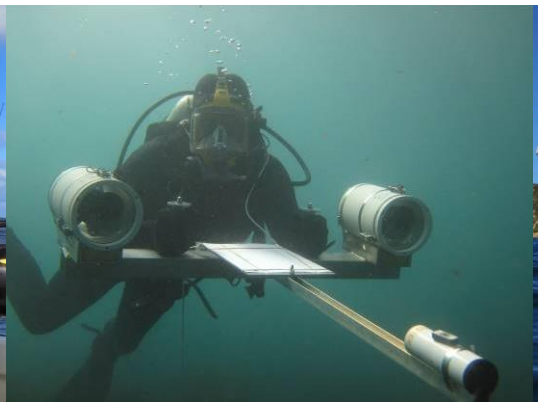
Marine Impact Assessment of Point Nepean Field Station

Matt Edmunds



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AUSTRALIAN MARINE ECOLOGY

Marine Impact Assessment of Point Nepean Field Station

Document Control Sheet

Description
Desktop study to assess potential sensitivities and impacts from a proposed field station at Point Nepean, including seawater intake and discharge for research facility.

Keywords
Point Nepean, Quarantine Station, Police Point, Port Phillip Heads, seawater facility, research, intake, discharge, impact, prediction, infrastructure, priority marine features, biotopes, eia, ebm.

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1	All	17-05-22	First version – desktop review
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Contents

1 Introduction

1.1 Background

The University of Melbourne (UOM) and Monash University (MU) (the Universities) are partnering to develop and jointly operate the Point Nepean Research and Education Field Station (PNREFS) – a research and education field station to be located in the Old Quarantine Station at the Point Nepean National Park. The Project will enhance a significant and historic part of the Point Nepean National Park, renewing and revitalising a heritage building (Badcoe Hall), developing a new building as well as adding to the surrounding precinct area.

The PNREFS will provide facilities for scientific research, community engagement, and teaching and accommodation purposes. The facilities will be jointly operated by the University of Melbourne and Monash University with both universities contributing towards operational activities.

The project proposes the following facilities:

Site A refurbishment	Adaptive re-use/ Refurbishment of Badcoe Hall (Building 8) for Flexible open space for Community Engagement, workshops, lectures and exhibitions.
Site B New Build	New building for University of Melbourne/ Monash University Shared facilities: Laboratory, Teaching and Shared Offices and Accommodation.
Site C Research tank (aquarium) hard stand area	Outdoor area to accommodate tanks to support PNREFS research and engagement activities.
Seawater system	Installation of a seawater system including pipes, tanks, pump shed/ station, inlet and outlet in bay, anchorage point in bay and treatment, route to be confirmed. Route options identified on Figure 1.1 below – not yet confirmed and likely to utilise horizontal directional drilling to minimise impact on surrounds.

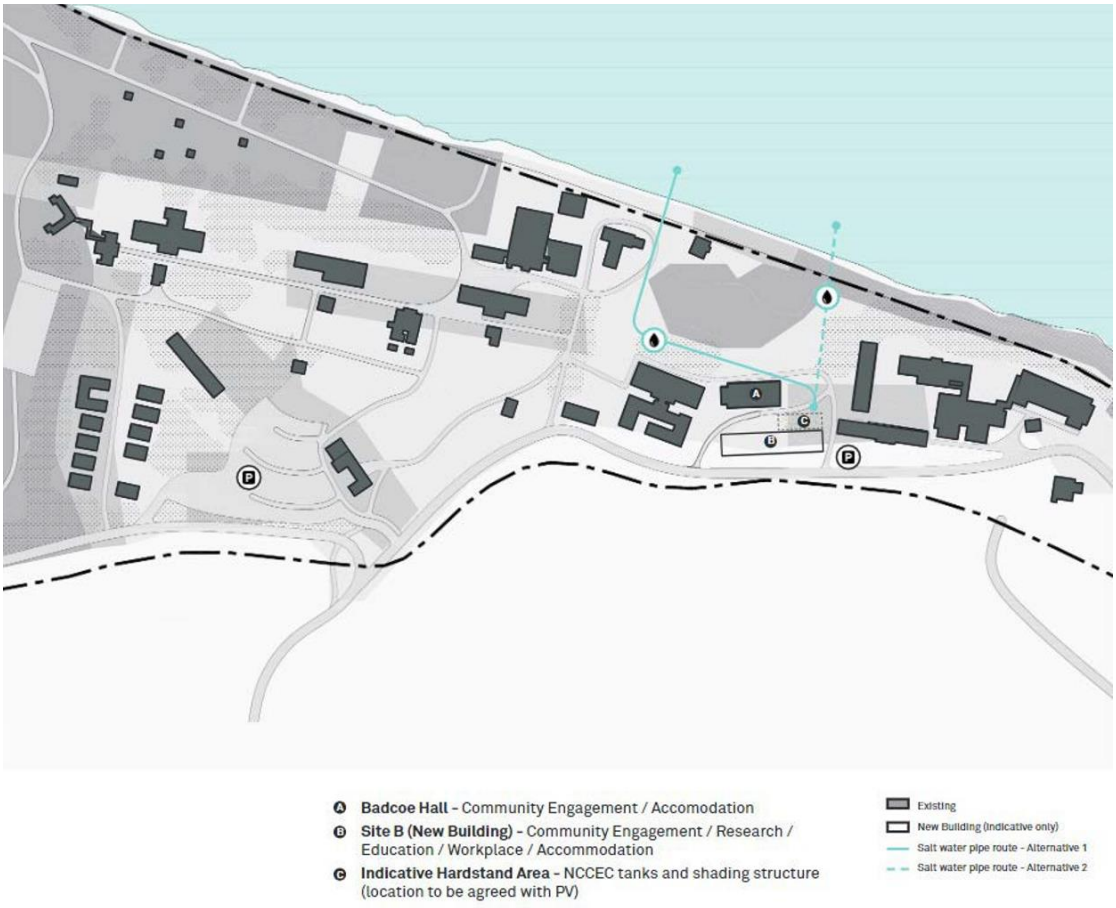


Figure 1.1. Site plan of proposed research facility (provided by The University of Melbourne).

1.2 Objectives and Scope of Work

The principal objectives of this study was to determine the existing environmental conditions, examine the potential for impacts and provide recommendations for preventing and minimising impacts related to construction and operation of the facility.

The scope of works for the marine environment assessment was:

- Review databases relating to flora and marine fauna, including the Victorian Biodiversity Atlas (VBA), the NatureKit tool, the NVIM tool and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool;
- A field survey to:
    - Describe the marine flora and fauna relevant to the project area;
    - Map the extent of marine flora and fauna in the study area;
    - Take photographs and record photo location points of marine flora and fauna in the study area; and

    - Describe the gradient (or depth range if action is to be taken in a marine area) relevant to the project area;
- Describe any Commonwealth Heritage Places or other places recognised as having heritage values relevant to the project area;
- Undertake a Vegetation Quality Assessment (required for detailed assessment pathway applications);
- Assess the potential for the study area to support habitat for species listed under the EPBC Act and the FFG Act;
- Identify the implications of state and federal biodiversity legislation and local policy and planning approvals relevant to the project, including but not limited to the EPBC Act, the FFG Act, the EE Act. This includes any self-assessments considered necessary under the legislation and identifying the appropriate assessment pathway for the permitting process, as determined by the Guidelines, using the NVIM tool;
- Determine offset requirements for any removal of native vegetation;
- Advise whether the proposed project likely to have any direct or indirect impact on the members of any listed migratory species, or their habitat;
- Advise whether the proposed project likely to have any direct or indirect impact on the members of any listed species or any threatened ecological community, or their habitat;
- Advise on issues that the project team should be aware of when designing and operating the seawater intake and outfall systems and structures to minimise impact on the marine environment (*e.g.* can the inlet and outlet structures be located in the Ticonderoga Bay area? What areas must be avoided?);
- Recommend any further assessments of the study area that may be required (such as targeted searches for EPBC Act listed species); and
- Provide an initial report outlining the findings of the investigations and prepare a final report after receipt of one set of consolidated comments.

2 Methods

2.1 Desktop Study

A desktop study was used to identify existing information relating to the marine and coastal habitats, flora, fauna and values in the project location and wider Point Nepean region. Much of this was compiled from the Department of Environment, Land, Water and Planning CoastKit resources, including:

- bathymetry DEM (2010);
- lidar seabed reflectance (2010);
- aerial photography (2010 onwards);
- geo-bibliography (1803-2017);
- biotope mapping and ground truthing points (1960-2019); and
- priority marine features atlas of sensitive and important flora, fauna and geoforms.

Other, more terrestrial and fauna-based databases were queried, in accordance with the scope:

- Victorian Biodiversity Atlas (VBA);
- NatureKit tool;
- NVIM tool; and
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool.

Other resources used included:

- plans by The University of Melbourne;
- imagery from NearMaps;
- Records and sightings of listed species;
- surveys in the region associated with the Port Phillip Bay Channel Deepening Project (2003-2008); and
- Parks Victoria long term subtidal reef monitoring program (1998-2015).

The spatial scope of the database queries varied according to the availability of the data and the context of the information. Natural values associated with potential localised and physical effects were addressed at scales of 100s to 1000s metres. Because the region is subject to very strong tidal currents, natural values that could be influenced by water quality and transported pressures were addressed at a wider scale of the Port Phillip Heads biotope region. This region encompasses the tidal stream affected areas inside the Heads from Lonsdale Bight in the west to Hovell Pile in the east. Most of the habitats and biotopes in the project area are represented in the western region from Point Franklin to Lonsdale Bight, with a different complement of biotopes occurring east of Point Franklin.

2.2 Field Survey

2.2.1 Littoral Survey

The littoral habitats of the project area were inspected during low tide on 18 July 2022. The inspection method consisted of:

- Inspection and georeferenced imagery to describe and ground truth species, biotopes and habitats;
- Search for any suitable habitat and presence of the FFG listed chiton *Bassethullia glypta*;
- Location and type of existing anthropogenic structures and modifications;
- Locations of existing drains; and
- Mapping of key features using a NearMap basemap.

The inspection was focused on the shore in front of the Quarantine Station, where the installation would pass under, and the rocky coast immediately to the east, where sensitive biota were more likely to occur. There was limited littoral habitat and walking access along the shore in front of bluff of Police Point to the east of the project site. Other rocky littoral habitats were inspected at the eastern side of the Police Point bluff and the western side of the Point Franklin Bluff. The sandy shore between the Quarantine Station and Observation Point to the west was also inspected.

2.2.2 Subtidal Survey

The subtidal survey will be completed pending suitable field conditions.

2.3 Ecological Impact Assessment

The ecological impact assessment encompassed considerations of the Victorian Marine and Coastal Knowledge Framework (DELWP 2021). The assessment was structured to encompass a socio-ecological model that connects activities, pressures, ecosystem components, priority marine features, supporting ecosystem processes and ecosystem services (Driver-Pressure-Services-Response model). The model was derived the components identified from the desktop review, field observations and description of the project. The components and linkages of the model were classified according to the standardised ecosystem categories developed as part of the CBiCS classification system and the EcoNet models within the Victorian CoastKit database (Edmunds *et al.* 2021; DELWP 2021).

A Feature-Activity-Sensitivity-Tool (FeAST) approach was used to provide an initial screening for effects of primary concern. The FeAST analysis categorises responses in terms of resilience and recovery to impact pressures and scored as a level of sensitivity. The sensitivity criteria are provided in table 2.1.

Table 2.1. Sensitivity criteria used for the Feature-Activity-Sensitivity-Tool (FeAST) screening of impacts.

Recovery	**Resistance**			
	Very low	**Low**	**Medium**	**High**
	> 75 % change	**25-75 % change**	**< 25 % change**	**No effect**
Very low, > 25 years	High	High	Moderate	Low
Low, 10-25 years	High	High	Moderate	Low
Medium, 2-10 years	Moderate	Moderate	Moderate	Low
High, < 2 years	Moderate	Low	Low	Very low

3 Desktop Review

3.1 Relevant Policies

The relevant legislation and policies are listed in Table 3.1. The two key policies are the Environmental Protection Act, which governs granting of a licence to discharge and the Marine and Coastal Act which governs consent for development and works. In the granting of permissions, other key acts include:

- any effects on significant species and communities (EPBC Act, FFG Act, Fisheries Act);
- any effects on significant areas (National Parks Act, Fisheries Act, EPBC Act and Ramsar convention); and
- any effects on significant social and economic activity (Fisheries Act, ports management, Port Phillip Bay EMP).

Table 3.1. Summary of legislation and policies relevant to marine aspects of the project. Items in bold are pertinent to this project.

Policy	Relevance considerations
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	• Matters of National Environmental Significance. • Listed conservation species and communities. • Migratory species. • Ramsar Convention wetlands. • **Listed Syngnathidae fishes including seahorses and sea dragons** • **Listed giant kelp community *Macrocystis***
Environmental Effects Act (1978) Vic	• Processes for preparation and assessment of an EES. • Assessment of potential for significant adverse effects.
Environment Protection Act (2017) Vic	• Protection of the environment through permitted activity and 'General Environmental Duty. • Objectives to minimise harm and maintain ecological integrity • **Provision of licence to discharge** • **Setting of licence conditions** • **General Environmental Duty** • **Environmental Reference standards**

Policy	Relevance considerations
Marine and Coastal Act (2018) Vic	• Management and planning of the marine and coastal environment. • Holistic, ecosystem-based management • Cumulative and incremental impact assessment • Sustainable development • **Consent for marine and coastal development and works.** • **Setting of consent conditions** • **Port Phillip Heads Marine Asset Area**
Flora and Fauna Guarantee Act (1988) Vic	• Threatened species and community listing • Threatening processes listing • Action plans • **Listed chiton *Bassethullia glypta*** • **Listed community Entrance Canyon sponge community (includes Portsea Hole).**
Fisheries Act (1991) Vic	• Ecologically sustainable fisheries • Maintenance of fishery habitat • Fishery management plans and licencing • Fishing sanctuaries and areas of significance • Protected aquatic biota • Noxious species • Pest and disease management • **Permit to remove noxious species, e.g. Undaria** • **Management of disease outbreaks**
National Parks (Marine National Parks and Marine Sanctuaries) (2002) Vic	• Marine National Parks and Marine Sanctuaries • Protection of natural environment and indigenous flora and fauna. • Protection of areas of significance • **Portsea Hole – Port Phillip Heads Marine National Park**
Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Site Management Plan (2018)	• Ramsar sites at Swan Bay and Mud Islands
Wildlife Act (1975) Vic Wildlife (Marine Mammals) Regulations (2009) Vic	• Minimise disturbance to wildlife • Restriction of activities near marine mammals • **Triconderoga Bay Sanctuary Zone – dolphin refuge**

Policy	Relevance considerations
Victorian Ports and Marine Safety	• Marine Safety Act (2010) Vic • Port Management Act (1995) Vic • Biosecurity Amendment (Ballast Water and Other Measures) Act (2017) Cth • Port of Melbourne port waters management • **Sorrento Channel vessel navigation**
Port Phillip Bay Environmental Management Plan	• Manage environmental, social and economic values. • Stakeholder stewardship • Water quality • Marine biodiversity

3.2 Spatial Queries

3.2.1 CoastKit

The outputs of the spatial queries from the DELWP CoastKit database are presented in Figures 3.1 to 3.12.

The desktop review was primarily based on the bibliography of studies in the Point Nepean general region. Approximately 190 studies were related to the area (Section 7.2 Bibliography), however only a few studies have specifically examined the marine habitats and biota in the Portsea to Triconderoga Bay area. A substantial amount of information was gained from a long-term reef monitoring program from 1998 to 2015, with one site located at Point Franklin (Site 2801; Figure 3.7; Edmunds and Musto 2015, Edmunds and Flynn 2016). Other significant biotope studies in the region were associated with the Channel Deepening Project (Edmunds *et al.* 2006, 2007, 2008) and mapping by Ball and Blake (Blake *et al.* 2001, 2012). The sponge and seaweed biodiversity values of the region were well established in the late 1800s (*e.g.* Harvey 1858; Wilson 1886-1895; Dendy 1897) and subsequently through seaweed studies in the 1970s to the present (Kraft *et al*., University of Melbourne).

There have been broad-scale habitat surveys in the region using glass-bottom boats, aerial imagery, lidar bathymetry and lidar reflectance (Blake *et al.* 2001, 2012; Figures 3.1 to 3.2). These surveys were generally at a coarse scale, in the order of 10s to 100s of metres. Advances in recent decades include development of the CBiCS biotope classification scheme (Edmunds *et al.* 2016, 2018, 2021) and higher resolution mapping tools (*e.g.* aerial and drone imagery, Figures 3.5 to 3.6). Habitat maps of the region have not been updated since 2001 (Figure 3.8; Blake *et al.* 2001).

Scientific monitoring in the region included the Subtidal Reef Monitoring Program at Point Franklin, 1998-2015 (Edmunds and Musto 2015; Edmunds 2016) and deep reef communities at Portsea Hole, 2003-2011 (Edmunds *et al.* 2007; 2009; 2011). The subtidal reef monitoring program data was converted to CBiCS biotope data in 2016 (Edmunds and Flynn 2016). There has been subsequent citizen science Reef Life Survey monitoring in the area, including a site located at the Quarantine Station (Figure 3.7). The Reef Life Survey includes fish and mobile benthic invertebrate abundances, but does not include benthic biotope data.

3.2.2 Nature Kit and Victorian Biodiversity Atlas

The Victorian Biodiversity Atlas (VBA) was accessed through the DELWP NatureKit website. The atlas was used to determine sightings and occurrences of listed and threatened flora and fauna on the coast and adjacent waters of Point Nepean. (Figures 3.16 and 3.17).

Coastal Flora

The Quarantine Station site consists of a cleared and landscaped area around the buildings and the aerial image indicates there is some remnant vegetation on or behind the dune at the beach (Figure 3.6). There is relatively intact natural vegetation along the bluff toward Police Point and across much of Nepean Point to the west of the site. The VBA indicated observations of threatened but non-sensitive flora outside the site, primarily to the south and east, including the species:

- Coast Bitter Bush *Adriana quadripartita*;
- Dune Poa *Poa poiformis* var *ramifer*;
- *Lotus australis* var *australis*;
- Coast twin leaf *Roepera billardierei*;
- Coast Colobanth *Colobanthus apetulatus* var *apetalus*;
- Late helmet- orchid *Corybas sp aff diemenicus* (Coastal); and
- Coast Wirilda *Acacia uncifolia*.

These sightings were spatially distant from the proposed project.

Coastal Fauna

The VBA only had a small number of observations for coastal fauna, including:

- White footed dunnart *Sminthopsis leucopus*;
- White throated needle tail swift *Hirundapus caudacutus*; and
- White bellied sea eagle *Haliaeetus leucogaster*;

These species are likely to occur near or traverse the project site and may be subject to behavioural impacts such as from noise or lighting during construction and operation.

Shore and Marine Fauna

A moderate number of shore birds of varying conservation concern were observed, with the most significant being the hooded dotterel *Thinornis cucullatus* at Observatory Point, to the west of the project area. Hooded dotteral have a declining population in Victoria and are vulnerable during breeding season, where chicks are reared on sandy beach nesting sites. They are have some tolerance to more distant behavioural disturbances, but are vulnerable to predation from predators and feral animals and direct disturbances at nesting and feeding areas. They are also vulnerable to natural events, such as storms and high waves, beach erosion or sand drift.

Other shore bird sightings on the Nepean Peninsula are of common and abundant species that, although protected species, are not vulnerable with respect to the project. These include sooty oyster catchers, cormorants and seagulls.

The waters around Point Nepean are frequented by the Burrunan dolphin *Tursiops australus*. This species is has only a small population size, with a significant proportion of the population residing in Port Phillip Bay. The Point Nepean coast from Police Point to Nepean Bay is a designated sanctuary. The dolphins are sensitive to disturbance from

recreational boaters, underwater noise, bioaccumulation of contaminants from prey and impacts on prey availability, including through fishing.

Other marine vertebrate fauna common to the area include:

- Common dolphin *Delphinus delphis*;
- Australian fur seal *Arctocephalus pusillus doriferus*;
- Little penguin *Eudyptula minor*.

The VBA and the EPBC Protected Matter Atlas both contain observations of vagrant and transient species. Although many of these species were significant species for conservation, such as the southern right whale *Eubalaena australis*, southern humpback whale *Megaptera novaeangliae* australis and albatrosses, any impact pathways would be addressed through the consideration of resident species.

3.2.3 NVIM Tool

The Native Vegetation Information Management system (NVIM) is an online tool to access Victoria's native vegetation information and determine what vegetation protection overlays occur with respect to mapped natural vegetation. The project area is within the Point Nepean National Park as the principal management overlay concerning any vegetation removal. The proposal is to develop existing and new buildings in a pre-existing built and landscaped environment and the installation of the intake and discharge pipes would use directional drilling. On this basis, the project is likely to be designed to avoid any removal of natural vegetation. This would be subject to findings of the field surveys.

3.2.4 EPBC Protected Matters Tool

The EPBC Protected Matters atlas provides information of known and probable areas of species and sites of national and international significance. Key listed sites were the Ramsar sites of Mud Islands and Swan Bay, which are also important for listed migratory bird species, in addition to South Channel Fort. These sites are some distance from the Quarantine Station, but are somewhat connected ecologically through tidal water transport.

Significant migratory species occur offshore from the southern coast of Nepean Bay, including oceanic sea birds, marine mammals, leatherback turtle and tuna. These species may occasionally enter Port Phillip Bay as transients or vagrants but are not considered a significant presence for the project. Listed sharks regularly enter the Bay, such as white shark *Carcharodon carcharias* and school shark *Galeorhinus galeus*. School shark predominantly traverse to Geelong Arm for breeding and white shark to not frequent the Portsea and Police Point area.

Key listed species of relevance were the giant kelp *Macrocystis pyrifera* and fishes of the Family Syngnathidae. This Family includes pipefishes, sea horses and sea dragons.

There are significant colonies of weedy sea dragons *Phyllopteryx taeniolatus* and short-headed sea horses *Hippocampus breviceps* in the Portsea and Sorrento regions. Sea dragon colonies also occur in Nepean Bay and at Queenscliff to the west. Giant kelp communities occurred to the west of the project area, including Nepean Bay, Lonsdale Bight and Popes Eye. This community is locally extinct, following declines during the millennial drought.

3.3 General Marine Environment

The Point Nepean shore is situated in the Port Phillip Heads tidal exchange area and biogeographical unit (Edmunds and Flynn 2018). It is moderately sheltered in not being directly exposed to breaking swell waves, but is subject to periodic strong ground surge. It is open to northerly and northwesterly winds, however the fetch is reduced by the shallow Great Sands that form the Nepean flood-tide delta. The water movement is predominantly from tidal currents, short-fetch waves and vessel wake. The strong tidal streams of the Port Phillip Heads biounit are an important driver of the ecosystem, including structuring geoforms, linking areas through water column transport, dispersing biological production and organic matter, providing food for filter feeders and reducing the benthic light climate through suspension of sediments.

The geoforms and substrate types are predominantly structured by calcarenite sandstone rock protruding from expanses of sand. The sand is formed into channels, sand waves and hollows by the tidal movements. Littoral rock habitat is present at Point Franklin and Police Point to the east and Nepean Bay to the west. These geoforms extend into the shallow infralittoral zone, forming flat, low profile reef structures with sandy veneers. Sublittoral low profile reef is extensive in the Portsea and Nepean Bay regions, to a depth of approximately 3-5 m where sandy habitats are prevalent.

The sandy shores in the Quarantine Station region generally consist of a narrow supralittoral berm, 2-5 m across and a narrow-sloped beach approximately 10 m across. A low-tide to nearshore sand platform generally occurs to 60 m offshore at the Quarantine Station site, before grading into various sandy geoforms between the shore and 19 m depth, where deep reef (circalittoral rock) structures occur (Figures 3.1 and 3.5).

The nearest deep environments are 1.5 km to Portsea Hole, 4.6 km to Schnapper Deep and 2.6 km to western South Channel. Given tidal streams range up to 7 knots, these areas are connected with respect to water transport by times of approximately 8, 25 and 14 minutes respectively during peak tidal streams each tide.

3.4 Habitats and Biotopes

3.4.1 Littoral Habitat

Littoral rock biotopes occur beneath the headland areas of Point Franklin, Police Point and Nepean Bay. There have been few studies of littoral rocky reef biotopes in Victoria (Edmunds and Flynn 2018). There is presently no desktop information on biotopes and littoral rock zonation at Point. There has been long-term monitoring on the southern, Bass Strait coast of Nepean Peninsula (Edmunds *et al.* 2015), however this has a different energy regime (Bellarine-Mornington biounit) and not applicable to the northern, moderate energy shores.

Littoral sediment biotopes are primarily in the form of beaches, supralittoral berms and vegetated dune. Some areas of the littoral sediment habitat has been converted to artificial shore armoring, including at Portsea and Nepean Bay. There has been considerable erosion of sediment shores in the Triconderoga Bay region in the last decade.

3.4.2 Nearshore - Upper Infralittoral Rock Habitat

The shallow sublittoral rock habitat generally has a veneer of sand with small areas of exposure. Much of this shallow reef is covered by the reef seagrass *Amphibolis antarctica*. This seagrass is very long-lived and, over time, outcompetes seaweed assemblages by trapping a veneer of sand amongst its horizontal rhizomes. This seagrass is prevalent on low profile, sandy moderately exposed reef throughout Victoria and has a very high primary production rate, providing significant production for surrounding ecosystems. Although highly productive, *Amphibolis* patches do not readily recover horizontally from any physical disturbance, with modelling indicating recovery in the 10s to 100s of years. *Amphibolis* provides detrital matter for swarms of mysid shrimps, which is a primary food source for seadragons *Phyllopteryx taeniolatus*.

There are a variety of *Amphibolis* biotopes in the region, grading from monospecific stands around Police Point to various assemblages with sub-canopy brown seaweeds. The occurrence of *Amphibolis* biotopes is restricted to Portsea, Nepean Bay, northern Lonsdale Bight and Queenscliff. Associated seaweeds include *Cystophora moniliformis*, *Cystophora retorta, Seirococcus axillaris* and the occasional *Macrocystis pyrifera* (subcanopy form).

Sandy veneer and low-profile reef seaweed assemblages are also prevalent on the Portsea and Nepean Bay shallow reefs. These assemblages include *Sargassum spinuligerum, Caulocystis cephalornithos, Cystophora monilifera, Cystophora retroflexa* and *Seirococcus axillaris*. The exposed rock in the sandy veneer biotopes have a high diversity of red thallose seaweeds (Figures 3.13 and 3.14). The abundance of the red algal species present is relatively variable between seasons and years,

indicating some resilience with respect to disturbances. (Edmunds 2017; Edmunds *et al.* 2017).

The sublittoral reef at Point Franklin supported a shallow expanse of kelp bed *Ecklonia radiata* (stunted wrinkled morph). This bed was prevalent on the slope of the reef and was highly persistent through time between May 1998 and prior to June 2009. The biota beneath the canopy included moderate abundances of sea urchins, low abundances of thallose red algae and high coverage of pink encrusting coralline algae. The lower edge of the kelp bed was bounded by *Amphibolis* biotope on sandy veneer reef.

In 2009, there had been significant *Ecklonia* dieback from disease (Figure 3.17). Such dieback was also observed in Nepean Bay, Lonsdale Bight and along the Surf Coast (Edmunds *et al.* 2013; Edmunds 2017; Edmunds *et al.* 2017). A scattering of marine pest *Undaria pinnatifida* kelp recruits were also observed during this survey. The kelp bed had recovered by February 2014 (Figure 3.18) and *Undaria* was not prevalent at that time, although the survey was in summer, during a time when *Undaria* is often senescent. *Undaria pinnatifida* has been progressively supplanting all *Ecklonia* kelp beds within Port Phillip Bay, including at Popes Eye. Most of the kelp beds are expected to be invaded by *Undaria* at some stage, if it has not established already. The rate of ecosystem change is likely to be dependent on levels of disturbance of natural ecosystems that provide novel surfaces for *Undaria* establishment. *Undaria* is seasonal in growth with the large kelp form prevalent in winter and spring and bare coralline encrusting rock present in summer-autumn, often with an increased abundance of sea urchins. *Undaria* can also establish a foothold through the colonisation of the woody stems of *Amphibolis* seagrass.

Vessel swing moorings are a considerable structuring influence on the nearshore seabed biotopes on the Portsea reefs, forming approximately circular areas of scoured or abraded reef.

3.4.3 Intermediate Depth - Lower Infralittoral Rock Habitat

Sandy-veneer reefs occur to depths of 19 m and are dominated by sponge and red algal seaweed clumps (lower infralittoral zone). These sponge-algal clumps are subject to a high degree of suspended sediment loading and sediment scouring. These clumps are also subject to physical abrasion by organic debris carried by the tidal currents, including large fronds of seaweeds. The diversity of the sponges and seaweeds is very high and this type of habitat is restricted to only a few locations in Victoria and within the Port Phillip Heads region. Notable patchers occur between Police Point and Portsea Hole (immediately east of the Quarantine Station), as well as in the western South Channel, Symonds Channel and north of Entrance Canyon. The patch between Portsea and Portsea Hole is relatively extensive, as evidenced on the lidar reflectance mapping (Figure 3.3).

The intermediate depth, lower infralittoral reef biotopes have not been formally surveyed and mapped and the biotopes have yet to be properly described. Casual observations indicate there are substantial differences in the sponge and seaweed compositions between the predominant areas of Portsea, Schnapper Deep, Symonds Channel and Shortland Bluff.

3.4.4 Circalittoral Rock Habitat

The Port Phillip Heads biogeographical unit is characterised by its unique seascape and physiographic setting. The Port Phillip Heads seascape was likely formed during the Paleocene Epoch by a meandering river channel cutting through various sequences of sedimentary rock to form a canyon between landforms that are now Point Nepean and Point Lonsdale. Sea level rise at the end of the Paleocene and into the Holocene lead to the unique underwater canyon, Entrance Canyon. The canyon is the deepest habitat in Victoria with a series of holes reaching to 103 m. It is situated just inside the narrow entrance into Port Phillip Bay, which has a shallow rocky bar, Rip Bank extending eastward across much of the entrance from Point Lonsdale. A second shallow rocky bar extends northward from Point Nepean to terminate in an underwater promontory known as The Plateau. These structures funnel strong currents through canyon, as well as creating areas considerable turbulence, with strong down and upwellings. Most of the prominent seascape features occur at the entrance, known as The Rip, encompassing, Rip Bank, Nepean Bank, Entrance Canyon and The Plateau. There are also complex formations at the western end of South Channel, such as Spec Reef and Far Side, with rocky areas becoming more dominated by sand covering to the east. Deeper, circalittoral habitat also occurs at Portsea Hole, offshore from Portsea, and Schnapper Deep in the central region of South Channel.

The calcarenite, sandstone and sediment formations of the seascape have been highly eroded to form a high diversity of geoforms, including platforms, walls, bombies, holes, caverns, maze-like ridges, rubble fields, tall sand ridges and clay beds. These geoforms also have complex microstructures, including ledges, shelves and undercuts to provide a very high diversity of niches for biota (Edmunds *et al.* 2006, 2007).

The circalittoral geoforms of Port Phillip Heads support an equally diverse and unique set of biotopes dominated by sessile invertebrates, commonly known as sponge gardens. All of the observed biotopes differ markedly from other circalittoral environments in Victoria. There are also marked variations in the biotopes along strong environmental gradients within Port Phillip Heads, including with depth, swell and ground surge exposure, current speed and turbulence, shading, geoform type, rock stability and sediment loading/scouring. Initial work has identified at least 25 visually distinct biotopes (Edmunds *et al.* 2006, 2007). These biotopes are presently being re-evaluated using more sensitive image classification techniques (DELWP CoastKit project).

3.4.5 Sublittoral Sediment Habitat

Highly mobile medium to fine sands are prevalent in the Port Phillip Heads biounit. These sands form a variety of structures and habitats, including the Great Sands flood tide delta, South Channel and Capel Sound at the seascape scale. Various channels, banks and fields of sand waves occur at the geoform scale. The sediment banks and beds near the Quarantine Station are largely bare of epibiota and depauperate of infauna. Significant sediment biotopes occur to the east of Point Franklin, including seagrass, *Pyura* ascidian beds, scallop beds and patches of seapens *Virgularia mirabilis* (Edmunds *et al.* 2004a, 2004b).

The sediment area at the Quarantine Station has not been formally surveyed or mapped. There are patches of benthic epibiota present based on aerial imagery (Figure 3.6). This may potentially include *Pyura* biogenic reef biotopes.

3.5 Biodiversity

3.5.1 Biodiversity Hotspot

The large range of seascapes, environmental gradients, habitats and biotopes in the Port Phillip Heads bioregional unit is reflected in the diversity of sessile biota. The area is renown for its diversity in seaweed and sessile invertebrate assemblages, since the first studies in the mid 1800s, such as by Harvey in the 1850s (Harvey 1855, 1858) and the Royal Society of Victoria in the 1880s and 1890s (Bale 1888; Lucas 1891; see also references for Carter, Dendy, Wilson, Lendenfeld and Tisdall).

The Port Phillip Heads region is a nationally significant biodiversity hotspot and is of international significance with respect to the taxonomy of sponges. Approximately a third of Australia's taxonomically described sponges occur in this region (Hooper and Weidenmayer 1994). The area is also a taxonomic type locality for a significant number of ascidians and seaweeds. Much of the taxonomy of Phylum Porifera comes from the foundational work of Carter and Dendy in the 1880s and 90s, with both scientists working on the thousands of sponge specimens collected from Port Phillip Heads. A relatively high number of ascidians and seaweed species have also been described from Port Phillip Heads specimens. The high species richness and diversity occurs across the range of depths, from nearshore seaweed and crevice communities to deep reef sponge gardens (Figures 3.17 to 3.21).

3.5.2 Mobile Invertebrates

Surveys as part of the Victorian Subtidal Reef Monitoring Program indicated abundances of mobile megafaunal invertebrates, including seastars, molluscs, echinoderms and crustaceans was relatively low on shallow reefs in the region, probably because of the high degree of disturbance from sand movements and historically high fishing pressures. The monitoring program detected a significant

reduction in seastar abundance and species richness around 2013 and 2014, which was associated with a wasting disease (Edmunds 2017; Edmunds *et al.* 2017).

The shallow sandy reefs of the region are significant habitat for greenlip abalone *Haliotis laevigata* (McShane *et al.* 1986). The population was been overfished and the fishery was subsequently closed. Although there has been recovery within the Port Phillip Heads Marine National Park at Point Nepean and Lonsdale Bight, abundances have remained very low at Point Franklin (Edmunds *et al.* 2017).

A relatively high diversity of nudibranchs has been observed at all reefs around Port Phillip Heads (*e.g.* Figure 3.21). This may be related to the high abundance and diversity of sessile invertebrates that form their diet.

The shallow sandy areas of Point Nepean and eastward to Rosebud are important areas for annual breeding aggregations of the spider crab *Leptomithrax gaimardii* (Figure 3.22). Dense aggregations occur for a few weeks during moulting in winter along the northern shores of the Mornington Peninsula and Point Nepean (Figure 3.15). The crabs are vulnerable to both natural and human pressures and disturbances during the aggregation period. Following moulting and mating, the crabs disperse throughout the Port Phillip Heads area, but typically inhabit the intermediate and deep habitats, including the deep Entrance Canyon sponge gardens and the intermediate depth biogenic reef clump habitat, such as in Capel Sound (Matt Edmunds, *pers. obs.*).

Moderate exposure reefs are inhabited over the winter months by the giant cuttle *Sepia apama* (Figure 3.23). The reef at Point Franklin is the easternmost extent of this species in Port Phillip Heads. The significance of these reefs to their population dynamics, such as for mating and breeding, is unknown.

3.5.3 Fishes

The fish assemblages vary significantly between reefs in the Port Phillip Heads region. The artificial Popes Eye structure is Victoria's oldest fully protected marine protected areas and has one of the highest densities and diversity of shallow reef fishes in Victoria. Most of the other shallow reefs in the region have moderate to low density and diversity of mobile fishes, reflecting both the predominantly low profile reef and high degree of fishing pressure. The reef at Point Franklin is particularly depauperate of fishes and is is subject to intense fishing pressure, both from anglers and novice spear fishers. Most observed fishes are small or inedible, including cowfishes, globefish, leatherjackets and cryptic wrasses. The Portsea area has sporadic sightings of unusual cryptic and sedentary fishes, including anglerfish, warty prowfish and goblinfish.

In the latter years of the Victorian Subtidal Reef Monitoring Program (ending in 2015), there was notable recruitment of western blue grouper *Achoerodus gouldii* within marine protected areas. This species is a large, top-order reef predator but has been

largely absent from Victorian reefs in recent decades, being high vulnerable to over-fishing. A small number of individuals were repeatedly sighted in the Point Lonsdale and Nepean Bay regions of the Port Phillip Heads Marine National Park (Edmunds *et al.* 2017).

The Port Phillip Heads region supports a high abundance of southern blue devilfish *Paraplesiops meleagris*. This species inhabits crevices and caverns and its abundance in this area reflects the habitats provided by the highly eroded calcarenite reefs.

The shallow reefs inside Port Phillip Heads are significant habitat for colonies of weedy sea dragon *Phyllopteryx taeniolatus* (Figure 3.24). Sea dragons are an EPBC and Victorian Fishery Act listed species and its restriction to colonies in particular habitats, which makes its shallow aggregations vulnerable to disturbance. The sea dragon colonies have a high site fidelity with home ranges generally being in the 100s of metres. Most of the colonies are associated with *Amphibolis* seagrass beds, but also the fringes of kelp beds. Significant colonies occur at Queenscliff and Portsea. At Portsea, the highest abundances occur between the Portsea Pier and Police Point. The sea dragon is Victoria's official marine emblem and highly popular with divers and photographers.

3.5.4 Wildlife

Significant seal haul outs occur at the artificial structures of Chinamans Hat and Popes Eye at the eastern end of The Great Sands. The artificial structures at Popes Eye are an important Australasian Gannet breeding site. Resident dolphin groups range throughout the Port Phillip Heads region but with an important feeding area being along the Triconderoga Bay region of Point Nepean.

3.6 Management Areas

The nearshore area at Portsea and Point Franklin is within the DELWP designation of the Port Phillip Heads Marine Asset Area Group, reflecting the many different values and natural assets within the region (Kent and Jenkins 2012).

The nearshore reefs have been identified as important for abalone fishery management, however the greenlip abalone fishery is closed to both commercial and recreational fishing in Port Phillip Bay.

The Quarantine Station is within the Triconderoga Bay dolphin sanctuary. This zone is designed to reduce the impacts from recreational vessels on dolphin feeding and resting congregations in the area.

The nearshore environment at the Quarantine Station is not covered by any other area-based management zone, however there are important management zones in adjacent waters (Figure 3.9 to 3.11):

- Port Phillip Heads Marine National Park, including:

  - Point Lonsdale and Lonsdale Bight;
  - Point Nepean; and
  - Portsea Hole;
- FFG listed Port Phillip Heads Entrance Canyon listed community;
- Point Nepean National Park; and
- Shipping channels.

A substantial area of the Port Phillip Heads region is managed shipping traffic and channel areas. This includes depth-managed channels, turning areas and dredged material sites. The proposed subsea installations would be outside commercial vessel transit areas.

3.7 Significant Sites and Features

3.7.1 Types of Priority Marine Features

Significant and priority features in the Point Nepean region include:

- Historical scientific survey sites of Royal Society of Victoria;
- Long-term intertidal, subtidal and deep reef ecological monitoring sites;
- Sponge and seaweed type locality sites;
- Point Nepean remnant coastal vegetation;
- Point Nepean bird area;
- Listed species;
- Sites of geomorphological significance;
- Sites of historical significance, including shipwrecks;
- Areas of notable ecosystem services.

3.7.2 Sites of Scientific Significance

The survey sites of Wilson (1895) were the predominant collection areas for the Royal Society of Victoria survey in the 1880s. Although primarily taxonomic based, those surveys provided important benchmark information from the area prior to considerable human changes, such as from fishing, dredging, blasting, introduced species and climate change. Two sampling areas, Stations I and VII, included the Quarantine Station area and new species were described from these sites (Figure 3.13).

The next set of benchmarks surveys occurred from 1957 to 1970 by the National Museum of Victoria, now Museum Victoria (Macpherson and Lynch, 1966). This was one of the few surveys to systematically sample the whole of Port Phillip Bay. A dredging transect was located at the Quarantine Station (Figure 3.13, Area 59 Site 224), however this was mostly on bare sand. Some seaweeds typical of low profile reef were sampled, indicating patch reef occurs in the area (Hope-Black 1971). This survey program later added bay-wide littoral rock survey, including sites at Point Nepean and Queenscliff (King *et al.* 1971).

Long term reef monitoring programs were established at Port Phillip Heads as part of marine protected areas performance assessment monitoring. The Subtidal Reef Monitoring Program was established at Port Phillip Heads in 1998 and the Intertidal Reef Monitoring Program was established in 2004 (Figure 3.14; Edmunds *et al.* 2015, 2017). These programs ran to 2015 and is the most comprehensive and longest running marine ecological time series in Victoria. The monitoring has been vital in understanding ecological processes and states. These sites are invaluable for future environmental status assessments and understanding recovery from management of activities and pressures.

The deep circalittoral reefs also have scientifically significant monitoring sites. These were established in the Entrance Canyon and Portsea Hole as part of the Channel Deepening Project (Figure 3.16; Edmunds *et al.* 2006, 2007, 2009). These sites were critically important in describing the geoforms, biotopes and morphospecies of deep reefs in the region and provide an important benchmark for future surveys and environmental management. As noted above, The Rip and Entrance Canyon environments are critically important with respect to ecosystem services of Port Phillip Bay. The geoforms govern the water quality and tidal/sea level characteristics of the whole of Port Phillip Bay and the geoforms are somewhat stabilised by the covering seaweed and sponge garden assemblages.

The Portsea area of Point Nepean is the type locality for at least 13 species of sponges and ascidians, including Portsea Pier and the area midway between Portsea Pier and Police Point. The wider region is the taxonomic type locality for hundreds of sponge, ascidian and seaweed species.

3.7.3 Listed Marine Species

***Chiton* Bassethullia glypta**

The Portsea area is habitat for the FFG listed chiton *Bassethullia glypta*. This chiton occurs in the littoral and upper sublittoral rocky shores along northern Nepean Peninsula shores and in the Flinders and Mushroom reef region. The species has been reported from Point Franklin and may possibly occur at Police Point, immediately east of the Quarantine Station. This species appears to be associated with gravelly and rubble littoral habitat, extending into the sublittoral fringe.

***Seagrass* Zostera nigricaulis**

The sublittoral seagrass *Zostera nigricaulis* is listed on the FFG Act as threatened. This species once covered large areas of sediment banks in the Port Phillip Heads area, particularly east of Point Franklin. Large seagrass beds occurred around Mud Islands, Camerons Bight, Sorrento Bank and Capel Sound (Blake and Ball 2001). The abundance declined substantially during the millennial drought, including much of the areas at Mud Islands, Sorrento Bank and Camerons Bight. The present extent in the region is unknown with no broadscale mapping since the mapping survey in 2000.

Although *Zostera nigricaulis* plants occur sporadically on sediments amongst reef at Portsea, Nepean Bay and Lonsdale Bight, there have been no prominent habitat or biotope forming beds west of Point Franklin.

***Giant Kelp* Macrocystis pyrifera**

Giant kelp forests of *Macrocystis pyrifera* were once common through the Port Phillip Heads region. This community type is listed as an EPBC Act ecological community and is vulnerable to changes in nutrient regimes and temperature through climate change. This is the only species that produces an overstorey seaweed canopy in Victoria, providing substantial biogenic habitat through the water column. It is associated with particular assemblages of seaweeds, invertebrates and fishes beneath the overstorey canopy. *Macrocystis* used to be particularly abundant in Lonsdale Bight and was common throughout the western region of Port Phillip Heads. *Macrocystis* coverage and abundance declined gradually up to the beginning of the millennial drought, reduced to isolated pocket-stands. At Port Phillip Heads, there were remnant stands in Nepean Bay and Popes Eye. Those stands had disappeared by 2002 and most of the open coast stands had disappeared by 2004. Macrocystis habitat is essentially extinct Victoria with low density populations occurring near areas with higher nutrient input such as river mouths (*e.g.* Glenelg River) or sewage outfalls (*e.g.* Warrnambool).

Although *Macrocystis* forest is no longer a direct management consideration for the region, it identifies an important learning:

- There is a need to manage and maintain the ecological integrity of existing kelp bed communities, even though they are common and abundant (as were forests of *Macrocystis*).

There is evidence of rapid declines in existing kelp bed species through climate change and disease outbreaks. Disease events were observed along the Nepean coast for *Ecklonia* and *Phyllospora* kelp beds and ‘common kelp *Ecklonia radiata* kelp beds have disappeared from long term monitoring sites along the Surf Coast (Edmunds *et al.* 2015).

Seahorses, Pipefishes and Seadragons Family Syngnathidae

The fishes of the Family Syngnathidae include sea horses, pipefishes and sea dragons and the whole Family is listed under the EPBC Act. As described above, sea dragon colonies occur close to the Quarantine Station, particularly on the *Amphibolis* seagrass reef. Pipe fishes are highly abundant in seagrass *Zostera nigricaulis* beds and on some shallow sheltered reefs dominated by mixed subcanopy brown seaweeds. Larger sea horses *Hippocampus abdominalis* occur on the jetties in the region and there are isolated colonies of short-headed seahorses *Hippocampus breviceps* on sandy-*Caulocystis* seaweed habitat in the Sorrento region. Syngnathidae species often occur in colonies or isolated habitat patches. Their conservation is largely based around preservation of their preferred habitat and biotopes.

3.7.4 Shore and Wetland Birds

Significant wetland bird habitat occurs in the region at Swan Bay and Mud Islands. Point Nepean is not a significant wetland bird area, however it is recognised as important for both habitat and feeding. The area contains a major proportion of the remnant native vegetation on the southern Mornington Peninsula and represents an important coastal habitat for native wildlife.

3.7.5 Coastal Vegetation

The Point Nepean remnant vegetation features a range of coastal communities including coastal dune scrub, coastal banksia woodland, coastal grassy forest, riparian forest, coastal tussock grassland, coastal heathland, swamp heathland and sand heathland. Significant plant species include Rare Bitter-bush, Coast Bitter-bush, Native Sow-thistle, Dune Thistle, Coast Daisy-bush, Sticky Daisy-bush, *Caladenia patersonii*, *Corybas despectans*, *Nicotiana maritima*, *Pteris comans*, *Pterostylis cucullate* and *Adiantum capillusveneris.*

3.7.6 Geomorphology

Point Franklin is listed as a site of State geomorphological significance as an unusual calcarenite cliff in Port Phillip Bay (Site GSS144).

3.7.7 Historic and Social Values

Sites of historical significance comprise Sheltons Lime Kiln, Fort Franklin, Fort Nepean and the Quarantine Station itself. There are no recorded historical shipwrecks near the Quarantine Station, however an anchor occurs offshore from the station and is a popular dive site. There are a considerable number of historical shipwrecks elsewhere in the Port Phillip Heads region.

Diving is a significant recreational activity in the region with popular sites at having prominent seascapes, biodiversity, fish abundance, shipwrecks, technical difficulty or a sheltered training site. There are several popular recreational dive sites in the Portsea area and this reflects the diversity of natural values, including Portsea Hole, *Amphibolis* beds with seadragon colonies and the diversity of fauna on Portsea Pier. Portsea is also a popular training and beginner diving area.

The beaches and nearshore areas or Point Nepean are highly significant for recreation and boating activities.

3.8 Marine Pests and Pathogens

There are numerous marine pests in Port Phillip Bay, however the most concerning in in the Point Nepean region is the invasive kelp wakame *Undaria pinnatifida*. This species has been observed in the region since 2009, however its present status is unknown. *Undaria* has been progressively invading and transforming shallow reef communities around Port Phillip Bay, permanently replacing natural *Ecklonia* kelp communities with a different structural and functional habitat. It is inevitable that the *Ecklonia* kelp community at Point Franklin will be transformed at some stage to *Undaria* beds. *Undaria* can also infest the woody stems of *Amphibolis* seagrass reefs and may possibly cause successional sifts on those reefs.

It is highly advantageous to delay and slow the spread of *Undaria*, particularly to other vulnerable sites elsewhere in Victoria. Such areas include Flinders and Westernport, Bunurong, Waratah Bay, Corner Inlet and Portland Bay. Similarly, the Point Nepean area is vulnerable to the introduction of new marine pests.

Port Phillip Heads seaweed assemblages include a variety of *Caulerpa* and sub-canopy brown seaweeds. The presence of these groups indicates the region may be vulnerable to infestations of similar species, such as *Caulerpa taxifolia*, *Caulerpa cylindrocarpa* and *Sargassum muticum*. There are also invasive marine pests that can infest circalittoral, filter feeding communities, such as colonial ascidians *Didemnum perlucidum* and *P. vexillum*.

Because marine pests can cause catastrophic ecosystem changes, it is essential the project maintains strict controls on the potential for pest translocation, including through construction vessels and equipment coming to the site, and those vessels travelling to unaffected sites. There are also

Seaweed and seastar die-off events were observed during the Subtidal Reef Monitoring Program, including at Point Franklin and Nepean Bay between 2009 and 2014. The seaweed communities showed signs of recovery while the seastar populations remained low, up to the end of the program in 2015. Such events have lead to substantial biotope changes along the open coast in Victoria and Tasmania. Disease events can be a precursor to the establishment of marine pests or cause successional changes in ecosystem structure.

There have been significant disease events that have affect large sections of the Victorian marine environment. Since the 1980s, aquaculture and native stocks of flat oyster in Port Phillip Bay have been periodically decimated by outbreaks of the parasite *Bonamia*. This has lead to losses of seafloor habitat and integrity, including mixed/coarse sediments and biogenic oyster reefs. Outbreaks of pilchard herpes virus occurred in 1995 and 1998, thought to have been introduced with American pilchard

feed for tuna aquaculture in south Australia (Whittington *et al.* 2008). This virus caused severe mortality of pilchards and resulted in lasting and significant ecosystem effects across southern Australia, including Victoria. An abalone viral ganglioneuritis outbreak occurred in western Victoria in 2006 with approximately 80 % mortality. A subsequent outbreak occurred in 2021. The origin and vectors of the virus were unclear, with the evidence suggesting the virus was endemic, but possibly amplified and/or modified in aquaculture facilities, with subsequent infection of wild stocks. Some persistence in aquaculture effluent drains, settling pods or vectors such as rodents has been suggested, but not confirmed.

The above examples highlight the need for strict biosecurity controls associated with the operation of aquarium, aquaculture and research facilities. The implications can have catastrophic consequences for ecosystems and ecosystem services. These can arise from seemingly trivial and innocuous events, hence the need for strict operational protocols.

3.9 Sensitivity of Sponge Gardens

The Port Phillip Heads area is a sponge biodiversity hotspot. Sponge communities are susceptible to die-off events which generally have wider ecosystem consequences:

- Florida Keys mass die off – Cyanobacteria blooms and hurricanes, recovery 10-15 years and affecting habitat for fishery species (Butler *et al.* 1995; Stevely *et al.* 2010);
- Port Phillip Heads – Rock dredging and substrate erosion causing rock fall impacts and event of overabundance of colonising species (Edmunds *et al.* 2006, 2009);
- Mediterranean Sea die off – Temperature and cyanobacteria related (Cerrano *et al*. 2000; Barrabou *et al.* 2009; Cebrian *et al.* 2011);
- Lough Hyne, Ireland – summer thermal stratification and deoxygenation of lower waters (Bell 2020; Shuster *et al.* 2021), mass mortality event prior to 2015 (Micaroni *et al.* 2021);
- Fiordland Sounds, New Zealand – mass sponge bleaching associated with marine heat waves (Victoria University of Wellington, 2022).
- Sponge disease outbreaks – susceptible to epidemic outbreaks, increasing prevalence in Mediterranean, Caribbean, Cozumel, Papua New Guinea and Great Barrier Reef (Smith 1941; Vacelet *et al.* 1994; Webster 2007; Webster and Taylor 2012).

The susceptibility of sponge communities to mass die-off events and to diseases is pertinent to the project. Particular attention needs to be given to prevent the release of any biological or chemical agent that could affect sponges, particularly with respect to any amplification of pathogens in the research facility. The release of any agent that could lead to mass sponge infection and die off would have a catastrophic risk to the ecosystem. Given sponge gardens may have a role in regulating and controlling seascape stability and erosion, their protection is of significance to tidal exchange through the Heads and the Port Phillip Bay environment as a whole.

3.10 Summary

The Point Nepean marine environment has high conservation values with respect to:

- FFG listed chiton *Bassethullia glypta*;
- FFG listed sponge garden community;
- Seagrass *Amphibolis* and sandy veneer low profile reef biotopes:
- Red algal seaweed diversity;
- Moderate energy kelp bed biotopes;
- Sponge and ascidian diversity;
- Listed Weedy seadragon colonies;
- Burrunan dolphin habitat;
- Site of geomorphological significance – calcarenite cliff;
- Point Nepean remnant coastal vegetation and bird area;
- National Parks, marine asset areas and Triconderoga dolphin sanctuary.

Some of these values are sensitive to impacts, such as the restricted distribution of seadragon colonies and the susceptibility for mass die-off of kelp beds and sponge gardens from pathogen outbreaks. There are two domains for the assessment of impacts of this project:

- Areas close to the site that may be largely impacted by physical disturbance and introduction of energy, causing behavioural disturbances; and
- The potential for wider, regional impacts through release of contaminants and biological agents.

There have been few scientific studies in the region in last decade. Key knowledge gaps addressed by the field studies included:

- The nature and location of patch reef and biogenic *Pyura* habitat near the Quarantine Station;
- The nature of any remnant native vegetation near proposed works on the site;
- The presence of any listed chiton *Bassethullia glypta* and nature of other littoral rock biota, including lichens, at Police Point; and
- The present status of the marine invasive species, such as *Undaria*.

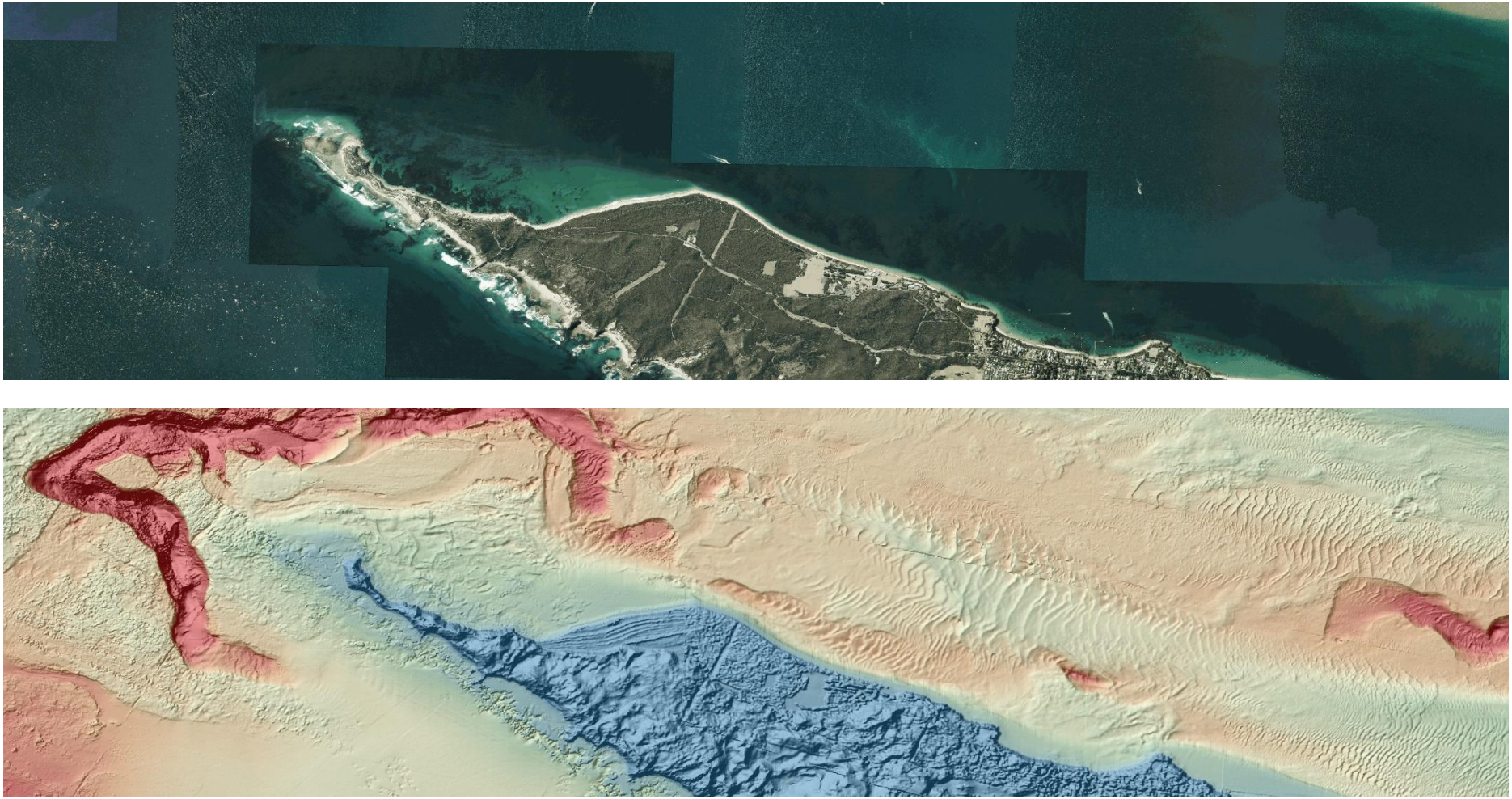


Figure 3.1. Project area environmental setting: CoastKit aerial photography and lidar bathymetry in the Point Nepean region.

Figure 3.2. Project area local seascape: CoastKit lidar bathymetry.

Figure 3.3. CoastKit lidar reflectance in the project region. Darker regions indicate areas of higher absorbance, including by benthic vegetation.

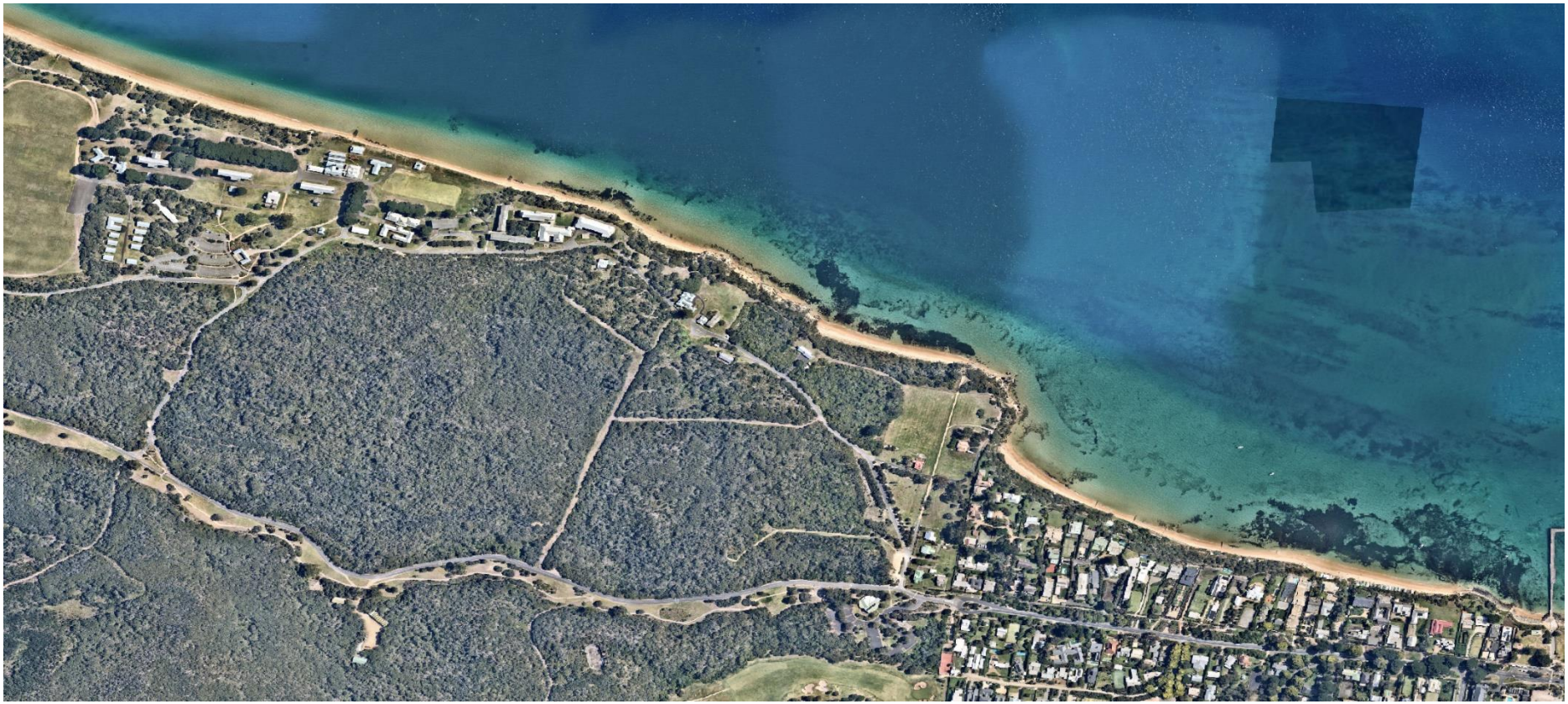


Figure 3.4. Aerial image of nearshore habitats in the project region (NearMap, 22 January 2021).

Figure 3.5. Aerial image of nearshore habitats at the project location (NearMap, 22 January 2021). Legend: (a) indicative inlet and outlet infrastructure; (b) probable *Pyura* biogenic reef; (c) probable low profile sandy veneer reef with diverse seaweeds; (d) seagrass *Amphibolis* on sandy veneer reef; (e) littoral rock and potential habitat for chiton *Bassethullia glypta*; and (f) supralittoral and coastal vegetation.

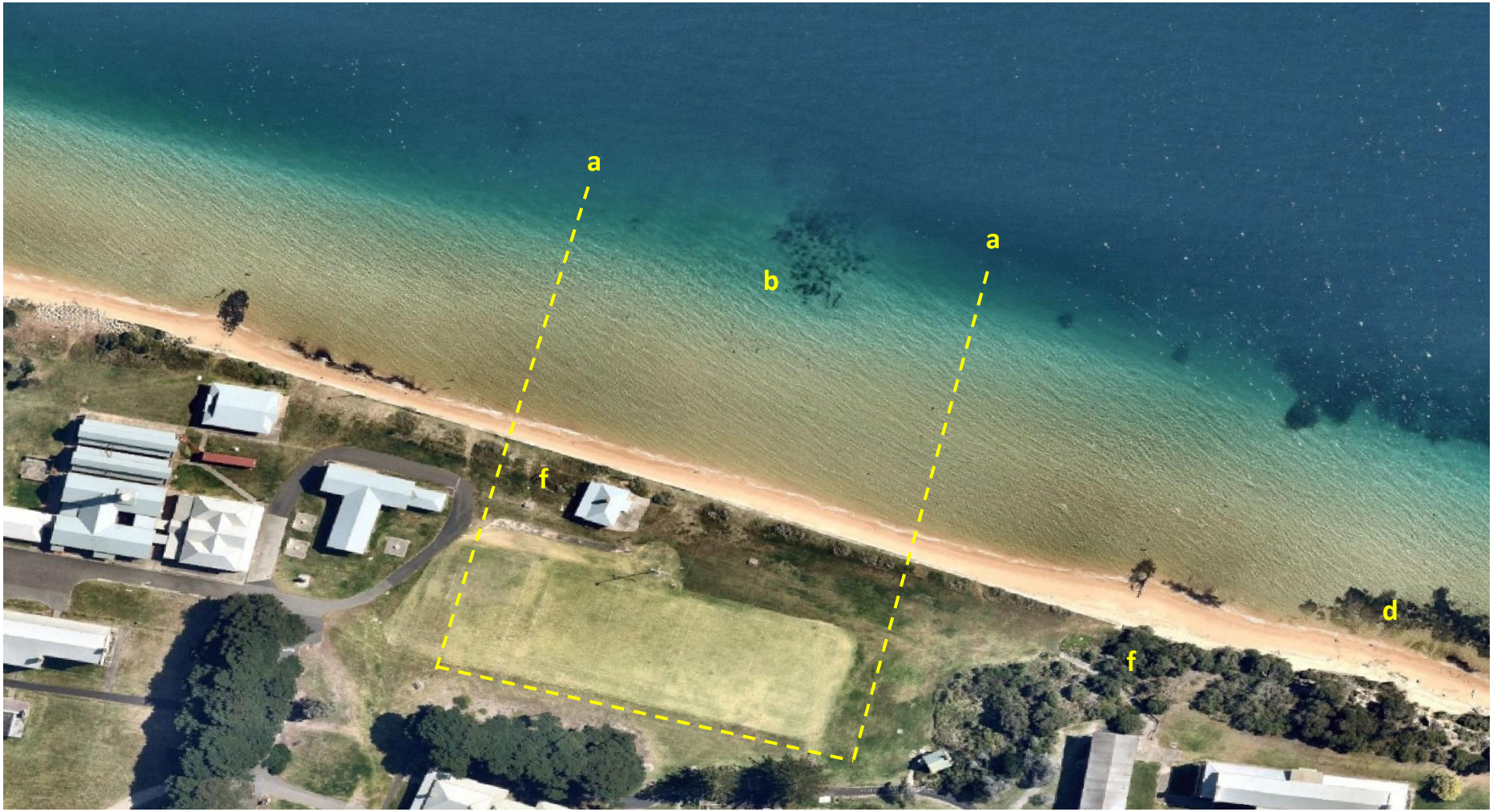


Figure 3.6. Aerial imagery of the proposed works area (NearMap, 22 January 2021). sources: DELWP and NearMap). Legend: (a) indicative inlet and outlet infrastructure; (b) *Pyura* biogenic reef; (d) seagrass *Amphibolis* on sandy veneer reef; and (f) supralittoral and coastal vegetation.

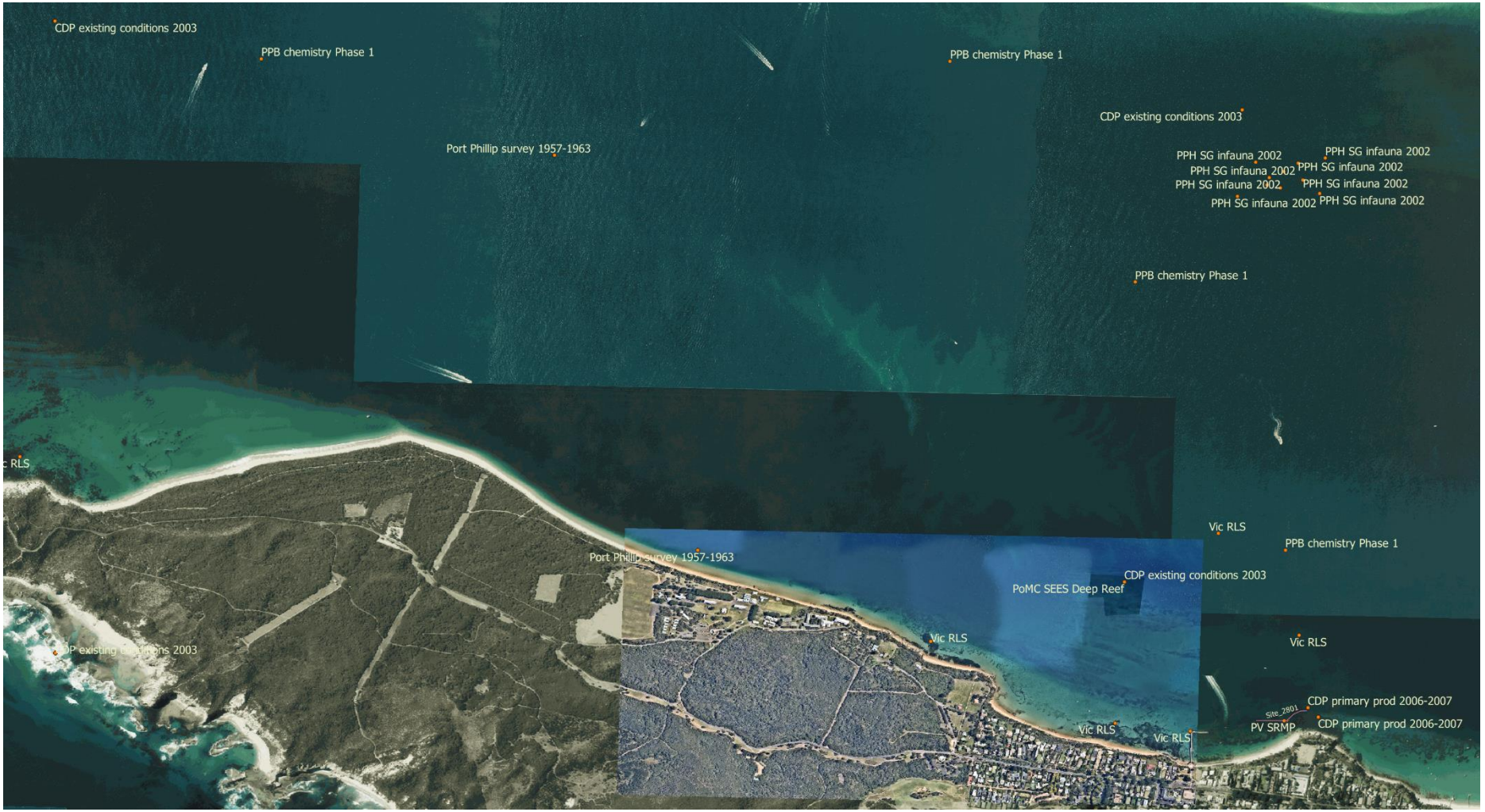


Figure 3.7. Historical surveys from CoastKit geo-bibliography records.

Figure 3.8. CoastKit biotope ground truthing records or northern Point Nepean.

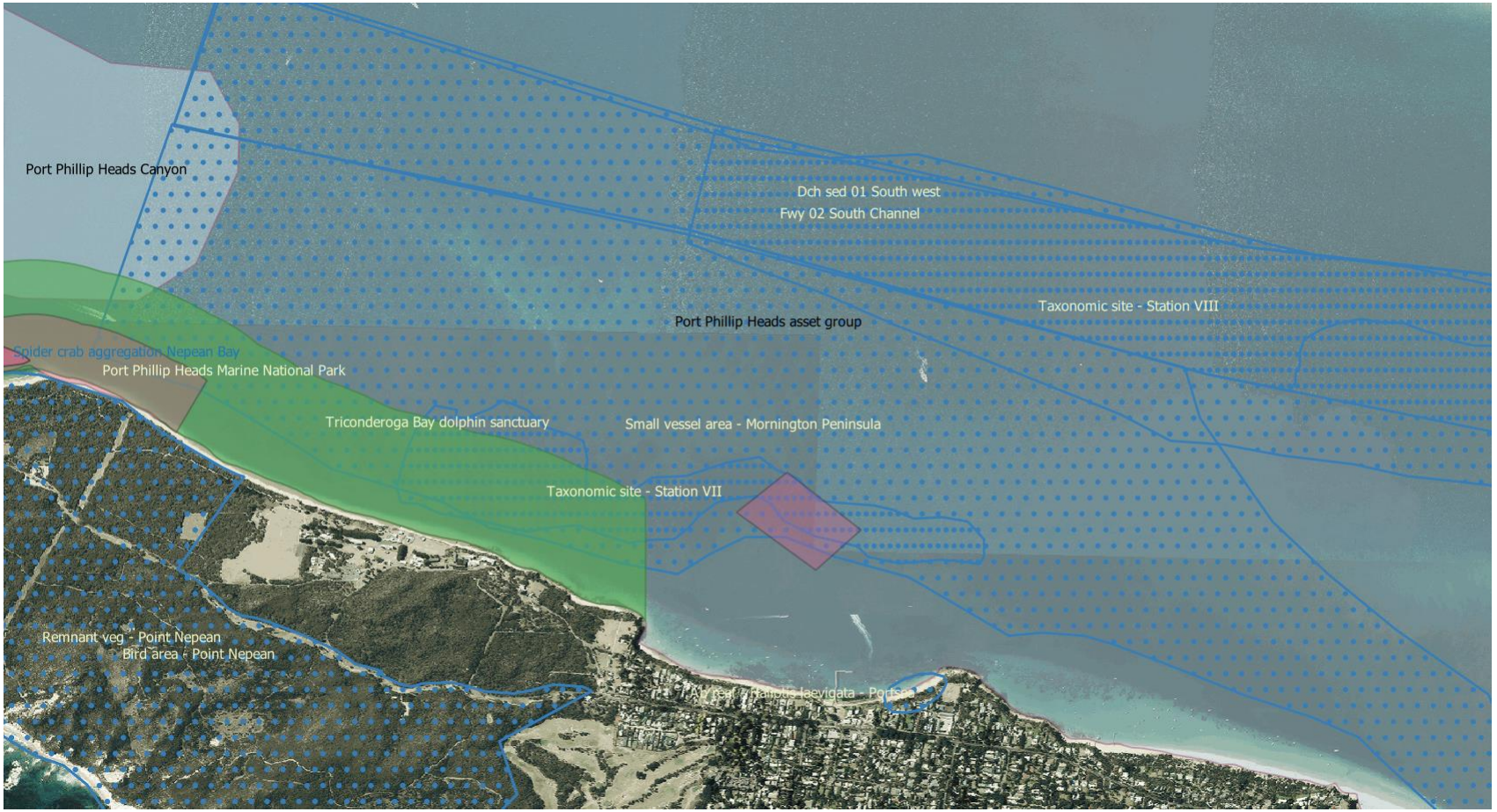


Figure 3.9. CoastKit marine management and asset areas near the Quarantine Station.

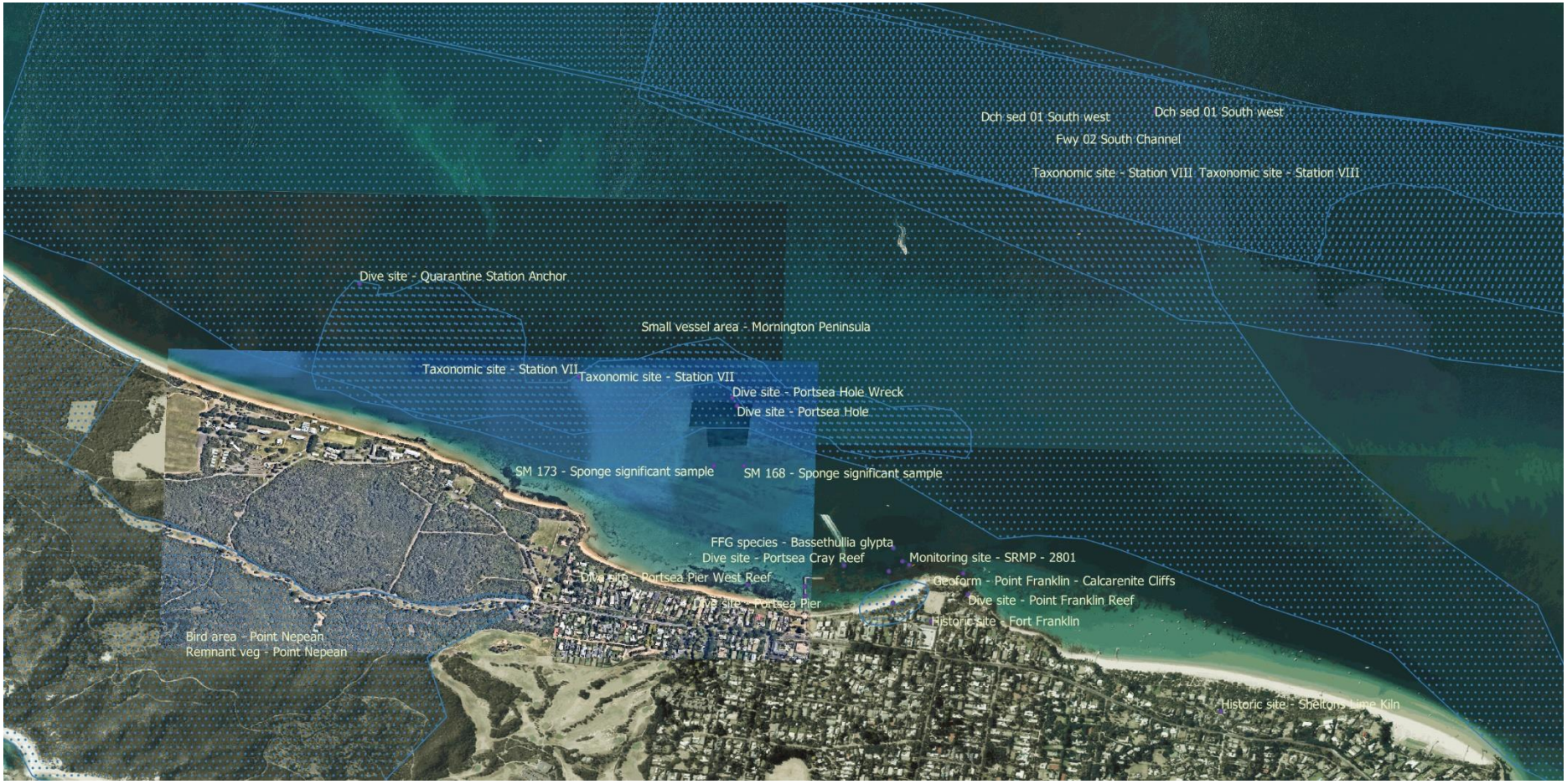


Figure 3.10. CoastKit priority marine feature records near the Quarantine Station.

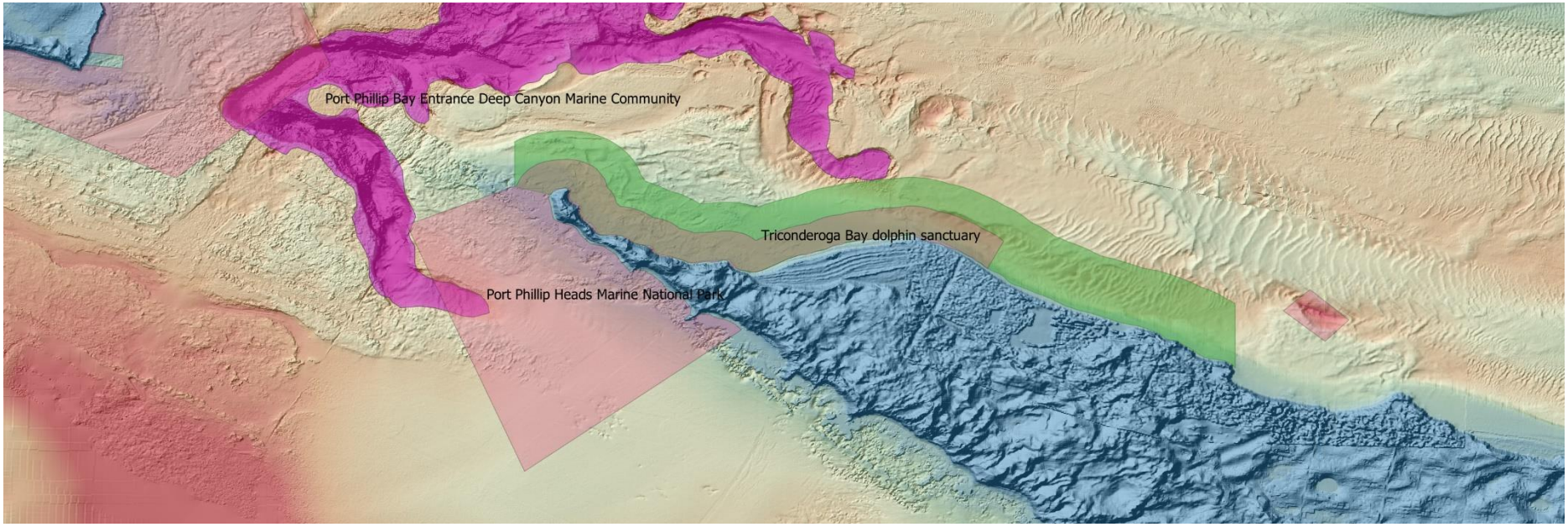


Figure 3.11. Marine protected areas in the Point Nepean region: Port Phillip Heads Marine National Park; FFG listed Entrance Canyon Marine Community; and Triconderoga Bay dolphin sanctuary.

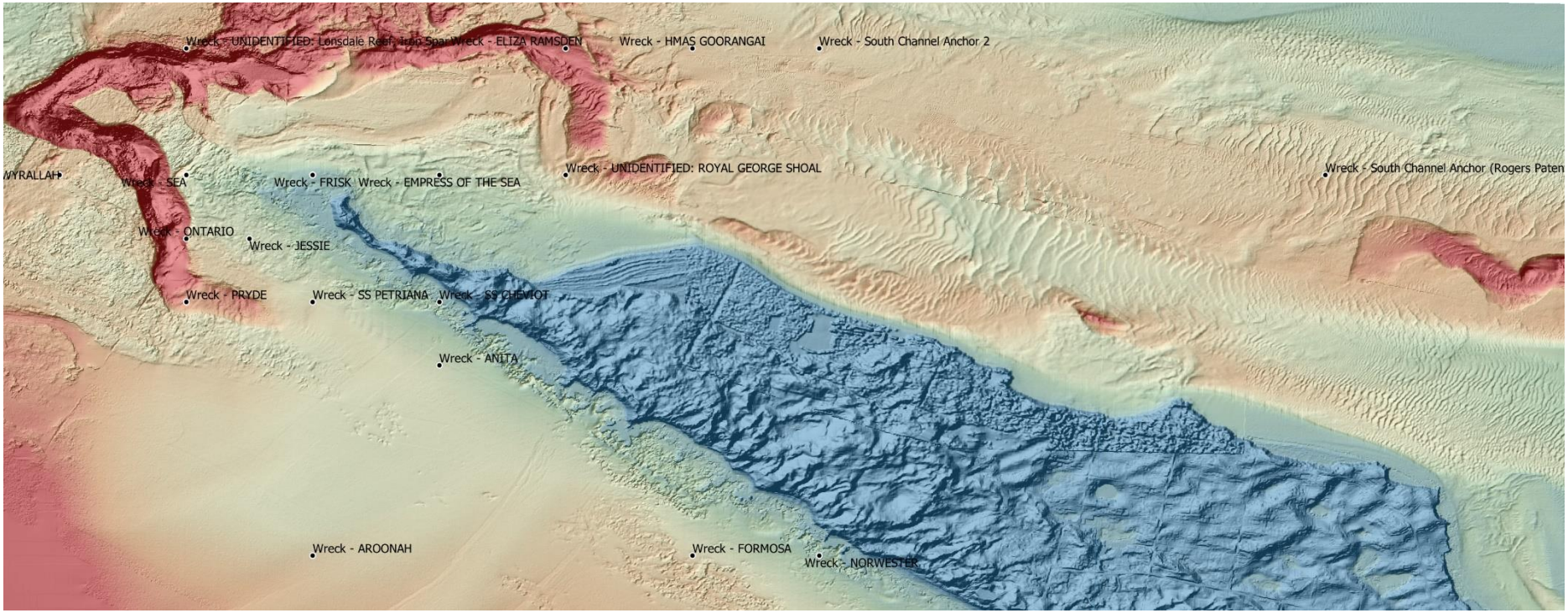


Figure 3.12. Approximate locations of historic shipwrecks from the national database.

Figure 3.13. Location of significant scientific benchmark survey sites near Point Nepean. Legend: (Pink) Royal Society of Victoria 1880s survey (Wilson 1895); (Cyan) Museum Victoria baywide sublittoral survey 1957-62 (Macpherson and Lynch 1966); (Orange) Museum Victoria baywide littoral rock survey (King *et al.* 1971).

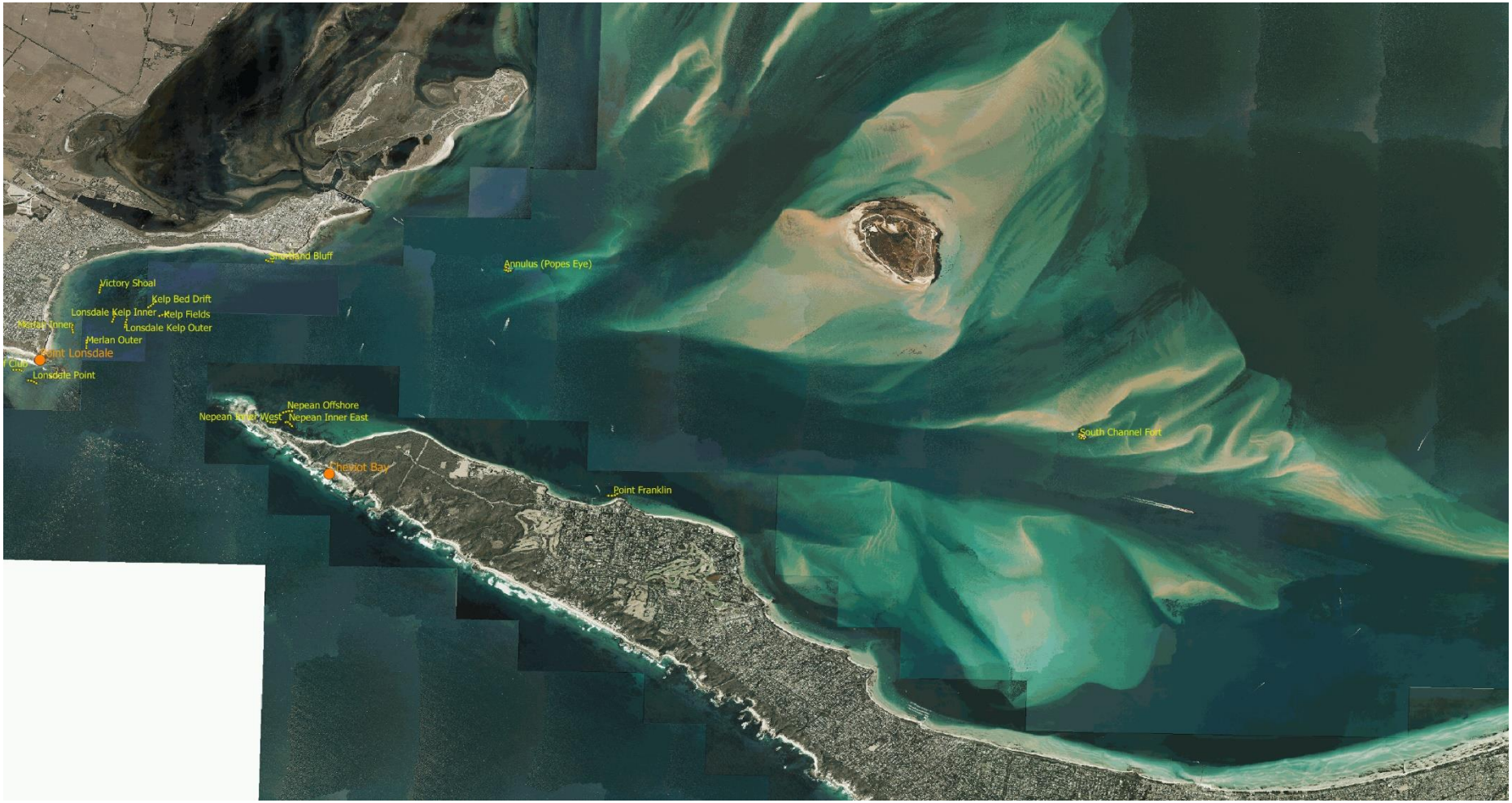


Figure 3.14. Location of long-term monitoring sites near Point Nepean. Legend: (Yellow) Subtidal Reef Monitoring Program, 1998-2015 (Edmunds 2017; Edmunds *et al.* 2017); (Orange) Intertidal Reef Monitoring Program, 2004-2014 (Edmunds *et al.* 2015).

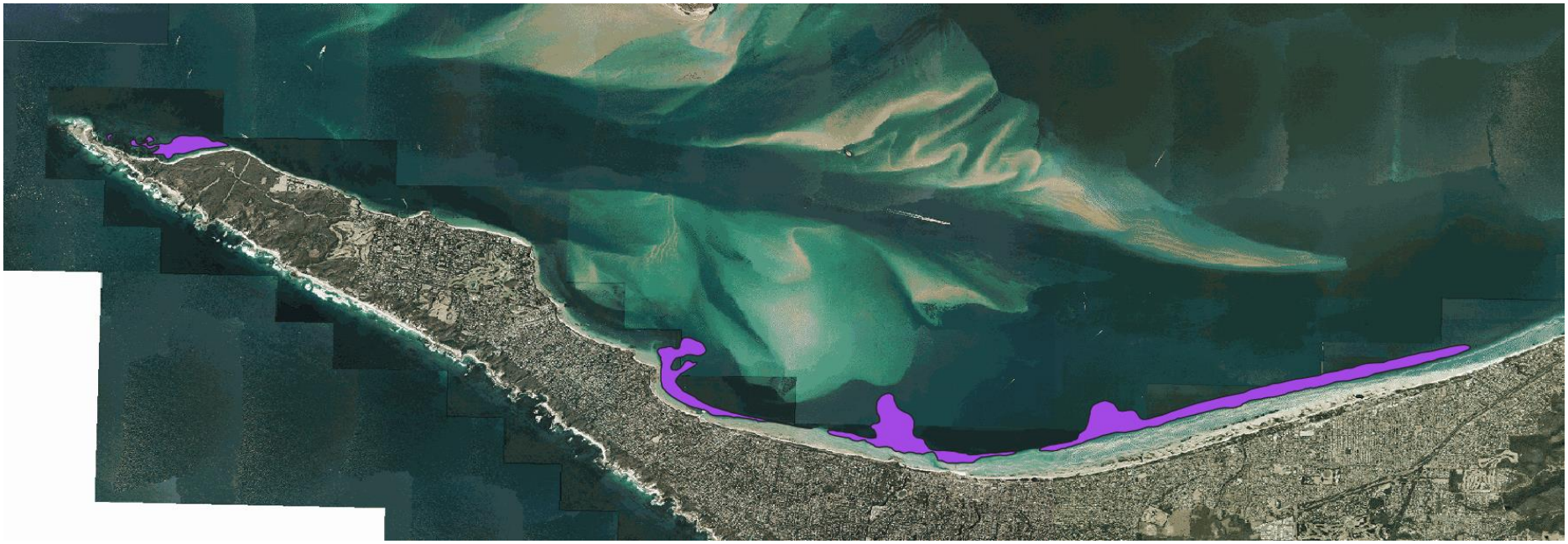
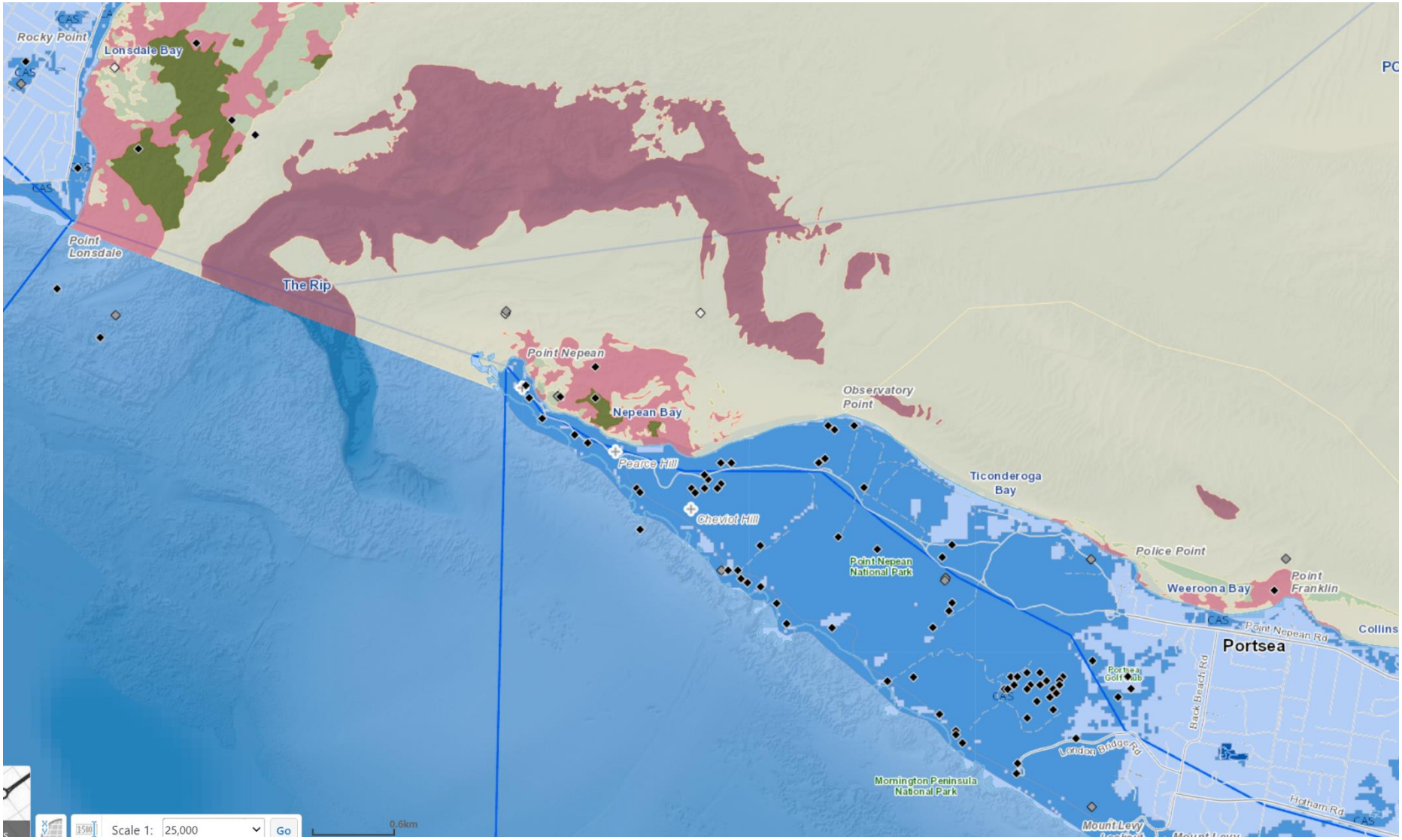


Figure 3.15. Location of spider crab *Leptomithrax gaimardii* winter mating aggregation areas (DELWP CoastKit Features Atlas).


Rocky Point
Lonsdale Bay
Point Lonsdale
The Rip
Point Nepean
Nepean Bay
Observatory Point
Pearce Hill
Chevlot Hill
Ticonderoga Bay
Police Point
Point Nepean National Park
Weeroona Bay
Point Franklin
Point Nepean Rd
Portsea
Collins
Back Beach Rd
London Bridge Rd
Mornington Peninsula National Park
Hotham Rd
Mount Levy
Scale 1: 25,000
Go
0.6km

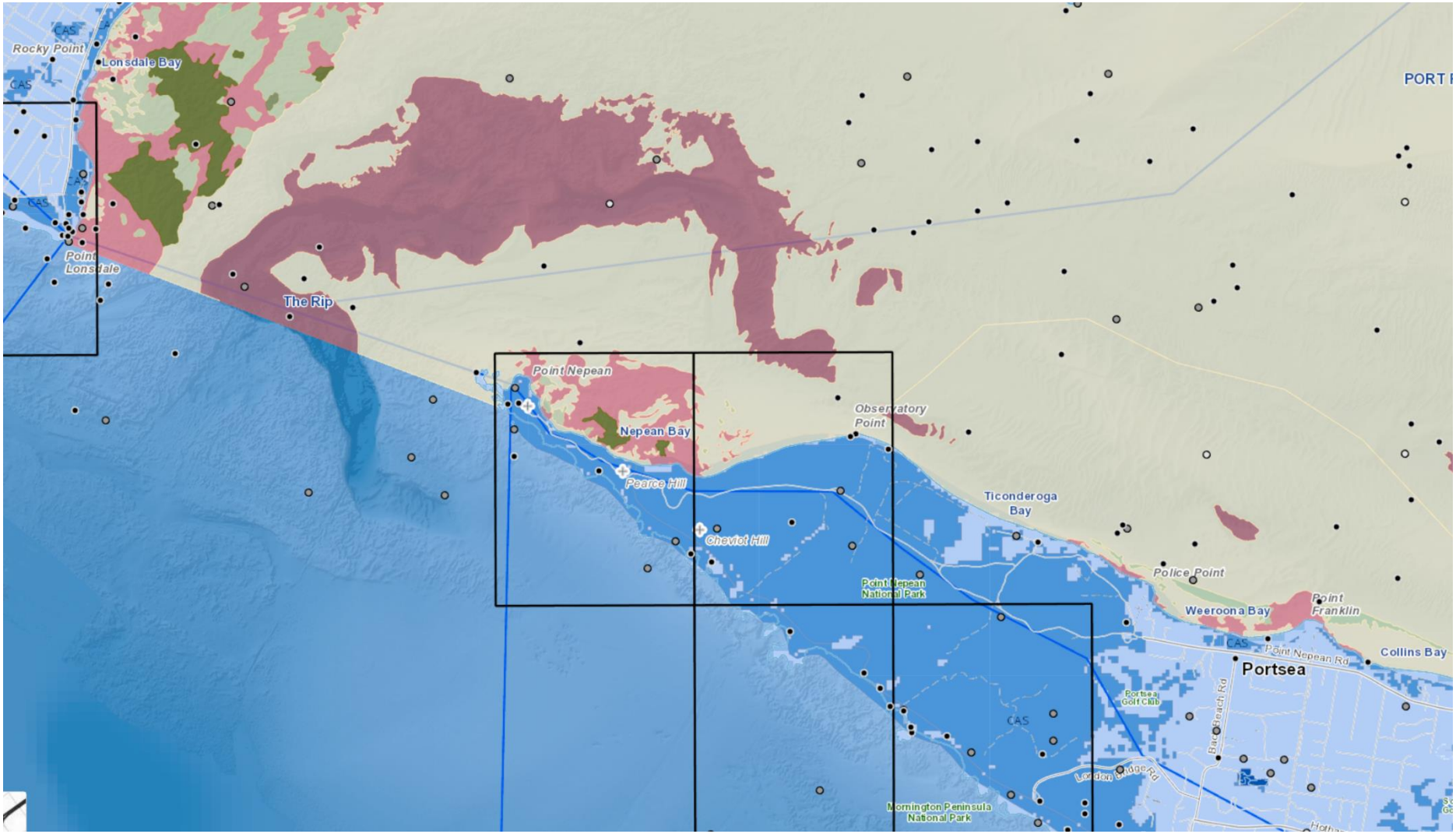

Rocky Point
Lonsdale Bay
CAS
Point Lonsdale
The Rip
Point Nepean
Nepean Bay
Observatory Point
Pearce Hill
Cheviot Hill
Ticonderoga Bay
Police Point
Point Nepean National Park
Weeroona Bay
Point Franklin
Collins Bay
Point Nepean Rd
Portsea
Portsea Golf Club
Mornington Peninsula National Park

Table 3.2. Biotopes documented in the Point Nepean region, 1998-2015, CoastKit Biotope Atlas.

Enviro	Broad Habitat	Habitat Complex	Code	Biotic Title
Marine	Littoral rock	Moderate energy	ba1.2	Moderate energy littoral rock [unsurveyed]
Marine	Littoral sediment	Sand	ba2.2	Littoral sand
Marine	Infralittoral rock	Moderate energy	ba3.211	*Amphibolis antarctica* monospecific stand on moderate energy rock
Marine	Infralittoral rock	Moderate energy	ba3.213	*Amphibolis* with *Ecklonia*
Marine	Infralittoral rock	Moderate energy	ba3.214	*Amphibolis* with *Seirococcus*
Marine	Infralittoral rock	Moderate energy	ba3.215	*Amphibolis* with *Cystophora* species
Marine	Infralittoral rock	Moderate energy	ba3.216	*Amphibolis* with *Caulerpa* species and other green seaweeds
Marine	Infralittoral rock	Moderate energy	ba3.217	*Amphibolis* with various *Cystophora* and *Caulerpa* species
Marine	Infralittoral rock	Moderate energy	ba3.218	*Amphibolis* with *Macrocystis pyrifera*
Marine	Infralittoral rock	Moderate energy	ba3.221	Dense *Ecklonia radiata* canopy with crustose coralline algae, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.2211	Stunted *Ecklonia radiata* with crustose coralline algae, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.222	Dense *Ecklonia radiata* canopy with *Cladophora prolifera*, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.223	*Ecklonia radiata* and *Caulerpa brownii*, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.224	*Ecklonia radiata* cover with *Macrocystis pyrifera*, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.225	*Ecklonia radiata* and sub-canopy browns, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.226	*Ecklonia radiata* and *Phyllotricha decipiens*, moderate energy
Marine	Infralittoral rock	Moderate energy	ba3.233	Seirococcus axillaris dominated assemblage
Marine	Infralittoral rock	Moderate energy	ba3.234	*Phyllotricha decipiens* assemblage
Marine	Infralittoral rock	Moderate energy	ba3.235	*Phyllotricha decipiens* assemblage with *Caulerpa brownii* and *Caulerpa muelleri*

Enviro	Broad Habitat	Habitat Complex	Code	Biotic Title
Marine	Infralittoral rock	Moderate energy	ba3.236	*Sargassum spinuligerum* and *Cladophora prolifera* with *Cystophora moniliformis* and *Amphibolis antarctica*
Marine	Infralittoral rock	Moderate energy	ba3.237	*Sargassum spinuligerum* and *Caulocystis* on sandy veneer rock
Marine	Infralittoral rock	Moderate energy	ba3.238	Semi-exposed *Phyllotricha* and *Sargassum* species on moderate energy rock
Marine	Infralittoral rock	Moderate energy	Ba3.25	*Undaria* assemblages on moderate energy rock
Marine	Infralittoral rock	Moderate energy	ba3.26	Tide-swept *Sargassum* mixed brown and red algal assemblage with sandy veneers
Marine	Infralittoral rock	Moderate energy	ba3.27	Tide-swept lower infralittoral red algal assemblage with sponges
Marine	Circalittoral rock	Moderate, tide	ba4.2b1	Portsea Hole circalittoral rock community.
Marine	Circalittoral rock	Strong tide, sandy	ba4.221	Entrance Canyon 1
Marine	Circalittoral rock	Strong tide, sandy	ba4.222	Entrance Canyon 5
Marine	Circalittoral rock	Strong tide, sandy	ba4.223	Entrance Canyon 10
Marine	Circalittoral rock	Strong tide, red algae	ba4.231	Entrance Canyon 4
Marine	Circalittoral rock	Strong tide, red algae	ba4.232	Entrance Canyon 7
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.241	Entrance Canyon 6
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.242	Entrance Canyon 12
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.243	Entrance Canyon 2
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.244	Entrance Canyon 3
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.245	Entrance Canyon 21
Marine	Circalittoral rock	Strong tide, hydroid fan	ba4.246	Entrance Canyon 16
Marine	Circalittoral rock	Strong tide, sponge-bryozoan	ba4.251	Entrance Canyon 19
Marine	Circalittoral rock	Strong tide, sponge-bryozoan	ba4.252	Entrance Canyon 20
Marine	Circalittoral rock	Strong tide, wall	ba4.261	Entrance Canyon 14
Marine	Circalittoral rock	Strong tide, wall	ba4.262	Entrance Canyon 23
Marine	Circalittoral rock	Strong tide, jewel anemone	ba4.271	Entrance Canyon 8
Marine	Circalittoral rock	Strong tide, jewel anemone	ba4.272	Entrance Canyon 22

Enviro	Broad Habitat	Habitat Complex	Code	Biotic Title
Marine	Circalittoral rock	Strong tide, deep hydroid-bryozoan	ba4.291	Entrance Canyon 18
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a1	Entrance Canyon 9
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a1	Entrance Canyon 11
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a2	Entrance Canyon 13
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a3	Entrance Canyon 15
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a4	Entrance Canyon 17
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a5	Entrance Canyon 24
Marine	Circalittoral rock	Strong tide, sponge dominant	ba4.2a6	Entrance Canyon 25
Marine	Circalittoral rock	Cavern	ba4.2c	Cavern communities
Marine	Sublittoral sediment	Coarse	ba5.4	Sublittoral mixed sediments
Marine	Sublittoral sediment	Epibiota	ba5.731	Mixed brown, red and green algae bed on sand with sparse interspersed sponges
Marine	Sublittoral sediment	Epibiota	ba5.732	Sponges on sand with relatively sparse interspersed mixed brown, red and green algae
Marine	Sublittoral sediment	Epibiota	[unlisted]	*Pyura* biogenic reef in tidal streams, moderate energy
Marine	Sublittoral sediment	Epibiota	[unlisted]	Seapen *Virgularia mirabilis* in tidal streams, moderate energy
Marine	Sublittoral sediment	Seagrass	ba5.831	*Zostera nigricaulis*

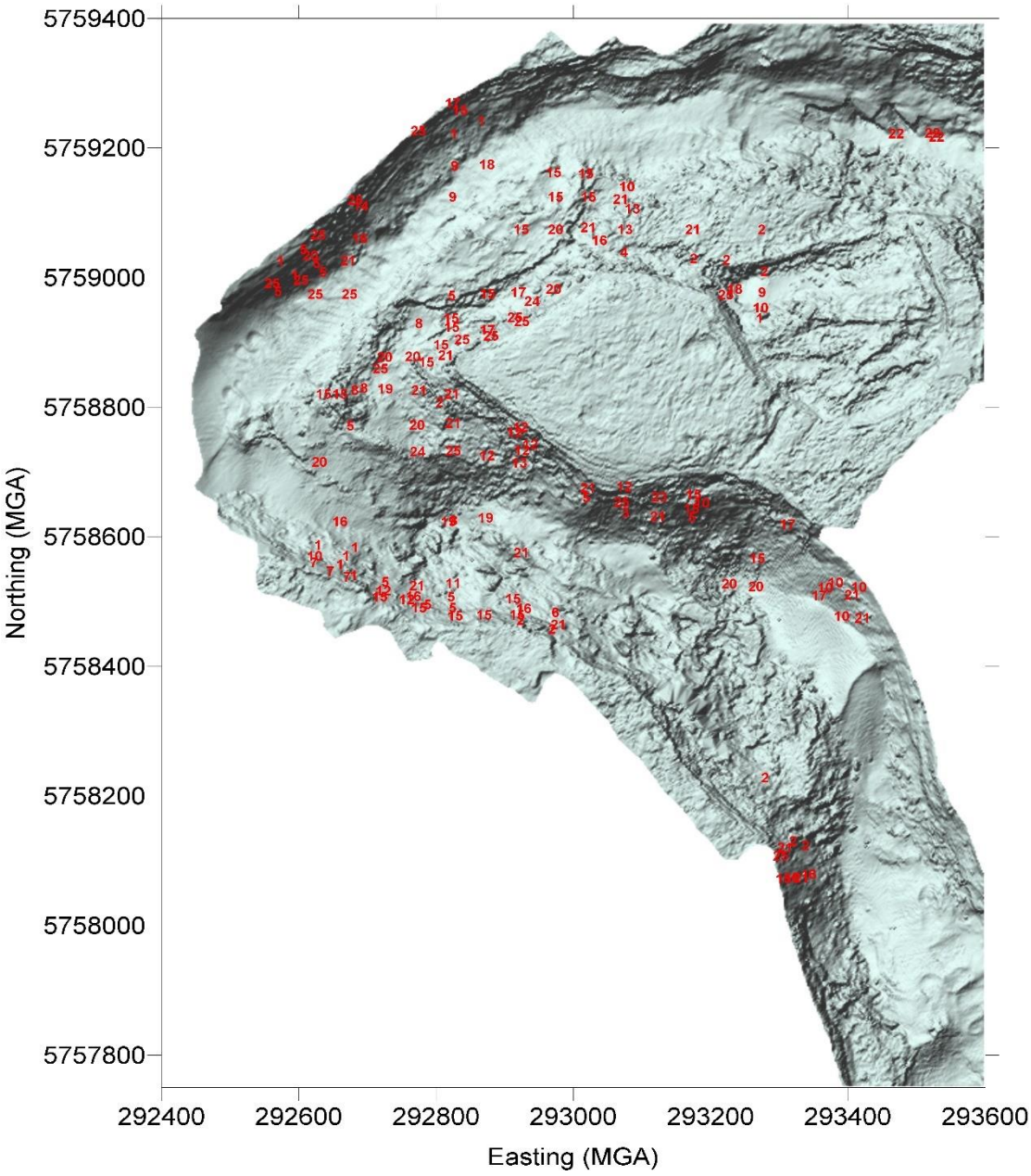


Figure 3.16. Location of deep reef survey and monitoring sites in The Entrance Canyon. Monitoring also occurred at Portsea Hole, further inside the Heads to the east (Edmunds *et al.* 2007, 2009).

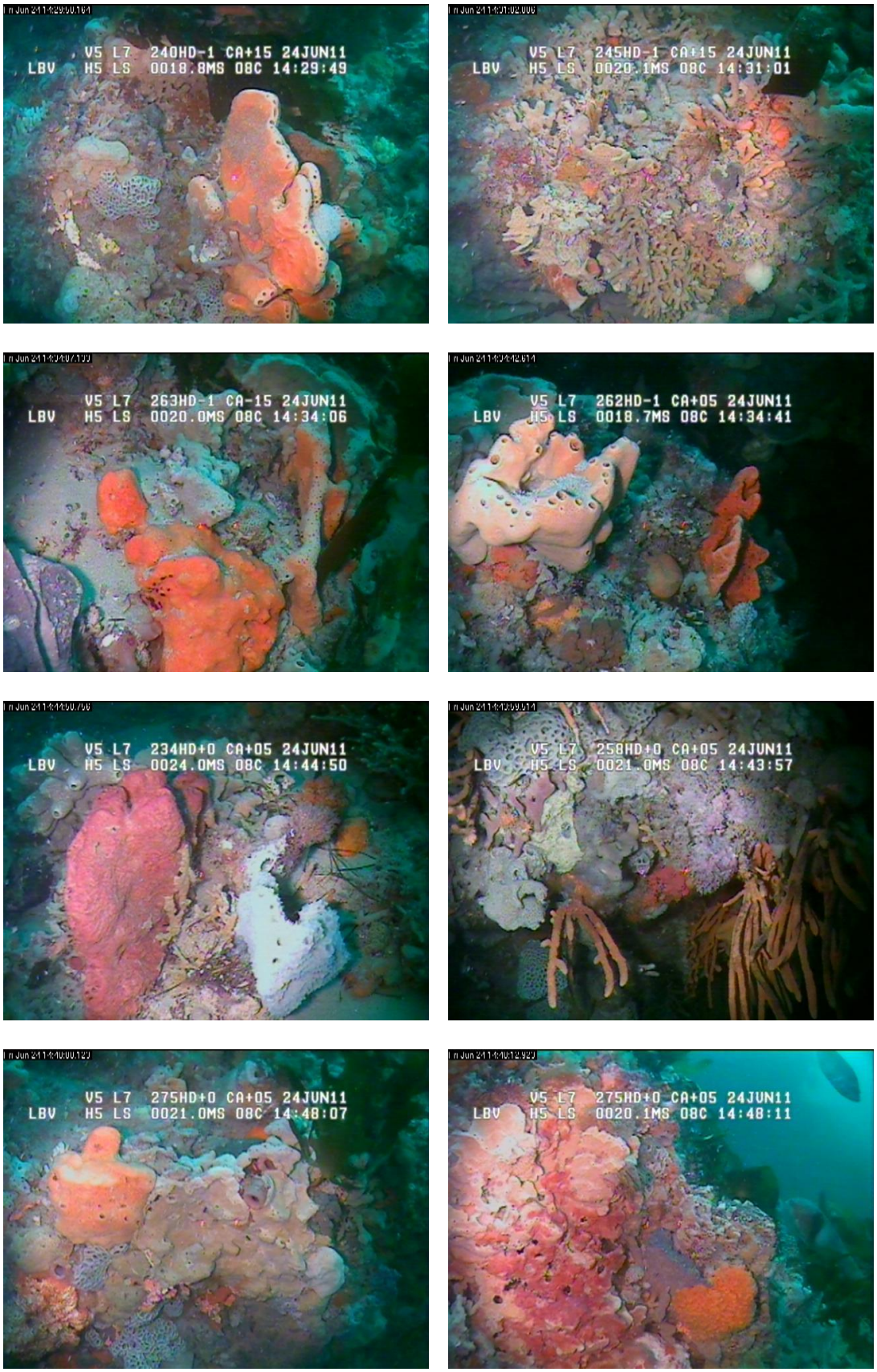


Figure 3.17. Example sponge diversity at Portsea Hole from ROV imagery (Australian Marine Ecology, 2011).

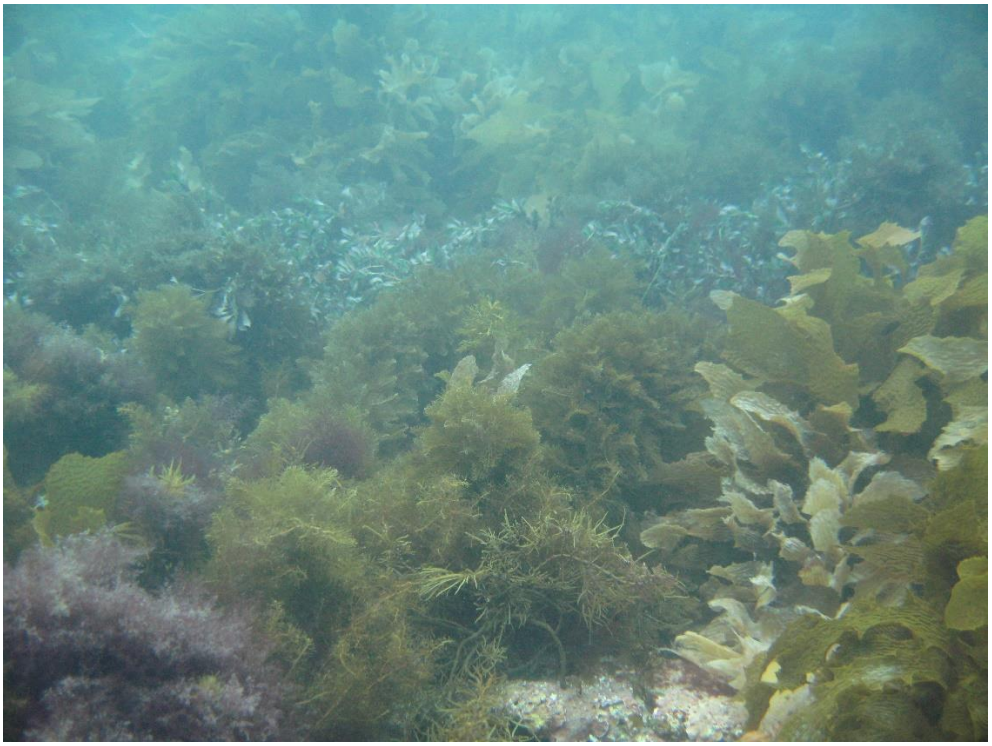


Figure 3.18. Sandy low profile reef biotopes at Portsea consisting of seagrass *Amphibolis antarctica*, subcanopy brown seaweed, high diversity thallose red seaweeds and occasional kelp plants *Ecklonia radiata*.

Figure 3.19. Example of thallose red seaweed *Echinothamion hysterix* (Portsea).

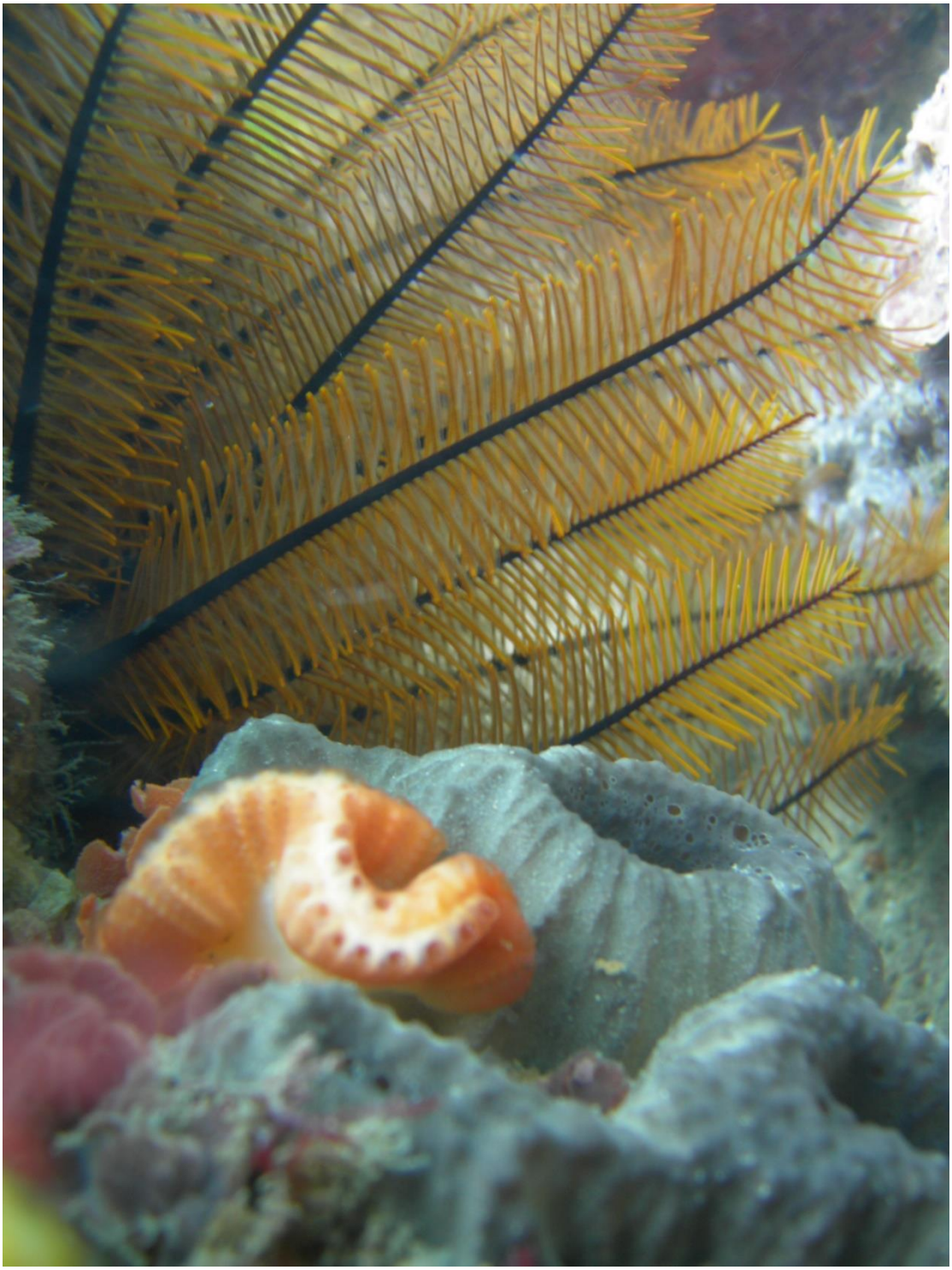


Figure 3.20. Example of sedentary and sessile invertebrate diversity at Portsea, including feather star *Cenolia trichopteran*, ascidian *Sycozoa cerebriformis* and volcano sponge *Ircinia* sp.

Figure 3.21. Example of nudibranch diversity at Portsea, *Ceratosoma brevicaudata*.

Figure 3.22. Spider crab *Leptomithrax gaimardii* – female with eggs (Popes Eye, 29 November 2009).

Figure 3.23. Seasonal (winter) habitat use by giant cuttlefish *Sepia apama*. The biotope pictures is sandy reef *Sargassum spinuligerum* habitat.

Figure 3.24. Colonies of weedy seadragon *Phyllopteryx taeniolatus* throughout the Point Nepean and Lonsdale Bight reefs, particularly where there on reef seagrass stands of *Amphibolis antarctica* (photo from Point Franklin).

Figure 3.25. Dieback in kelp *Ecklonia radiata* at Point Franklin, 2 June 2009.

Figure 3.26. Recovery of *Ecklonia radiata* at Point Franklin, 7 February 2014.

4 Littoral Field Survey

4.1 Littoral Habitats

The littoral field survey identified three general habitat regions:

- Highly modified shore in front of the Quarantine Station;
- Sandy beach with sandy berm and low coastal scarp, west to Observation Point; and
- Coastal bluff with short sandy beaches, east to Police Point.

The Quarantine Station shore was structured by a low sea wall with a short sandy beach in the eulittoral zone. The beach was littered with remnant structures and debris, including former seawalls, jetties, drains and groynes. The seawall included various drain openings (Figures 4.3 to 4.6).

The habitats along the westward shore to Observation Point consisted of predominantly sand beach with a moderately broad, low sandy berm in the supralittoral zone. This berm was backed by a low coastal scarp that has been variously modified by human settlement (Figures 4.7 to 4.8).

The habitat to the east was structured by calcarenite bluffs extending into the eulittoral zone and basal sandy pocket beaches (Figures 4.9 to 4.12). Most of the rocky littoral habitat considered of vertical or steeply sloped rock associated with the bluffs. There was no rocky bedrock or rubble platform at the base of the bluffs. Much of the observed bluff habitat in the Police Point region appeared to extend directly into the sublittoral zone.

Small patches of low-profile rock were emergent through the sand in the eastern area. Patches of sandy-veneer platform bedrock were adjacent to the emergent rock.

4.2 Biotopes

4.2.1 Littoral Sediments

The eulittoral zone sandy beaches in front of Quarantine Station and westward to Observation Point were bare and did not contain sensitive biotopes.

Remnant saltbush *Atriplex* vegetation was present in patches along the top of the sea wall at Quarantine Station. These patches were small in area and fragmented in coverage, separated by mowed grass, adjacent to the parade grounds. Some stands of Atriplex community were present along the Observation Point shore, but also in a discontinuous distribution. Any shore-based construction activity should be able to avoid disturbance of the existing remnant vegetation by using the grassed areas.

4.2.2 Littoral Rock and Hard Substrata

The artificial structures and debris adjacent to the quarantine station were highly sand affected and did not support any significant biotopes or species. On some structures there was green algal growth indicating higher nutrient inputs nearby, likely from drainage from the built environment.

The hard substrata of the bluff environment to the east was predominantly steeply sloped rock with upper eulittoral, supralittoral fringe and supralittoral zone habitats. The biotopes in these zones were relatively simple with low diversity and consisted of:

- Green algal turf above the sand interface;
- Littorinid gastropod and lichen *Lichena* band; and
- Supralittoral grey-black lichen band extending up the vertical rock faces (Figures 4.10 to 4.12).

The small patches of emergent rocks, mostly in the lower eulittoral zone, were inhabited by typical littoral species, but not forming any distinct bands of biotopes (Figure 4.13). Abundances were typically low and included tube worms *Galeolaria caespitosa* and limpets *Cellana tramoserica* and *Siphonaria diemenensis*.

Small stands of brown alga *Hormosira banksii* were present on some patches (Figure 4.14). These stands were notable in having the small-vesicle ecomorph of the species, where vesicle size is associated with wave exposure and nutrient conditions. Hormosira banksii is an indicator of good environmental condition and this morph is not common around Port Phillip Bay. Consequently, although this stand is low and fragmented in area, it has a modicum of value with respect to scientific ecosystem services.

Flat, platform reef with a sandy veneer was present adjacent to the *Hormosira* patches and was inhabited by the subcanopy brown alga *Caulocystis cephalornithos* and sparse thalli of red and green seaweeds, including *Ulva* (Figure 4.15).

4.3 Chiton *Bassethullia glypta*

No chitons were observed on the small isolated littoral rock outcrops to the east of the Quarantine Station. It is understood that the chiton *Bassethullia glypta* is typically associated with sandy rubble habitat, which was not observed near the Quarantine Station or along the bluff shores to the east. Such habitat was observed at Point Franklin. Although the survey did not preclude the presence of *Bassethullia glypta* in the region, the limited habitat means it is unlikely to occur near any works associated with this project. As noted above and as a precaution, there should be avoidance of any construction disturbances in the nearshore area of the bluffs to the east of Quarantine Station.

Figure 4.1. Quarantine Station sea wall, eulittoral sandy beach and remnant saltbush vegetation on top of the sea wall. July 2022.

Figure 4.2. Quarantine Station sea wall: example drain outlet. July 2022.

Figure 4.3. Quarantine Station sea wall: remnant salt-bush vegetation *Atriplex cinerea* and grasses community. July 2022.

Figure 4.4. Quarantine Station sea wall: grasses associated with salt-bush vegetation including coastal salt grass *Distichlis distichophylla*. July 2022.

Figure 4.5. Quarantine Station western sea wall, rock revetment and artificial debris in beach sands. July 2022.

Figure 4.6. Quarantine Station west: artificial debris in beach sands with turfing green algae which is indicative of nutrient enrichment. July 2022.

Figure 4.7. Observation Point beach slope, vegetated berm, isolated saltbush stands, and coastal scarp. July 2022.

Figure 4.8. Observation Point coastal modifications. July 2022.

Figure 4.9. Coastal bluff habitat east of Quarantine Station. July 2022.

Figure 4.10. Coastal bluff habitat biotopes: turfing green algae, littorinid gastropods with lichen *Lichena confinis.* July 2022.

Figure 4.11. Coastal bluff habitat biotopes: grey-black upper supralittoral (splash zone) lichens on calcarenite rock. July 2022.

Figure 4.12. Coastal and littoral bluff habitat, east Police Point. Rock formations pass directly into the sublittoral environment. Supralittoral grey-black lichen is the predominant biotope. July 2022.

Figure 4.13. Littoral rock biota on isolated rocks: low abundance tube worms *Galeolaria caespitosa* and limpets *Siphonaria diemenensis* and *Cellana tramoserica*. July 2022.

Figure 4.14. Littoral rock biota on isolated rocks: lower eulittoral Neptunes necklace seaweed *Hormosira banksii*, small vesicle morph. July 2022.

Figure 4.15. Littoral rock biota on isolated rocks: sublittoral fringe seaweeds on sandy veneer platform reef, including *Caulocystis cephalornithos* and *Ulva* (formerly *Enteromorpha*). July 2022.

5 Sublittoral Field Survey

Pending suitable field conditions.

6 Impact Assessment

6.1 Ecosystem Components

The seascape of the Quarantine Station area (Triconderoga Bay) is mostly composed of sandy channels and sand banks with strong tidal currents (Figure 6.1). An inshore channel is formed along the Point Nepean coast by offshore sand banks of Nicholsons Knoll and South Sand. The substratum in the channel is highly mobile sand with heavily rippled to sand wave geoforms. The channel is also structured by calcarenite bedrock which protrudes in places, including at Portsea Hole. Portsea Hole consists of a sandy scour hole with a rock wall along the south-western edge.

The Portsea Hole vertical rock habitat supports a diverse sessile invertebrate, sponge garden biotope. This biotope has affinities with the Entrance Canyon biotope complexes, but maintains a distinct biotope structure over time.

The nearshore, southern-side of the channel has a relatively steep sandy slope, shallowing to a shallow sublittoral sandy bank. This bank is mostly bare sand with patches of platform reef with a veneer of sand. These sandy veneer reefs support seaweed biotopes of subcanopy brown seaweeds (habitat for sea horses) and *Amphibolis* seagrass (habitat for sea dragons). The sandy slope habitat has occasional patches of *Pyura* ascidians, *Caulerpa* seaweed and other sediment epibiota.

Nearshore platform reef extends from the top of Portsea Hole southwards towards Weeroona Bay, Portsea. This reef is covered in a veneer of sand and inhabited by sponge and seaweed clumps. Shallow reef emergence is greater to the east of Police Point, in Weeroona Bay and around Point Franklin. These reefs support seaweed biotopes.

The littoral zone is relatively narrow near the Quarantine Station. A sea wall is present in front of the Station, with just sandy beach and remnant artificial hard structures present in the eulittoral zone. Remnant saltbush Atriplex stands occur in patches along the top of the sea wall, surrounded by mowed grass that forms the former military parade grounds. To the west of the seawall, the shore has a moderately wide sandy berm in the supralittoral fringe. To the east are rocky bluffs with mostly sand in the eulittoral zone. The vertical rock supports bands of green algae, littorinid gastropods and lichens. There are occasional patches of sandy veneer bedrock and rock outcrops with small, isolated littoral rock communities, including small stands of brown alga *Hormosira banksii*. Rocky habitat that would support the chiton *Bassethullia glypta* was not observed.

6.2 Activities, Pressures and Impact Pathways

6.2.1 Design and Construction

Design

The proposed research seawater system is designed for a maximum flow of 10 L/s. The expected typical operation is expected to have average flows of 5-8 L/s, but on an intermittent basis during each day.

It is proposed to install the intake and outlet by horizontal directional drilling (HDD), to pass underneath coastal structures of sensitive heritage and cultural value. The pipes would emerge in the adjacent nearshore channel, at or beyond the toe of the channel slope. The intake and outlet structures would have mattresses or other types of covers to avoid snagging of vessel anchors or fishing gear. The installations would be staggered transverse to the tidal current flows. Modelling indicated dilutions of 100:1 may be achieved within 25 m of the outlet. The outlet is expected to only need one diffuser port, facilitating maintenance and servicing.

Pressures

The use of horizontal directional drilling would prevent construction impacts in the coastal, littoral and nearshore sublittoral zones. The proposed siting of the intake and outlet would be away from the intermediate-depth seaweed-sponge sandy-veneer reef habitat to the south of Portsea hole.

Potential construction-related pressures include:

- Incidental release of drilling muds such as bentonite into the water column;
- Alteration of the seabed from gravel and drilling muds and any moorings and mooring lines;
- Introduction of marine invasive species via construction vessels and equipment during seabed installations;
- Disturbance of littoral and coastal habitat and biota via shore-based operations; and
- Noise, light and visual disturbances from marine construction operations.

Spatial Extent

Construction-related effects are expected to be highly localised to the frontage of the Quarantine Station, excepting any translocation of marine invasive species.

6.2.2 Operation

Activity and Pressures

Potential operation-related pressures include:

- Changed substratum represented by mattressed pipes and intake and outlet structures;
- Loss of biota from entrainment in the intake;
- Changed water quality from discharges, including nutrients, temperature, salinity and organics;
- Release of any contaminants, pests, pathogens, non-indigenous species or non-local genotypes.

Flows and Mixing

Numerical modelling has been completed, indicating that the extent of the mixing zone of the discharge will be limited to 25 m from the outlet due to the relatively small discharge flowrate and the naturally occurring highly dispersive hydrodynamics of the area.

The proposed siting of the intake and outlet is in a nearshore tidal channel that is separated from South Channel by the sandy banks of Nicholsons Knoll and South Sand. This channel directs flows via Triconderoga Bay, Portsea Hole, Sorrento Channel, Camerons Bight and Capel Sound.

Flood Tidal Streams

During flooding tidal streams, the channel waters are typically representative of Bass Strait waters (excepting periods of wave action over Rip Bank at The Entrance). Flooding streams are likely to deliver the best water quality to the intake. Discharges would be into essentially linear flows, passing through Portsea Hole and around Point King into Sorrento Channel.

Ebb Tidal Streams

Ebbing tidal streams would travel in the channel parallel to the shore in Triconderoga Bay until shallowing of the channel at Observation Point. At this point there is likely to be mixing with waters ebbing from South Channel, with subsequent divergence into a shallower stream passing along the coast and into Nepean Bay and a deeper stream passing into The Entrance Canyon.

During ebbing tidal streams, the water quality typically has a much higher suspended sediment loading and include organic matter and biota entrained from the southern sand banks and Capel Sound area. The intake would receive relatively lower water quality for the research facility while discharge effects on water quality are less likely to be detectable.

Habitats and Biotopes subject to Discharges

The habitats and biotopes predominantly exposed to discharges on flooding tidal streams would be the sponge garden of Portsea Hole and the various seagrass, *Caulerpa*, *Pyura*, scallop bed and seapen habitats of Camerons Bight and Capel Sound. Although initial dilution is expected to be high.

The most vulnerable communities during flooding tides would be Portsea Hole sponge garden and the adjacent sponge-algal biotope. These biotopes would be exposed within 19 minutes of discharge, on average, and within contained channel seascape. There is expected to be considerable additional mixing and dilution with dispersal further into the Bay and by the time waters reach Capel Sound.

Any epibenthic biota on the channel slope inshore of the intake and outlet are potentially exposed to impact pressures.

It is expected that discharges at the base of the channel in Triconderoga Bay will generally be retained in the channel seascape and not immediately mix with shallower water. This the nearshore reef habitats of Police Point, Weeroona Bay (Portsea) and Point Franklin are not expected to be exposed to any intake or discharge effects.

The discharges in ebbing waters would be subject to much greater mixing and dilution, particularly at the shallowing and conjunction of waters at Observation Point and subsequent highly turbulent flows through the Entrance Canyon seascape. The greater dispersion of ebbing flows would encompass the shallow reef seaweed and *Amphibolis* seagrass beds of Nepean Bay and the various sponge garden biotopes of The Entrance Canyon.

Spatial Extent

Effects of permanent seabed structures and any water quality changes would be highly localised to within scales of 10s to 100s of metres. The positioning of the intake on mobile sandy habitat of the channel floor minimises entrainment-related risks, particularly for recruitment shadows for vulnerable epibiota biotopes.

Although the discharge environment results in rapid dilution, the strong tidal currents mean effects from any release of contaminants, pests, pathogens and non-local species and genotypes could occur over a large area. The vulnerable area would range from the Shallow and deep reefs of the Heads and Entrance Canyon in the west to the seagrass, Pyura and other epibenthic communities of Capel Sound, Hovell Pile, Pinnace Channel and Middle Ground Shelf.

6.2.3 Impact Pathways

The predicted impact pathways are summarised in Figure 6.2.

6.3 Feature-Sensitivity Analysis

The sensitivity screening analysis is presented in Table 6.1 and Figure 6.2. The analysis indicated the nearshore reef communities were the most sensitive to constructure operations, primarily from any disturbance or abrasion from mooring lines and anchoring. Moderate sensitivity to biological disturbance from lighting, noise, vibration and physical presence was detected for dolphins and shore birds during construction.

All biota is sensitive to the introduction of invasive pests, with construction vessels commonly being a source of translocation.

During operation, the high biodiversity sponge garden and seaweed biotopes of the region were the most sensitive. Although the risks are unknown, but manageable, such biotopes are vulnerable to any release of pathogens, genetically modified and non-indigenous biota and potentially some types of chemical contaminants. Mass die-off events recorded in the literature indicate mass die-off can occur with recovery in the order of decades. Victorian ecosystems have previously had die off events and pathogens released from shore facilities have caused considerable harm.

Potential impacts on specific marine features are addressed in more detail in the following sections.

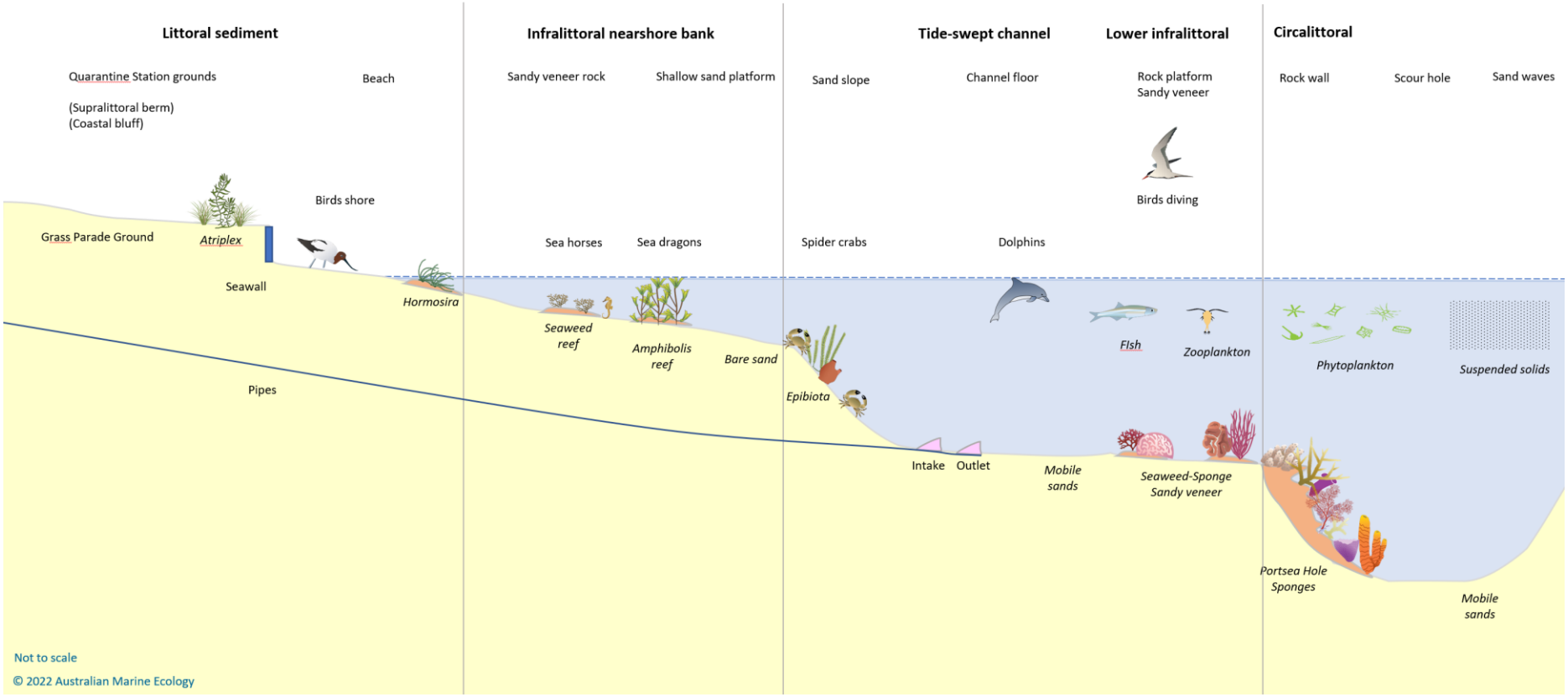


Figure 6.1. Conceptual model of ecosystem components in the Triconderoga Bay project area (not to scale).

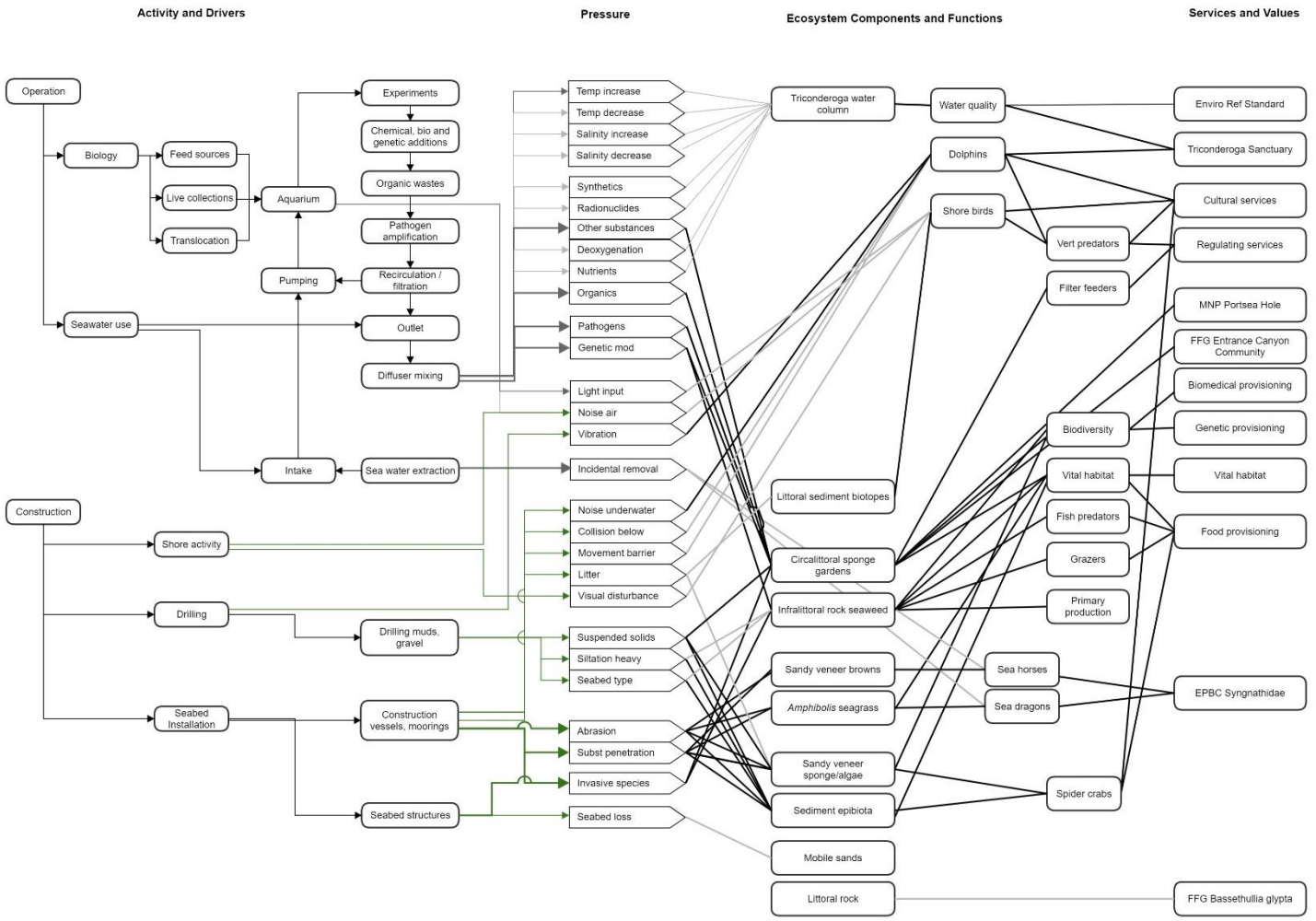


Figure 6.2. Model of potential impact pathways with respect to activity-drivers, pressures, ecosystem features and ecosystem services.

Table 6.1. Feature-Activity-Sensitivity (FeAST) assessment for potential impacts of the project.

Priority Feature	Activity	Pressure	Resilience	Recovery	Sensitivity
FFG Entrance sponge community Portsea Hole Marine National Park Sponge biodiversity	Seabed installation	Invasive species	Low	Very low	High
	Seawater discharge	Invasive species	Low	Very low	High
		Pathogens	Very low	Low	High
		Genetically modified material	Unknown	Low	High
		Deleterious contaminants	Unknown	Low	High
FFG chiton *Bassethullia glypta*	Seabed installation	Not spatially vulnerable			Very low
Burrunan dolphin Triconderoga Bay Sanctuary	Drilling	Noise and vibration	Low	High	Moderate
	Seabed installation	Biological disturbance	Moderate	High	Low
		Movement barrier	Moderate	High	Low
		Collision	Moderate	Moderate	Moderate
Shore birds	Drilling	Noise and vibration	Moderate	Variable	Moderate
		Biological disturbance	Moderate	Variable	Moderate
		Movement barrier	Low	High	Low
		Light	Moderate	High	Low
		Litter	High	Moderate	Very low
EPBC sea dragons **EPBC sea horses**	Seabed installation	Biotope alteration	Very low	Low isolated colonies	High
		Biotope alteration	Very low	Low isolated colonies	High
	Seawater extraction	Entrainment of hatchlings Intake spatially segregate – deep and on sand	High	Moderate	Moderate

Priority Feature	Activity	Pressure	Resilience	Recovery	Sensitivity
Spider crab aggregations	Seabed installation	Biotope alteration	Very low	Moderate - aggregations over wider area	Moderate - migrations across bare sand
Neashore seaweed biotopes **Amphibolis biotopes** **Sediment epibiotic biotopes** **Seaweed and sponge sandy veneer**	Drilling	Suspended solids	High	High	Low - provided not continuous
		Heavy sedimentation	High	High	Low - provided not continuous
	Seabed installation	Invasive species	Low	Very low	High
		Abrasion	Low	Very low (Amphibolis)	Low
		Substrate penetration	Low	Very low (Amphibolis)	Low
	Seawater discharge	Invasive species	Low	Very low	High
		Pathogens	Low	Moderate	Moderate
		Genetically mod material	Unknown	Unknown	High
		Deleterious contaminants	Unknown	Unknown	High
Water quality	Drilling - release of drilling muds	Suspended sediments	Well mixed	Rapidly flushed	NA
	Seawater discharge	Changes in temperature	Well mixed	Rapidly flushed	NA
		Changes in salinity	Well mixed	Rapidly flushed	NA
		Nutrients	Well mixed	Rapidly flushed	NA
		Organic loading	Well mixed	Rapidly flushed	NA
		Reduced oxygen	Well mixed	Rapidly flushed	NA

6.4 Heritage Sites

Apart from the Quarantine Buildings themselves, the project footprint is remote from heritage sites and shipwrecks. There is a non-heritage listed anchor offshore from the Quarantine Station which is also a recreational dive site. This artefact should be avoided in the siting design of the subsea structures.

6.5 Geoforms

The project proposes to minimise disturbance to coastal and shore geoforms through the use of directional drilling. Impacts on sublittoral geoforms would be avoided by situating the subsea structures away from any patch reef habitat. The subsea installations are likely to have a local and minor influence on sediment movement and accretion. This is unlikely to affect significant habitats or biodiversity if the sediments around patch reefs and any *Pyura* biogenic reef remain unaffected.

6.6 Vegetation Removal and Offsets

The project construction and operation can be designed to avoid disturbance to natural vegetation stands. There is no need for vegetation removal and offsets.

6.7 Ramsar Sites and Migratory Species

The general Port Phillip Heads area is important for shore, wetland and migratory birds. The region has key breeding, roosting and feeding areas at Swan Bay, Mud Islands and South Channel Fort, with Swan Bay and Mud Islands also being part of the Port Phillip-Bellarine Ramsar site. The project footprint is well removed from these areas provided contaminant and pathogen pressures are closely managed during operations.

There are a variety of migratory marine species that occur on the ocean side of Point Nepean, including whales, turtles, sharks and seabirds. There are occasional visitations from their normal area of occurrence into Port Phillip Bay. The proposed project does not have impact pathways leading to these species.

There are many species that migrate into Port Phillip Bay for obligate breeding or habitat use and feeding. The migration can be daily, seasonal or just for short breeding periods. These include little penguin, school and gummy sharks, bronze whaler sharks, snapper, King George whiting and kingfish. These species are unlikely to be affected by the project provided the local biotopes are not affected, which can provide stepping-stone migration paths in some cases.

6.8 Littoral Habitats and Biota

6.8.1 Littoral Biotopes

The littoral field survey indicated there were three general habitat zones along Triconderoga Bay, with the area in front of the Quarantine Station being highly modified by a sea wall and derelict structures. The habitat is predominantly bare sandy beach. Remnant coastal saltbush *Atriplex* vegetation occurs in patches along the top of the seawall. Any disturbance pressures to this vegetation should be avoided. There is access between the shore and the research facility across mowed grassland.

The littoral habitat immediately to the east consists of bluffs with basal sand pocket beaches extending into the sublittoral sandy platform. There are some isolated low rocky platforms with small patches of littoral rock communities or sandy veneer rock seaweed communities. Although these isolated outcrops are relatively small in area, their disturbance can be avoided as there are considerable areas of bare sand in the area for use by construction operations. These isolated patches include stands of brown alga *Hormosira banksii*. These stands are of the small-vesicle ecomorph of the species and are of scientific value, particularly as *Hormosira* is an indicator of good environmental condition in other parts of Port Phillip Bay.

6.8.2 FFG Listed Chiton

The FFG listed chiton *Bassethullia glypta* is only known from approximately 20 records and its existence and preferred habitat is predominantly inside Port Phillip Heads, on rocky and rubbly habitat from Sorrento to Queenscliff.

The field surveys did not detect suitable littoral rocky habitat for *B. glypta* in the Quarantine Station and Police Point area. Regardless, the horizontal directional drilling method would avoid disturbance of all littoral biota.

Potentially suitable habitat for *B. glypta* was observed at Point Franklin, with patches of sandy gravel and rubble. Potential impacts can be avoided through:

- Minimal release of drilling muds (bentonite) during construction; and
- Operational controls to prevention discharge of any contaminants, pathogens or other deleterious biological material from the seawater outlet.

6.9 Nearshore Sublittoral Biota

6.9.1 Infralittoral Reef Kelp Beds

The nearest kelp bed habitat occurs at Point Franklin to the east and Nepean Bay to the west. These areas are well outside the range of any environmental pressures caused by the intake or outlet with the exception of pathogens and marine pests. Both of these reefs have been subject to disease and kelp dieback events (Edmunds 2015) and these areas may be sensitive to any pathogens released by the field station. These areas have been increasingly affected by marine pests, particularly the Japanese kelp *Undaria*

pinnatifida. The present status of the *Undaria* infestation is unknown, however it had been progressively advancing from east to west along northern shore of the Mornington Peninsula.

The subsea intake and outlet structures would provide a novel surface for the attachment of marine invasive species and possibly a staging point for advancing infestation of *Undaria* into Nepean Bay.

The design of the subsea structures minimises the area of novel hard surfaces and the potential for pest colonisation.

The location of the seabed structures is on highly mobile sandy habitat in high current flows. This may naturally limit the establishment of deleterious biota, however periodic inspection is recommended.

6.9.2 Shallow Sandy Reef Biotopes

There are substantial areas of shallow, low profile or pavement reef supporting stands of the reef inhabiting seagrass *Amphibolis antarctica*. This seagrass traps sand among its horizontal rhizomes to form a sandy veneer over the reef. Although seaweed diversity is much reduced on these reefs, *Amphibolis* has a high primary production rate, including regular shedding of leaves to provide particulate organic matter inputs to both local and more widely dispersed biotopes. The *Amphibolis* stands are primarily restricted to moderate energy habitats from Point Franklin to Queenscliff and in Nepean Bay and Lonsdale Bight. Despite prolific seedling production and high leaf production, their patch formation and horizontal patch growth is very slow, probably in the order of 10s to 100s years. *Amphibolis* biotopes are likely to be a climax community, developing after a succession of seaweed biotopes. Recovery from any physical patch disturbances is likely to be very slow, if at all.

In addition to the high sensitivity of *Amphibolis* biotopes, this habitat usually supports colonies of sea dragons *Phyllopteryx taeniolatus*, which is an EPBC listed species. Although sea dragons are relatively common and popular with recreational divers, they are vulnerable to impacts through occurring in spatially segregated colonies.

The low profile reefs of the Port Phillip Heads region are an important area for greenlip abalone *Haliotis laevigata*. Populations were severely depleted by harvesting and this area has been significant for population recovery (Edmunds 2017).

The low-profile reefs occur to the east of the Field Station area and are vulnerable to disturbance principally from construction activity. Construction impacts include the formation of rubble and impacts from release and settlement of drilling muds and clays. There is also vulnerability to any mooring lines and anchoring.

The low profile, Amphibolis reef biotopes are generally not vulnerable to operation impacts through placement of the structures on the floor of the channel at 19 m depth.

Recommendations include:

- Any release of drilling muds or formation of rubble, avoids disturbance during construction is minimised;
- The inshore reef habitats are protected from any construction scouring, including avoidance of any vessel mooring lines and anchorages in the nearshore zone (shallower than 5 m);
- Prevention of marine pest translocation; and
- Prevention of discharge of any pathogens, toxicants or contaminants from the seawater outlet.

6.9.3 *Pyura* Biogenic Reef

The higher current sediments are occupied by patches of biogenic reef-forming *Pyura* ascidians. These reef patches support a high diversity of seaweeds and sessile invertebrates and are also likely to have a significant influence on sediment transport patterns and seafloor geoforms. These biotopes provide habitat and migration routes for the spider crab *Leptomithrax gaimardii*.

Very little is known about the dynamics and recovery rates of this biotope, however dredging and monitoring in the north of Port Phillip Bay found recovery did not occur. This biotope should be treated as highly sensitive and should not be disturbed. Disturbances may have wider ramifications through possible influences on sediment transport processes.

Any disturbance to *Pyura* and other epibenthic biotopes should be avoided, including careful use of construction vessels and moorings.

6.9.4 Mobile Sands

The bare sandy habitats in the region are highly mobile and have a low abundance and diversity of infauna and epibiota. The project is unlikely to have any impacts on this biotope.

The siting of the intake and outlet on the sandy floor of the Triconderoga Bay channel minimises any direct biological impacts.

6.10 Offshore Sublittoral Biota

6.10.1 Lower Infralittoral Sandy Scour Reef

The offshore area north of Point Nepean consists of a high diversity of sandy and rocky geoforms, including sand waves, channels and rocky outcrops. Much of the area is sandy habitat with occasional low-profile rock and ridges poking through the sediments. These sandy veneer and sandy scour reefs to 19 m depth support a high diversity of seaweeds with sparse sponge clumps (lower infralittoral rock habitat). Little is known of the distribution and significance of this habitat and the biota. The nearest known patch is to the south of Portsea Hole (1500 m northeast of the Field Station).

6.10.2 Circalittoral Rock Sponge Garden

The sponge diversity is particularly high and both nationally and internationally significant. The deep reef, circalittoral rock habitat is listed as an FFG Threatened community and portions are within the Port Phillip Heads Marine National Park.

The sponge gardens are some distance from the Field Station and unlikely to be affected by any physical and water quality effects of the project.

Sponges are highly vulnerable to pathogens, which can lead to mass die-off events. An issue with sponge infections is that they produce mucus strings that can be transported by currents to readily infect sponges over wide ranges. Sessile invertebrate communities are also susceptible to overgrowth by marine pests. Impacts on sponges in the region would be devastating for biodiversity and natural ecosystems and associated populations.

Sponges in the Heads region are likely to have an important ecosystem services role. The upper layers of the Canyon consist of highly friable aeolianite / calcarenite sandstone (lithified sand dunes). These are highly susceptible to erosion and the covering biota is likely to restrict or limit erosion processes. This is particularly important in the Heads, where the water exchange and tide height for all of Port Phillip Bay is regulated by the bottleneck geoforms in the Heads. Even if the likelihood of risks of discharged components are small, there are potentially catastrophic consequence levels for natural values and ecosystem services.

Consequently, strict operational controls are highly recommended on the use of any chemical contaminants or deleterious biological agents used at the Field Station.

6.11 Marine Pests

Although the present marine pest status is unknown, the invasive kelp *Undaria pinnatifida* and kelp dieback diseases are known in the region. The greatest risk for

ecological harm is the translocation to other sensitive marine habitats. Construction works have spread this pest in the past, such as to the Apollo Bay harbour.

The risks not only include the translocation of marine pests to the site during construction and operation, but also translocation of existing pests to elsewhere. As seen with *Undaria*, *Caulerpa* and other pests, marine pest infestation can cause catastrophic and permanent impacts to ecosystems.

It is essential that all construction works have translocation prevention procedures, including inspection, cleaning, drying and antifouling of vessels, machinery and equipment before moving to any marine or coastal environment.

There must also be strict protocols for the operation of the Field Station, including:

- Appropriate sterilisation of equipment and vessels when changing location of field activities from around Point Nepean to elsewhere;
- Close vetting of the biota examined and disposed from work at the station – biota collected outside the local area should not be returned to limit any spread of pests and pathogens; and
- Close vetting of introduced feed or bait used in the facility.

6.12 Operation of the Aquarium Facility

The field research station is proposed to provide aquarium facilities for research work on living marine biota. For the most part, this is expected to be benign with few implications for discharges of aquarium water back to the marine environment.

There are perceivable risks that could have severe implications. These include:

- The intended or unintended use of chemicals, radionuclides, nerve agents or other biological agents that can cause severe impacts;
- The introduction of pests and pathogens within food and bait, as happened with the introduction of the pilchard virus;
- The introduction of genetic variants or mutants that can 'escape' natural ecosystem regulation, such as the aquarium seaweed variant of *Caulerpa taxifolia*; and
- The amplification of viruses and other pathogens, as happened with abalone aquaculture facilities.

The risks of introducing contaminants, pests or pathogens are heightened in that the facility would be a training facility used by only newly trained students and unlikely to have an appreciation of the environmental risks. There may be reduced pressures, awareness or implications in preventing environmental harm in such a facility as compared to a commercial operation.

The facility should have strict, documented protocols and close supervision, by responsible and experienced persons, to prevent contamination of the aquaria and ensure the outlet returns uncontaminated water to the natural environment. There should be both controls on the nature of the work permitted in the aquaria and consequences for breaches in returned water quality. Under the General Environmental Duty provision of the Environment Protection Act, penalties may be incurred by the holder of the licence, however it is recommended there are formal processes within the field station to ensure responsible actions of the researchers and students.

6.13 Conclusions and Recommendations

The Point Nepean marine environment has a considerable number of high priority marine features. These features include reef seagrass *Amphibolis* beds, kelp *Ecklonia* beds, sea dragon colonies, giant cuttle wintering, spider crab aggregations, a biodiversity hotspot for seaweeds and sponges, recovering green-lip abalone populations and the rare chiton *Bassethullia glypta*. There have been few surveys in recent years and there are knowledge gaps on the present status and distribution of these values.

There are considerable high priority marine values that occur in patches that make them vulnerable to disturbance. Most disturbances from the proposed intake and outlet structures would be mitigated through positioning away from reef and sandy reef habitats, the use of directional drilling under the sensitive nearshore biota and care during construction to minimise physical disturbances.

The most severe and widely spread impact risks would be through:

- the translocation of marine pests and pathogens – construction and operation activity; and
- release of contaminants, toxicants or pathogens from the outlet that may impact on sensitive sponge and other biotopes.

A particular concern is the potential for inexperienced, unconcerned or irresponsible users of the aquarium facility causing the release of highly deleterious chemicals and biological agents. This has occurred in the past through well-controlled commercial operations, so use of the aquarium facility for research and teaching requires particularly heightened controls.

Recommendations for preventing and managing the environmental risks include:

1. Positioning the seabed structures on the floor of the sandy channel of Triconderoga Bay;
2. Construction activity to minimise disturbance of shallow nearshore and littoral habitats, including use of any mooring lines and release of drilling muds;
3. Construction works avoid the use of any machinery, moorings and vessel activity across reef patches predominantly covered in *Amphibolis* seagrass;
4. Strict marine pest translocation protocols are in place to prevent introductions to the site of transfer to other sites;
5. Strict research facility operation and management protocols are in place to ensure pathogens, chemicals, contaminants and other deleterious agents are not introduced, amplified or released from the site; and
6. A level of monitoring of local biotope types and distributions to confirm impacts were restricted and contribute to the knowledge base for future assessments, including invaluable information on the resilience and recovery of biotopes to disturbance.

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