines – Gas and liquid petroleum field pressure testing*, the approved test plan will include the procedures and precautions for the disposal of the test water (see mitigation measure MM-CO07).

The likelihood of inappropriate handling, storage and disposal of the water is considered unlikely and potential impacts to human health and/or the environment would be minor.

Fuel and chemical leaks and spills

During construction, there is potential for leaks or spills to occur from machinery/plant, fuel and chemical storage which could impact on human health and the environment. However, with the application of industry standard mitigation measures, potential impacts from leaks or spills would be minor. In addition to mitigation measures such as minimal storage of chemicals at the work site, bunding of areas where storage is required and storing chemicals away from waterways, a potential spill would be localised and contained at the active work site rather than being widespread (see mitigation measure MM-CO08).

Waste streams

The project would generate wastes other than soil, trench water and drilling muds, including waste from transportation and storage of the pipe, pipeline coating waste, welding/grinding waste and machinery waste.

Inappropriate management and disposal of these waste streams could result in minor impacts to human health, aesthetics and/or the environment. However, the potential for these impacts to occur will be mitigated by suitable storage, reusing and recycling (where practicable) and disposal at appropriately licensed facilities in accordance with the applicable regulations and guidelines (see mitigation measure MM-CO09).

Operation impacts

Operation of the project has the potential to cause leaks or spills from machinery/plant, fuel and chemicals storage and usage and mismanagement of waste streams (solid inert, liquid, organic, packaging etc.). Such spills may have the potential to affect human health, aesthetics and/or the environment.

Leaks and spills

There is potential for leaks and spills to occur during operation, which could impact on human health and the environment.

The treatment facility would include the bulk storage and distribution of hazardous materials such as natural gas, liquid nitrogen and odorant. Up to 1200m^3 liquid nitrogen would be stored in vacuum insulated vessels. Liquid nitrogen would be stored below -150 °C and natural gas and odorant would be stored and distributed as gas. Any potential release of these materials would not be expected to contaminate soil or groundwater.

Other miscellaneous hazardous materials and chemicals relating to the project (i.e., for routine maintenance) may be stored within the Geelong Refinery site. These materials will be managed in accordance with the relevant safety data sheets (SDSs) and Australian Standards. A dangerous goods and hazardous materials register along with current SDSs will be maintained during project operation. The potential for impacts on soil, groundwater and surface water associated with leaks and spills would be minor with the application of industry standard procedures and the implementation of project's Operational Environmental Management Plans (OEMPs) (see mitigation measure MM-CO08). The Geelong Refinery has well established procedures for the avoidance and management of potential spills from day to day activities.

Waste streams

The project is not likely to generate large amounts of wastes during operation and maintenance activities. Wastes that may be generated include oils and grease from pipeline maintenance activities, dust and steel flakes from infrequent pipeline pigging activities (every five years) and mixed solid waste such as food scraps, paper, glass, packaging and recyclables.

The project will manage waste in accordance with existing and well-established refinery practices and in accordance with the Environment Protection Regulations 2021 and the APGA Code of Environmental Practice – Onshore Pipelines. Waste generation will be minimised through recycling, with all waste that cannot be recycled disposed to a licensed waste management facility. Therefore, the potential for impacts on human health, land, surface water, groundwater or aesthetics associated with loss of operational waste streams would be minor and can be readily managed and contained (see mitigation measure MM-CO09).

Residual impacts

Residual impacts of the project on human health and the environment from disturbance of contaminated soils, groundwater and/or acid sulfate soils would be avoided and minimised with the implementation of industry standard mitigation measures.

Existing contamination was found to be limited in extent, and predominantly located within the boundary of the Geelong Refinery. Contamination was not encountered along the underground pipeline alignment, with the exception of minor traces of PFAS. Due to the contained nature of the contamination, disturbance of contaminated soils and groundwater during the project has limited potential to impact on human health and the environment with the implementation of industry standard management measures.

Acid sulfate soils may be encountered in shallow soils in Zone 1 during construction, however, will be managed in accordance with a management strategy resulting in a negligible impact on human health and/or the environment. Management of other waste forms including drilling mud and hydrotest water with industry standard practices would ensure potential impacts on human health and/or the environment are avoided and minimised to the extent practicable.

The potential for impacts on soil, groundwater and surface water associated with leaks and spills during operation would be avoided and minimised with the application of industry standard procedures and the implementation of the project's OEMP. Large amounts of waste are not anticipated to be generated during operation and will managed in accordance with the applicable regulations.

10.3 Summary of mitigation measures

The mitigation measures to manage potential impacts on the land environment are outlined in **Table 10-9**.

Table 10-9 Land environment mitigation measures

Mitigation measure ID	Mitigation measure	Project phase
Terrestrial ecology		
Prevent construction impacting on retained vegetation and habitat		
MM-TE01	Complete construction works within the 15-20 m construction ROW to restrict impacts on retained native vegetation and habitat.	Construction
MM-TE02	Establish No-Go Zones (NGZs) to protect retained areas of native vegetation and the area of NTGVVP beyond the construction footprint.	Construction
MM-TE03	Fence NGZs with highly visible fencing designed to last the duration of construction works. Fencing will be appropriately signed.	Construction
MM-TE04	Clearly mark NGZs and the works area limit on all maps and construction drawings prior to commencement of works. No works are to occur outside the marked footprint for the works.	Construction
MM-TE05	Undertake all earthworks in a manner that minimises soil erosion and adhere to the Construction Techniques for Sediment Pollution Control (EPA, 1991).	Construction
MM-TE06	Reduce the need for large-scale excavation at the margins of construction works where trees occur within 15 m to avoid impacts on the root zones (e.g. Between School and Torresdale Roads)	Design
MM-TE07	Conduct an arborist assessment to identify those trees that will not be adversely impacted by the works, those that may not be impacted if protection measures are implemented, and those where loss is unavoidable.	Design

Mitigation measure ID	Mitigation measure	Project phase
Minimise disturbance, injury, or death of wildlife		
MM-TE08	Manage any open pits or trenches to reduce potential for fauna entrapment. Implement measures such as: • Minimise the period trenches and other excavations are open • Design excavations with slopes less than 45o to provide exit ramps for fauna • Create 'ladders' to enable fauna to exit the excavations (e.g. branches, ropes, planks) • Ensure fauna are discouraged from work areas by erecting barriers where practicable • A protocol included in the site induction around the procedure for finding trapped fauna.	Construction
MM-TE09	Design any fencing required to define construction boundaries or to protect NGZs in accordance with relevant DELWP guidelines to limit fauna strike.	Design
MM-TE10	Design lighting (if required) for night works or for security purposes, design the number, type and layout of lights to light only the construction area with reference to the National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (DoEE, 2020). The design should: • Keep lights close to the ground • Direct and shield lights to avoid light spill beyond the workspace • 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 LEDs if possible.	Design
MM-TE11	Minimise night-time works to reduce impacts of noise and light on nocturnal animals.	Construction
MM-TE12	Conduct pre-clearing survey at all sites where trees and shrubs being removed to assess presence of fauna.	Construction
MM-TE13	Engage a suitably qualified wildlife handler ('wildlife spotter'), holding a relevant and current authorisation under the *Wildlife Act 1975*, to salvage any wildlife encountered during the construction program.	Construction
Control spread and/or introduction of weeds and/or pathogens		
MM-TE14	Implement hygiene measures to ensure opportunities for the introduction and spread of weeds (importation of seeds and other vegetative material to the site) and pathogens are limited. This will include vehicle inspections and establishment of wash down facilities.	Construction
MM-TE15	Treat high risk weeds from construction areas prior to works commencing.	Construction
MM-TE16	Manage any outbreak of noxious and/or Weeds or National Environmental Significance (WoNS) within construction areas that occurs due to construction activity. Prevent spread into adjacent land.	Construction

Mitigation measure ID	Mitigation measure	Project phase
MM-TE17	Manage and control spread of noxious weeds as per the responsibilities outlined in the CaLP Act.	Operation
Reduce erosion, sedimentation and contamination risk to retained vegetation and habitat		
MM-TE18	Implement measures to manage erosion and sedimentation, address the management, handling, and storage of hazardous chemicals, and manage dust to minimise impacts on retained vegetation and habitat and aquatic environments.	Construction
Contractor / personnel awareness of ecological values		
MM-TE19	Induct all contract staff on the presence and location of ecological values and inform them of all relevant protective measures and obligations while undertaking construction activities.	Construction
Surface water		
MM-SW01	Discharge water The CEMP will include surface water management strategies. Construction activities are to conform to the surface water requirements of the *Environment Protection Act 2017*. Site management mitigation measures will include vehicle wheel wash and rumble bars at worksite egress points, appropriate placement of material stockpiles and chemical storages, covered loads, street sweeping and water quality monitoring, where required. Depending on rainfall, soil condition and groundwater table, dewatering may be required, particularly associated with pipeline trenching. The following mitigation measures are recommended for management of excavated water: • Water collected from excavated areas will be recycled and reused for construction activities such as dust suppression. • Where discharge to waterbodies is unavoidable, water will be collected and treated if turbidity exceeds EPA requirements prior to discharging. • Discharge to land will not occur within 50 metres of watercourses or be discharged directly into stormwater drains. • Discharge of water to land will avoid soil erosion or sedimentation of land or water. Sediment control devices such as silt fence to remove suspended solids and dissipate flow will be used where required. • Water will not be discharged to waterways, wetlands or into stormwater drains without approval from relevant authorities. • Water will be tested for pH and salinity prior to discharge to land. pH and salinity will not exceed acceptable limits in EPA guideline. • Water that cannot be treated to meet the relevant discharge criteria will be disposed to an EPA Victoria licensed facility. • Relevant landholder(s) and water authorities will be consulted, and permission obtained prior to discharge to land. • Discharge will be to low gradient, stable, grassed areas and be undertaken in accordance with landholder requirements and through "irrigation type" systems to prevent scour or erosion. Visual monitoring during land discharge will be undertaken to ensure water does not enter existing waterways and/or wetlands.	Construction

Mitigation measure ID	Mitigation measure	Project phase
	Groundwater encountered during construction of the pipeline will be managed in accordance with mitigation measure MM-CO02.	
MM-SW02	**Managing runoff** • Obstructions to flow will be removed. • Flow diversion banks will be placed upstream of spoil material if required. • An overflow spillway will be constructed to allow runoff from external catchments to pass over the spoil material at a controlled location without causing erosion. • During the works, sediment control devices such as bunding or silt fences will be set around stockpiled material, earthworks and disturbed areas to minimise loss of sediment to the receiving environment. • Temporary diversions will be provided to allow flow around the excavation area.	Construction
MM-SW03	**Watercourse trenching** Where trenching is undertaken over a watercourse, the following mitigation measures will be undertaken: • Undertake works in accordance with APGA guidelines. • Where practicable, all trenched watercourse crossings will be constructed during no flow conditions and reinstated as soon as possible. • Weather forecasts will be monitored to avoid having open trenches at the waterway when high rainfall events are expected. • Where watercourses are trenched, all obstructions to flow will be removed as soon as practicable after the pipe is laid and backfilled. • Trenching on both sides of the waterway will be fully excavated and prepared prior to undertaking the final section of trenching over the waterway. • Waterway reinstatement will be carried out in consultation with the CMA. • The exposed trench within the watercourse will be reinstated immediately following the installation and commissioning of the pipeline, including providing suitable compaction and revegetation. • Waterway reinstatement will be designed to avoid future erosion. This may include the use of riprap made of stones and fabric mesh to stabilise the waterway. • If necessary, a geofabric will be provided to prevent erosion and scour until the vegetation has established. • Visual monitoring will be undertaken downstream of the trench during flow events if the trench has not been reinstated. • Sediment control devices such as silt fences will be used to remove suspended solids and dissipate flow where required.	Construction

Mitigation measure ID	Mitigation measure	Project phase
MM-SW04	**Capture and treat runoff from treatment facility** Runoff from the treatment facility after a rain event will be captured and managed by the controlled discharge facilities (CDF) in place at the refinery.	Operation
Groundwater		
MM-GW01	**Loss of registered bores** Through continued liaison with landholders the location of potentially affected bores (due to damage, destruction or loss of access) will be confirmed prior to construction and make-good arrangements agreed if required.	Construction
Contamination and acid sulfate soils		
MM-CO01	**Contaminated soils** • Manage contaminated soil (as identified within Zone 1 – the refinery) in accordance with: – EP Act 2017 – EP Regulations 2021 – ERS 2021 and in consideration of EPA Publication 1834 – PFAS National Environmental Management Plan 2.0 (2020), or subsequent publication – EPA Victoria Publication: 1669.4: Interim Position Statement on PFAS, or subsequent publication • Stockpiles of trench spoil should be managed in accordance with *APGA Code of Environmental Practice – Onshore Pipelines*. • Sample and classify excess soils and HDD screened cuttings for off-site disposal in accordance with: – EPA Victoria Publication IWRG702: Soil Sampling, or subsequent publication – EPA Victoria Publication 1828.2: Waste Disposal Categories - Characteristics and Thresholds, or subsequent publication • Manage and transport contaminated spoil for off-site treatment/ disposal in accordance with: – EP Act 2017 and EP Regulations 2021. • Any material imported for use as backfill should comply with the EPA Victoria Publication 1828.2 Waste Disposal Categories - Characteristics and Thresholds for 'Fill Material' and meet the requirements of the Fill Material Determination (Gazette No. S 301, 18 June 2021). The backfill should be accompanied by relevant documentation confirming its compliance to the 'Fill Material' criteria.	Construction

Mitigation measure ID	Mitigation measure	Project phase
MM-CO02	**Contaminated groundwater** • Manage contaminated groundwater in accordance with: – EP Act 2017 – EP Regulations 2021 – ERS 2021 – PFAS National Environmental Management Plan 2.0 (2020), or subsequent publication • Minimise disturbance of saturated soil and groundwater within the PFAS affected areas (refinery and in vicinity of GW05) and prevent migration of PFAS into the surrounding soil or surface water. Disturbance may be minimised by design of the infrastructure not to extend into the water table or to be bypassed by using HDD techniques. • Water from areas that have been identified as contaminated should not be discharged to the environment (land, waterways, sewer). • Where a wet-trench installation approach is not undertaken contaminated water should be sampled and either treated onsite, depending on contaminant encountered (this may require approval from the EPA Victoria) or disposed offsite to an EPA Victoria licensed facility.	Construction
MM-CO03	**Contaminant migration** Trench dewatering of groundwater or perched water should be avoided. In the unlikely event that dewatering of groundwater or perched water inflow is unavoidable, the trench should be dewatered prior to lowering the pipes.	Construction
MM-CO04	**Unexpected finds** Incorporate management strategies within the CEMP to manage potential unexpected finds. • In the event that unknown contamination (including asbestos containing material) is encountered during construction: – Cease ground disturbance at the unknown contamination location and within the immediate vicinity. – Assess site contamination in accordance with the National Environment Protection (Assessment of Site Contamination) Measure (2013) and identify appropriate remedial action. The remedial action must manage contamination to prevent impact to human health and the environment in accordance with the Duty to Manage. – Undertake required remediation. – Such material may be identified by visual or olfactory observations, the presence of asbestos and/or other anthropogenic material.	Construction

Mitigation measure ID	Mitigation measure	Project phase
MM-CO05	**Acid Sulfate Soils** • Incorporate management strategies within the CEMP to manage potential ASS risks for a 'Medium' ASS hazard (CASS BPMG, 2010) in accordance with: – Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999, or subsequent publication – EPA Victoria Publication IWRG655.1: Acid Sulfate Soil and Rock, or subsequent publication – Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010), or subsequent publication – National Acid Sulfate Soils Guidance (series of documents) 2018, or subsequent publication • The CEMP must be approved by the Pipeline regulator in consultation with EPA Victoria. • Construction works should not occur during wet months unless conditions are such that land degradation and surface water management problems can be avoided, or appropriate mitigation measures implemented. • Provide training to relevant site-based personnel on the requirements of the ASS management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010). • Minimise the duration of stockpiling in accordance with the CASS BPMG (2010). • Include a procedure for managing unexpected discovery of ASS/PASS in the CEMP. • If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile. The CEMP should include details for when or if the requirements for containment with bund and a leachate collection system is necessary. • Capture and manage run-off that has the potential to be impacted by stockpile material in accordance with the CASS BPMG (2010). • Develop and implement a monitoring program as part of the CEMP in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils. • Include management procedure for trench dewatering that will limit PASS activation in accordance with the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010) and the National ASS Guidance 'Guidance for the dewatering of aid sulfate soils in shallow groundwater environments', in the Project CEMP	Construction

Mitigation measure ID	Mitigation measure	Project phase
MM-CO06	**Drilling mud disposal** Dispose drilling muds in accordance with: • The EP Act 2017 and the EP Regulations 2021 – Schedule 5 of the Regulations will be used to classify drilling mud for appropriate disposal. • Requirements for disposal of drilling mud should be confirmed at the time of construction. • APGA Code of Environmental Practice – Onshore Pipelines	Construction
MM-CO07	**Hydrotest water** • Manage hydrostatic test water in accordance with ERS 2021 (Water) and APGA Code of Environmental Practice – Onshore Pipelines. • Reuse water where practicable to conserve water and minimise the volume of water to be disposed of. • If water is unable to be reused or recycled dispose of in accordance with EP Regulations 2021.	
MM-CO08	**Fuel and chemical leaks and spills** • Store bulk fuel (if required) in self-bunded tanks in accordance with relevant Australian standards (AS1940-2017 and AS1692-2006). • Refuelling or maintenance of equipment, machinery and vehicles should be conducted at least 20 metres or as far away as is reasonably practical from any waterway with appropriate measures to contain spills. For sensitive sites (i.e. wetlands), refuelling or maintenance of equipment should be conducted no closer than 50 metres. • Store hazardous materials in ventilated, self-bunded and secured containers in accordance with the *Occupational Health and Safety Act 2004* (OHS Act) and *Occupational Health and Safety Regulations 2007* (OHS Regulations). • Store dangerous goods in accordance with the *Dangerous Goods (Storage and Handling) Regulations 2012* and the code of practice for the storage and handling of dangerous goods. • Undertake routine and scheduled maintenance of vehicles and plant/machinery/equipment to minimise the potential for leaks/spills to occur. • Supply spill kits and firefighting equipment with the chemicals required by legislation. • Maintain dangerous goods and hazardous materials register and current SDSs. • If a chemical leak or spill has occurred, the duty to respond to harm as per, Section 31 of the EP Act 2017, may be required.	Construction and operation

Mitigation measure ID	Mitigation measure	Project phase
MM-CO09	**Waste management** • Manage waste in accordance with Environment Protection Regulations 2021 and the APGA Code of Environmental Practice – Onshore Pipelines, including establishment of appropriate and secured waste storage locations on-site, as required. • Develop and implement waste management procedures. • Reuse or recycle waste materials where practicable. • Collect and transport wastes by licensed contractors for disposal at appropriately licensed facilities. • Provide waste containers for different types of waste generated onsite. • Refuse containers should be lidded to mitigate fauna access.	Construction and operation

10.4 Conclusion

Construction and operation of the project is considered unlikely to have adverse impacts on terrestrial ecology, migratory shorebirds and other waterbirds or the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, with minor exceptions during construction of the onshore pipeline.

Construction of the onshore pipeline would remove 0.091 ha of Western (Basalt) Plains Grassland Community and would impact on a small extent of marginal foraging habitat for Swift Parrot and Grey-headed Flying-fox (planted eucalypts). Golden Sun Moth may occur in mown Chilean Needle-grass adjacent to the SWP connector at Lara which resulted in design modifications to a required laydown area to minimise the area affected. The Golden Sun Moth was assumed to be present in this area when considering potential impacts. Construction activities are unlikely to result in a significant impact to these ecological values, and mitigation measures such as establishing no-go zones to protect vegetation and avoiding large scale excavations in proximity to trees would be implemented.

The food chain of migratory shorebirds and other waterbirds reliant on seagrass beds and plankton and larvae would not be adversely impacted by the project. The proposed recycling of cooled seawater from the FSRU into the refinery for cooling water during operation would result in an improvement to the temperature of the current refinery discharge and bring it closer to ambient conditions in Corio Bay. Operation of the project would not result in a change to the already licenced chlorine concentrations from the refinery discharge as the same dosing levels would be applied for the cooling water. The temperature and chlorine plumes modelled for the project indicate that neither plume reaches Limeburners Bay or the Ramsar site.

The existing Geelong refinery has been discharging warm water and low levels of chlorine into Corio Bay for over 60 years. This enabled EES technical studies to assess the impacts of this discharge as a baseline for assessing potential project impacts. The studies found a healthy marine ecosystem offshore from the refinery discharge. On this basis, there is strong empirical evidence to suggest that the project discharge will not have adverse impacts on seagrass or on the food chain supporting terrestrial shorebirds and other waterbirds in Corio Bay and the Ramsar wetland.

Construction activities may have the potential to impact local and downstream sensitive receiving waterbodies and watercourses through the mobilisation of sediment, changes in water quality and changes in stream hydrology/stability prior to recommended mitigations being applied. The project is not located within a floodplain and does not intersect any low-lying or flat areas that are subject to flooding.

Given the short construction timeframe for the project and short length of the underground pipeline, it is unlikely that temporary construction works would impact on surface water and nearby sensitive receptors. Surface water runoff during construction would be managed with the implementation of industry standard mitigation measures to avoid sedimentation impacts in nearby

waterways and sensitive receptors. The single waterway crossing required for the project would be trenched and reinstated with minimal short-term impact. It is highly unlikely that the project's operation would have surface water impacts on nearby sensitive receptors with existing run-off water management systems in place at the refinery. Residual impacts on surface water associated with construction and operation of the project would be minor.

There is very limited potential for groundwater to be intersected during construction. Generally, groundwater is at depths below the anticipated 2m trench depth required for the gas pipeline. There is potential for foundations or piles associated with the treatment facility on the refinery site to intersect groundwater, but this would be a very localised occurrence and not deemed to have any material impacts on groundwater levels or flow. The potential impacts of private groundwater bores being lost, damaged or becoming inaccessible during construction are considered negligible with the recommended mitigation measure of 'ground truthing' bore locations and liaison with the landholder/bore owner. Groundwater levels or flow are not expected to be impacted by the underground pipeline or the foundations or piles beneath structures within the treatment facility during operation of the project. Residual impacts from trenched sections and HDD sections (if any) of the underground pipeline, and the presence of piles or foundations would be negligible in extent and magnitude.

Due to the limited extent of existing contamination external to the Geelong Refinery, construction of the project has limited potential to adversely impact soil, groundwater and receiving surface water, as well as human health. Existing contamination is predominantly located within the boundaries of the Geelong Refinery and can be managed with existing contaminant management procedures. Residual impacts associated with the disturbance of contaminated material would be minor. Potential environmental impacts associated with acid sulfate soils, where confirmed present, are limited by the shallow depth of trenching, minimising the duration of stockpiling and avoiding trench dewatering activities (where groundwater is intersected). Operation of the project has the potential to cause leaks or spills from machinery/plant, fuel and chemicals storage and usage and mismanagement of waste streams. Such spills and waste streams have the potential to affect human health, aesthetics and/or the environment; however, potential impacts would be minor and readily managed with industry standard procedures.

In response to the EES evaluation objective described at the beginning of this chapter, impacts of the project on the land environment have been assessed and mitigation measures have been identified to avoid and minimise adverse effects.