

Report to: Parks Victoria

# **Rye Pier Approach Reconstruction**

**Retention of redundant piles as ecological  
habitat for recreational divers**



**July 2021**



# Rye Pier Approach Reconstruction Retention of redundant piles as ecological habitat for recreational divers

## Executive Summary

Rye Pier is central to the beach and marine environmental amenity of the Mornington Peninsula. The natural biodiversity values of Port Phillip's nearshore marine environment around Rye are characterised by the clear waters, clean sandy seabed and relative absence of natural reefs.

The piles of Rye Pier provide a solid structure for attachment of plants and animals that are otherwise found on Port Phillip natural reefs located 10s of kilometres from Rye. The growth on the piles of the Pier, the easy access to deep water via the new Pier landing, lack of strong currents and sheltered waters during southerly wind conditions provide Rye Pier as an important location for SCUBA divers, marine naturalists and underwater photographers and videographers.

Parks Victoria is committed to maintaining the marine natural history values of the Pier to divers when the existing deteriorated wooden approach structure is replaced by a new, wider wooden structure. This report was commissioned to provide guidance on the value of the piles along the Pier alignment to marine naturalists and recommend sections of the Pier and heights above seabed that the piles to be replaced may be retained to maintain as much of the existing marine ecological values to divers as possible.

The study established a depth profile along the Pier alignment and found that the marine ecological value to divers of the marine biota inhabiting the Pier piles increased with increasing distance from shore and increasing water depth. Four distance intervals and corresponding depth ranges were identified and rated with increasing value to divers. The intervals are consistent with the observations of, and values to, local marine naturalists.

CEE provided marine ecological, diver amenity and existing condition-based guidance on the treatment of the redundant existing piles that will be replaced during the planned rebuild of the Pier. The guidance treatment of the four sections is summarised below

- i. Chainage 0 to 120 m – Intertidal section  
Redundant piles may be extracted completely or cut off at seabed level
- ii. Chainage 120 m to 150 m - Water depth 0 m to 1 m CD.  
Redundant piles may be extracted completely or cut off at seabed level or cut off redundant piles at level of stumps that are presently found in this section
- iii. Chainage 150 m to 200 m - Water depth 1 m to 2 m CD.  
Redundant piles should be cut off at around 0.5 m below chart datum \*
- iv. Chainage 200 m to 300 m - Water depth 2 m to 3 m CD.  
Redundant piles should be cut off at around 0.5 m below chart datum \*

Although the area of old pile habitat will be reduced to some extent by these options, most of the amount of habitat usually accessible to divers and photographers will be retained. Importantly, the habitat provided by the Pier will be *increased* with the installation of a similar number of new wooden piles that will be colonised by marine biota in the area. The process of colonisation and ecological succession will result in the same biota that presently inhabit the Pier pile habitat. The increased number of piles and habitat area is likely to increase the number of species present and increase the value of the Pier to divers.

It is recommended that the new piles be ecologically monitored to provide information and an evidence-base for management of pile reconstruction programs in the future.



# Rye Pier Approach Reconstruction

## Retention of redundant piles as ecological habitat for recreational divers

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Cover Image: marine life on cut-off piles beneath Rye Pier (July 2021)



# Rye Pier Approach Reconstruction

## Retention of redundant piles as ecological habitat for recreational divers

### 1 Background

Parks Victoria manages many public piers and jetties within Port Phillip, including the Rye Pier. Maintenance and upgrades are a necessary part of providing safe and useful Piers and jetties. The pier approach is nearing the end of its design life and is showing signs of structural failure posing a risk to public safety. Engineering inspections identified several piles have failed which is compromising the load limits and structural integrity of the Pier.

Parks Victoria is committed to replacing 290 m of the existing timber main Pier from the shoreline to the lower landing with similar timber materials along the same alignment. The deck of the new Pier will be widened from the existing 3 metres to 4.2 metres. The deck of the new Pier will be 600 mm higher than the existing Pier to cater for future sea level rise. The number of piles will be similar to structure it is replacing.

The existing pier at Rye is a popular snorkelling and SCUBA diving destinations. Diverse and colourful marine biological communities have colonised the jetty piles and other hard substrates on the seabed around the Pier. The typically clear waters allow a wide range of marine biota to grow on the Pier pilings including seaweeds and a diversity of colourful filter-feeding sessile invertebrates such as sponges, tube-worms, bryozoans, molluscs and ascidians. These biota provide biogenic habitat for a range of more mobile, visible animals such as bait crabs, seastars, fish and seahorses. The highly accessible, colourful and photogenic plants and animals on the piles provide stark contrast with the extensive relatively bare, clean sand that extends along the nearshore waters either side of the Pier of Port Phillip at Rye. The location of the Pier on the Mornington Peninsula's northern shoreline is a perfectly shore dive that is sheltered from afternoon seabreezes in summer and cold southerly winds in winter.

The Pier also provides access for snorkellers and divers wishing to view seasonal aggregations of the Spider Crab (*Leptomithrax gaimardii*) that often occur near the Pier in May/June. These deeper offshore waters would otherwise only be accessible by boat or via a long swim. Parks Victoria recognised the value of the Pier and associated artificial marine habitat to divers and marine naturalist and replaced the damaged lower landing with new all-abilities access steps and landings for divers and snorkellers at the lower landing towards the offshore end of the Pier in 2020.

In planning to replace the existing pier approach, Parks Victoria acknowledges that many of the existing piles provide established habitat for marine biota. Hence Parks is committed to rebuilding the pier using an approach that retains a healthy proportion of the existing biological community associated with the pile habitat. Reconstruction of the pier head is not within the scope of this project.

#### 1.1 Scope of work

Parks Victoria sought advice from marine ecologists at CEE to

- Advise on the marine ecological characteristics of the wooden jetty piles from the shore, to the lower landing of Rye Pier, and
- Determine suitable options to retain redundant piles and associated biota that may be left in the seabed to continue to provide interest for SCUBA to divers, marine naturalists and underwater photographers and videographers.





## 2 Study area

The Rye Pier study area and features are shown below. Rye Pier extends approximately 360 m northward of the shoreline at Rye (Figure 1).

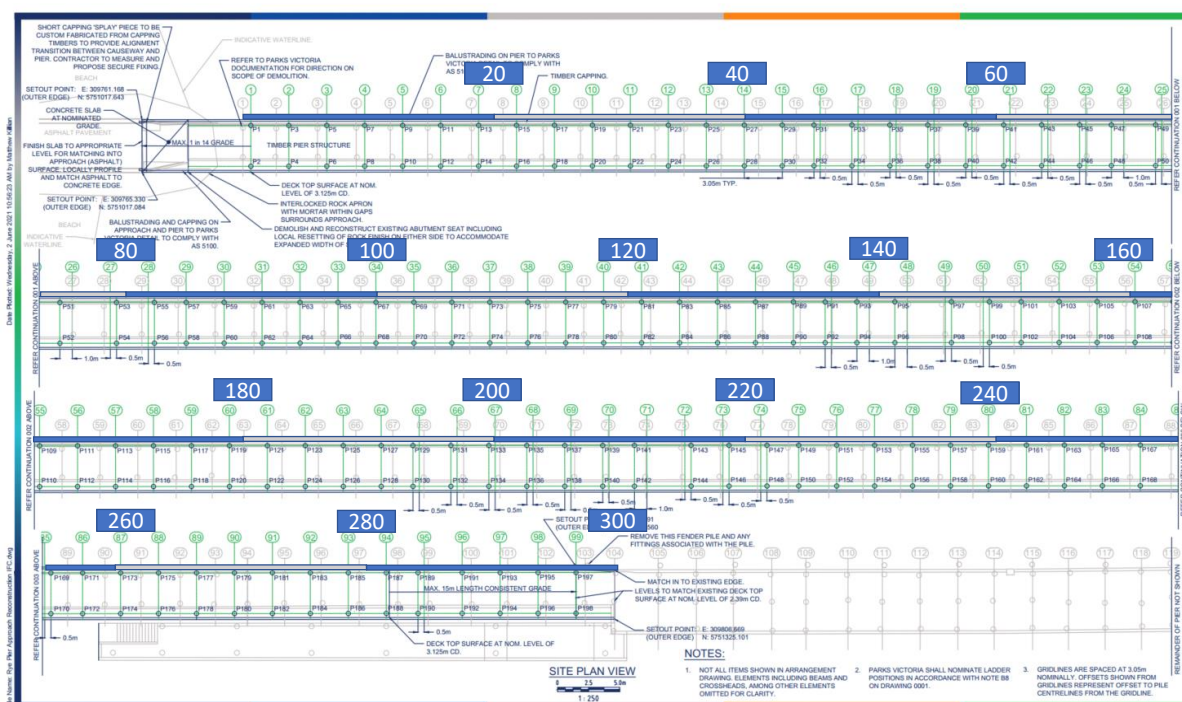
The first 140 m of the pier traverses the beach and a series of intertidal and shallow sandbars and channels. The seabed slopes gently beyond the nearshore sand bar system from the low tide mark at around 120 m through to 2 m depth below chart datum at 250 m offshore to around 5 m depth at the end of the Pier.

The mean low to high tidal range (MLLW to MHHW) at Rye is approximately 0.8 m. Greatest astronomical tide is approximately 1 m (VRCA tide tables for Dromana).

The pier comprises pairs of timber piles at 3 to 4 m intervals supporting a timber deck (Figure 2).



**Figure 1. Rye Pier showing length to be rebuilt and bathymetry**  
(Blue and grey bars on right-hand figure are approximately 20 m intervals)



**Figure 2. Rye Pier existing and proposed pile arrangement**

Source: Sureside Consulting Drawing 21/005/DW/0007, Rye Pier Approach Construction Project  
Distance bars added by CEE: Blue and grey bars are approximately 20 m intervals

### 3 Water depth along Pier

Much of the alignment of this jetty passes over intertidal or very shallow sandy seabed. These conditions usually result in settlement or colonisation by short-lived, ephemeral species. The removal of these piles close to the seabed and replacement by other wooden piles will have little effect on the marine ecological value of the existing Pier.

The potential artificial marine ecological value increases as the water depth below low water increases along the Pier alignment. A more permanent ecological community of plants and animals may occupy a band on the piles between the low tide mark and a distance above the seabed that is beyond the effects of sand movement and sand scour. This zone will be called the "biotic band" for the purposes of this high-level (granular) investigation.

The biotic band at Rye Pier is valued by recreational divers, underwater photographers, videographers and marine naturalists. Parks Victoria is keen to maintain biodiversity associated with old wooden piles, while the new wooden piles are installed and the natural process of biological colonisation and ecological succession proceeds and eventually results in a relatively stable 'climax' community on the Pier piles.

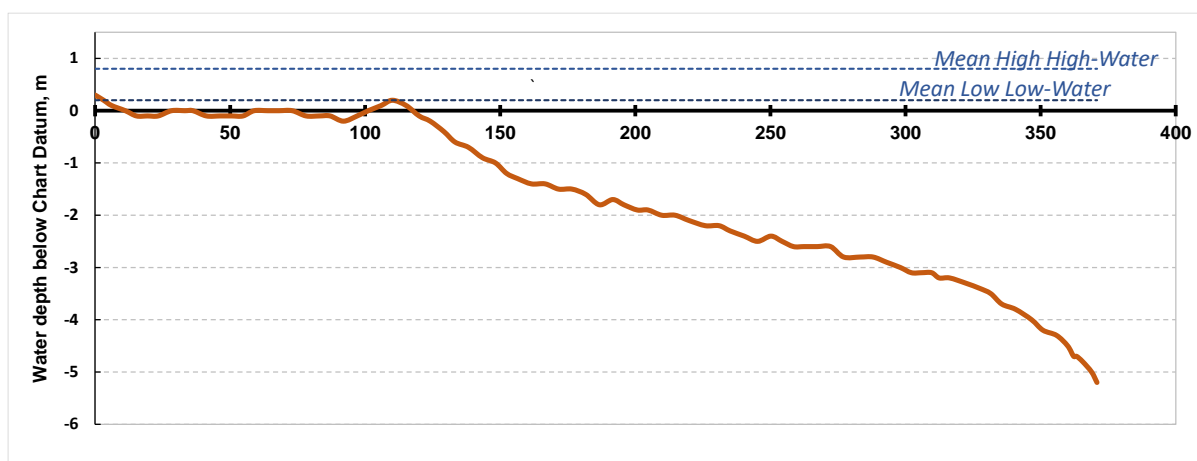
CEE previously examined and documented the marine communities at the lower landing and we have a good understanding of the general community composition at other jetties in Port Phillip and Western Port.

### 3.1 Pier depth profile

As discussed above, water depth is a key consideration of this study. However, the depth of the seabed along the Pier was known only from spot depths on navigation charts, so a depth profile was established as a reference point for this study.

- CEE survey vessel's Garmin EchoMap was used to record water depth and position at 5 second intervals as the vessel was slowly navigated parallel to the western side of the Pier on 9 July 2021.
- Recorded water depths were checked against measured water depth using a lead line, and were found to be the same  $\pm 0.05$  m.
- The predicted tide height at the time of the profile run (15:00 hrs, 9 July 2021) was close to 0.9 m high tide.
- Validated recorded depths were adjusted to Chart Datum (Lowest Astronomical Tide) by subtracting the predicted tide height at the time of the survey.

The resulting depth profile along the 360 m length of the Pier together with high high-water low low-water levels are shown in Figure 3.



**Figure 3. Seawater depth along Rye Pier, CEE 2021**

(Depth recordings only for the purposes of this study. Not for navigation, design or construction)

The figure shows that:

- The seabed over the first 100 m of the Pier alignment is relatively flat at about lowest astronomical tide level.
- There was a shallow sand bar at about chainage 110 m.
- The seabed sloped relatively steeply from 0 m depth at chainage 120 m to -1.5 m at chainage 170 m.
- The slope was less steep from chainage 170 m to around 3 m depth at around 170 m chainage.
- The seabed slope increased from 170 m chainage to the end of the Pier at around 360 m chainage where the depth was recorded at -4.6 m.
- The seabed continued to increase at a steep rate.



## 4 Pier pile habitat characteristics

Marine ecologists viewed the Pier from the survey boat commencing at the shore line and snorkeled along the length from about chainage 140 m to the end of the Pier the on 9 July 2021, and made qualitative observations and photographically documenting marine growth on the existing wooden piles.

Marine growth on the piles comprised a diverse mixture of encrusting invertebrates that coated the entire pile from the low water mark to the seabed. Macroalgae (seaweeds) were also present, but were not particularly diverse at the time of the winter survey.

### 1.1.1 Intertidal pile habitat

Piles from the first pair on the shoreline to approximately 120 m from the first piles are located in the intertidal area. The whole pile of each pile is exposed to air at some stage. An increasing length of pile is permanently submerged 120 m to the end of the Pier, but the top 1 m of all these piles is periodically exposed by the tidal rise and fall of the sea level and this part of the pile is characterized by biota that are adapted to life in the intertidal zone.

The piles were relatively bare of biota over the intertidal zone except for: sparsely scattered barnacles in the upper intertidal; scattered limpets (*Siphonaria diemensis*) in the mid-lower intertidal; blue mussels (*Mytilus planulatus*) close to the low tide mark and; macroalgae at the (*Ulva*, *Laurencia*, *Sargassum* in that order) at and just below the low tide mark. An intertidal biological zonation pattern from upper to lower intertidal zone such as this is expected in most marine intertidal areas where the habitat is sufficiently solid for animals and plants to attach.

This zonation pattern was not consistent between piles, which were often lacking in mussel and algal zones. In the absence of mussels and algae, the low tide mark was bare and a sharp reduction in the diameter and condition of the permanently submerged wooden pile below the low tide level was visible. It is likely that this point represents a position of potential structural failure of the pile.



Figure 4. Intertidal zonation on piles: Limpets> mussels> macroalgae

### 1.1.2 Subtidal pile habitat

The pile habitat below the low tide mark was characterised by almost complete cover by a diversity of encrusting invertebrate animals, with macroalga (mostly the brown seaweed *Sargassum*) also abundant. Only a small area of the lower pile within about 5 to 10 cm of the seabed was bare due to sand scour of short-term variations (days to weeks) in sand level.

The introduced kelp *Undaria pinnatifida* was the only obvious introduced species present, and was only observed on a single pile. A range of other introduced species may be present on the Pier among the encrusting invertebrates or at different times of the year.

Invertebrate growth on the wooden piles was characterised by encrusting forms of sponges and colonial ascidians, with smaller patches of bryozoans. Hydroids and solitary ascidians were also present. Encrusting red and orange sponges were common on the piles from the shallow to the deep parts of the piles along most of the Pier alignment from chainage 140 m (pile pair approx 100) to chainage 360 m.

The form of sponges was mostly relatively thin and encrusting on subtidal sections of piles along the full alignment. There was some indication of heavier encrusting form particularly towards the base of some piles and on cut-off piles from chainage 180 m to 200 m and beyond (pile pairs 124) . The brown seaweed *Sargassum* was reasonably abundant at this point, but sparse under the end of the Pier where the extended deck of the Pier shaded piles.

This pattern of growth on the piles is consistent with recent *Inaturalist* members' observations that "*prime territory for seahorses beneath Rye Pier commences at approximately Pylon 124 and extends to and well beyond the steps of the new ... platform*" (Email to Parks Victoria 6 July 2021).



Chainage 140, SD 1.9 m, CD 1.0 m      Chainage 160, SD 2.2 m, CD 1.3 m

**Figure 5. Pier piles chainage 140 and 160**



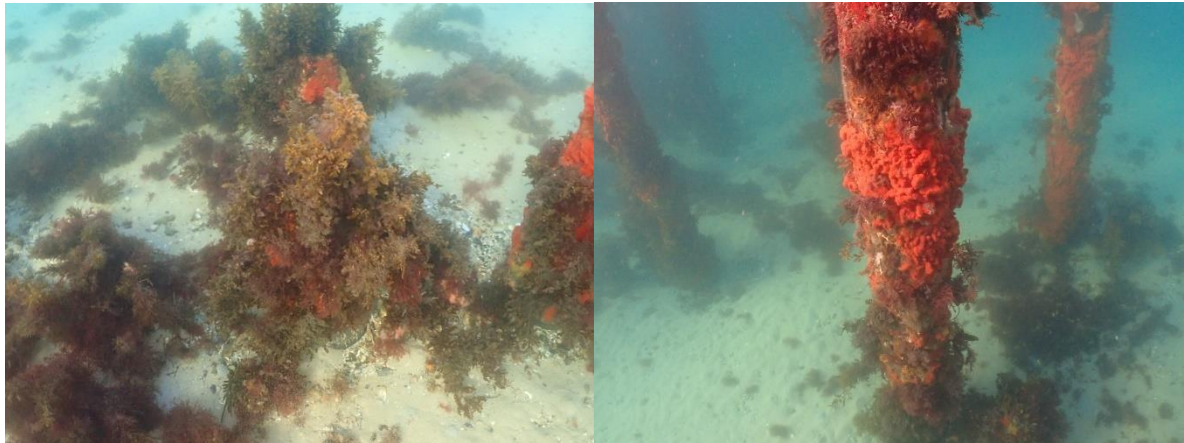


Chainage 180, SD 2.6 m, CD 1.7 m Chainage 190, SD, CD 1.8 m  
**Figure 6. Pier piles chainage 180 and 190**



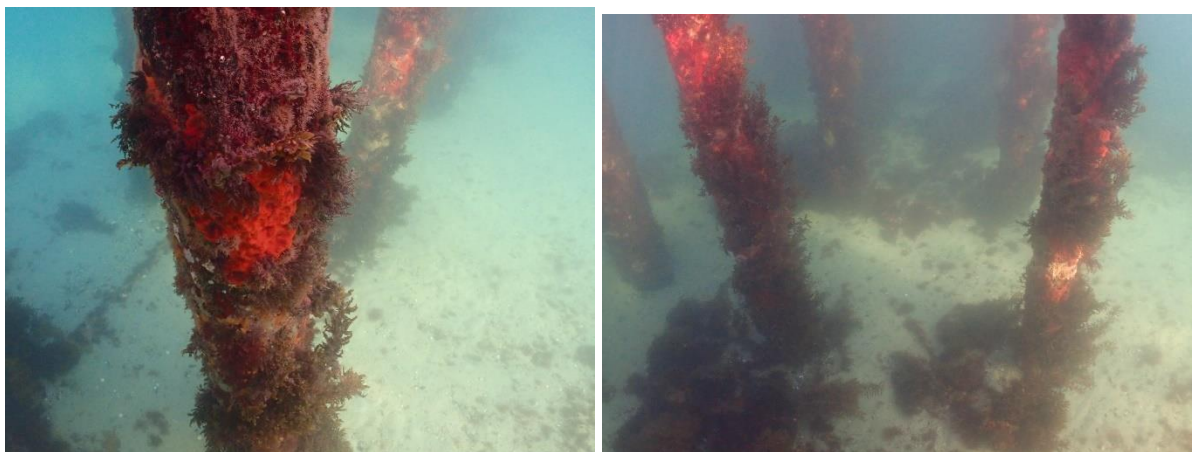
Chainage 200, SD 2.8 m, CD 1.9 m Chainage 220, SD 3.0 m, CD 2.1 m  
**Figure 7. Pier piles chainage 200 and 220**





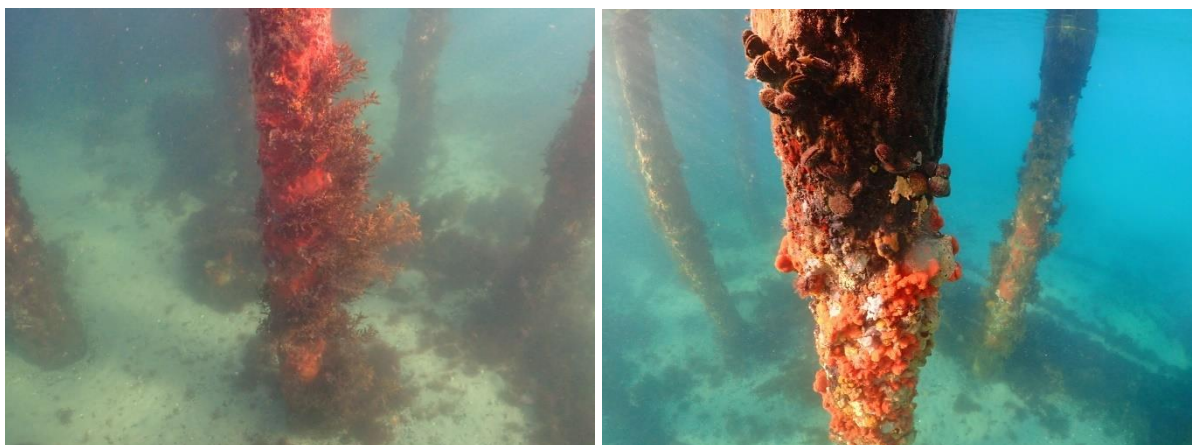
Chainage 230, SD 3.0 m, CD 2.1 m      Chainage 240, SD 3.2 m, CD 2.3 m

**Figure 8. Pier piles chainage 230 and 240**



Chainage 250, SD 3.5 m CD 2.6 m      Chainage 270, SD 3.7 m, CD 2.8 m

**Figure 9. Pier piles chainage 250 and 270**



Chainage 280, SD 3.8 m, CD 2.9 m

**Figure 10. Pier piles chainage 280**



Chainage 290, SD 4.0 m, CD 3.1 m      Chainage 350, SD 5.3 m, CD 4.4 m

**Figure 11. Pier piles chainage 290 and 350**

#### 4.1.1 Existing pile stumps

Pile stumps protrude from the seabed beneath the existing Pier all along the existing alignment. In the intertidal zone they are cut off close to the seabed, further along they are cut off at varying heights above the seabed but at a depth below the sea surface which appeared to correspond to the low water mark to about 0.5 m below low water. A detailed elevation survey of the pile stumps is required to determine the consistency of these observations. Marine growth on the pile stumps was similar to the adjacent complete piles.



**Figure 12. Piles at around chainage 140, Survey Water Depth 1.9 m, Depth to CD 1.0 m**



### 1.1.3 New Lower Landing

Parks Victoria installed a new lower landing and access platform for SCUBA divers at Rye Pier late in 2019. Observations of the landing during the July 2021 inspection showed that a range of marine invertebrates had colonised the HDPE jacketed steel piles and the landing structures.

The upper parts of the HDPE coating of the piles were covered with a thin growth of encrusting bryozoans. Growth on the lower parts of the piles was considerably thicker than the upper parts. The assemblage on the lower parts included encrusting bryozoans and sponges, colonial and solitary ascidians, bivalve molluscs, hydroids and red and brown algae.



Figure 13. New lower landing Rye Pier July 2021



Figure 14. New lower landing HDPE jacketed steel piles: upper section of pile

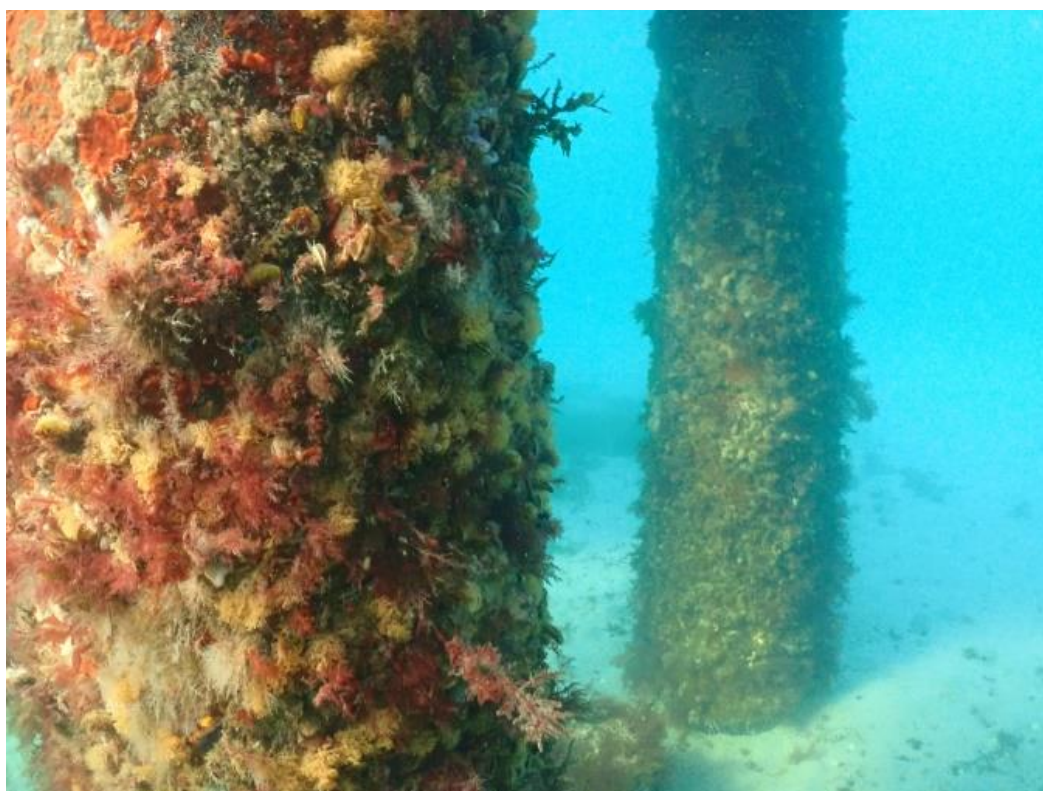
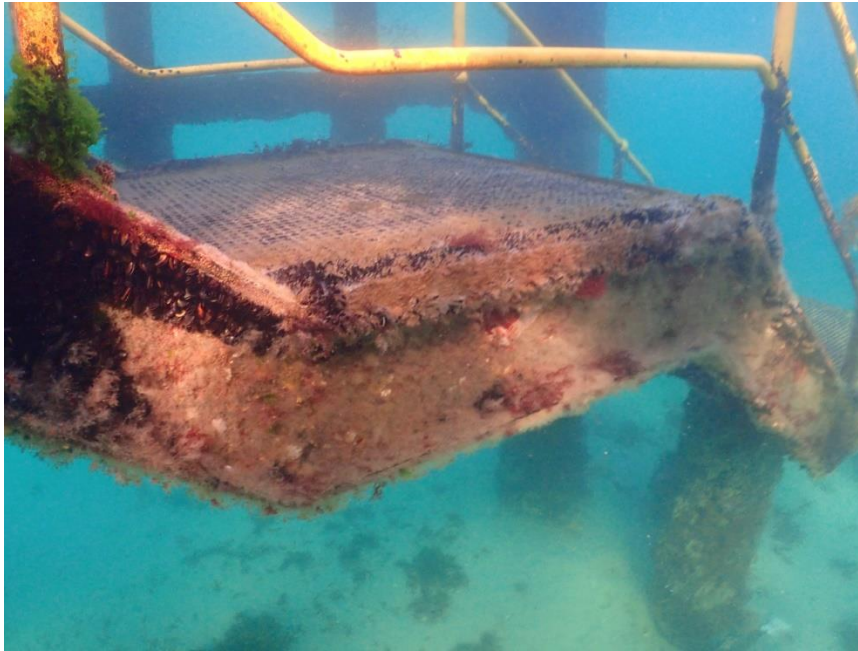


Figure 15. New lower landing HDPE jacketed steel piles: lower section of pile





**Figure 16. First stage at low tide mark, with mussel and hydroid growth**



**Figure 17. New lower landing - second stage at lowest landing**  
Encrusting growth of sponges, colonial ascidians solitary ascidians and hydroids

## 5 Optimal length of pile to remain as marine life habitat

Maintaining the Pier in a safe and functional condition requires periodic replacement of structurally unsound timber piles, beams and decking. Replacement of piles typically involves cutting off the old pile at or near the seabed, and installation of a new pile in adjacent seabed. Numerous piles have been replaced in this manner at Rye Pier over the years.

Observation of piles previously cut off beneath Rye Pier revealed that nearshore piles (within 120 m of the shoreline) were cut-off at seabed level, whereas offshore piles were cut off at increasing heights above the seabed from around 0.5 m to 1.5 m above the seabed. The remaining stumps appeared to be decaying mostly around the end. As noted above, marine growth appeared to be heaviest toward the base of some complete piles and cut off piles.

### 5.1 Ecological considerations

Ecological value with respect to Pier pilings may be considered in terms of the perception of the users of the Pier. Few marine naturalists are interested in the colours, shapes and species of the marine algae (seaweeds), which are of great interest to phycologists (scientists who study seaweeds). Most field naturalists and underwater photographers are more interested in the colourful and intricate shapes and patterns of the sponges, bryozoans and ascidians, mobile invertebrates like nudibranchs, seastars, crabs and octopus, the seahorses, pipefish, and fish that are associated with the habitat created on the piles by the seaweeds and encrusting invertebrates.

The interest marine field naturalists is reflected in the composition of Inaturalist list of 169 species recorded in the Rye Pier area (Table 1). Many of the fish recorded were not directly associated with the Pier pile habitat.

**Table 1. Percentage of total number of species recorded at Rye Pier**  
(source : [www.inaturalist.org](http://www.inaturalist.org))

Marine biological group	% species recorded
Fish, rays and sharks	40%
Mobile invertebrates	34%
Fixed and encrusting invertebrates	13%
Marine plants	7%
Seahorses and pipefish	4%
Birds	2%
Mammals	1%

#### 5.1.1 Biological growth with distance from shore

CEE's observations of marine growth on the Rye Pier piles 2021 indicated that winter growth was relatively sparse through the intertidal zone length of pier from Chainage 0 to 120. The increasing length of piles below the low water mark provides more pile habitat for growth, with consistent full cover of piles over 1 m of piles below the low water mark at chainage 140 m. The amount of subtidal habitat per pile increases along the Pier as water depth increases below the low tide mark. Biological growth appeared to greatest offshore from about chainage 180 m to 200 m, or 1.8 m depth.

Local field naturalist divers advised Parks Victoria in July 2021 the following useful summary of marine life along the length of the Pier based on their observations over many years (chainages and depth added by CEE):

- a) Piles 0 to 80: very little marine life, some sponges and ascidians  
*Chainage 0 to 115 m, mostly intertidal zone*
- b) Piles 80 to 124: some mussels and seastars  
*Chainage 115 m to ~180 m, depth 0 m to 1.8 m CD*
- c) Piles 124 and beyond “prime territory for seahorses”  
*Beyond chainage 180m, Depths greater than 1.7 m CD*

The local marine naturalists observations were consistent with CEE’s observation of generally of more abundant growth offshore from chainage 180 m, where water depth is approximately 1.7 m deep relative to chart datum (Figure 6). The conditions of denser encrusting invertebrate growth and presence of macroalgae noted by CEE provide good habitat for seahorses and pipefish as well as mobile invertebrates such as crabs and nudibranchs.

### 5.1.2 Biological growth with height above seabed

The marine ecological observations during this July 2021 and CEE’s previous September 2019<sup>1</sup> survey at Rye Pier show that vertical zonation of the *subtidal* community below the low water mark on the existing Pier pilings was relatively weak. No strong pattern of greater diversity or preference of biota for particular depth ranges was observed over the wooden piles. In contrast, observation of the new HDPE jacketed piles of the new lower landing at chainage 260 m in July 2021 showed greater diversity and abundance of the lower parts of the piles over the first 18 months since the piles were installed.



**Figure 18 Marine life on existing cut-off piles at Rye Pier near lower landing, CEE September 2019**

<sup>1</sup> “Rye Pier Lower Landing Replacement. Effects on Marine Life.” Report to Parks Victoria by CEE Pty Ltd, 4/150 Chesterville Road Cheltenham VIC 3192.



In general, biological growth at different depths on the piles is affected by:

- Tidal exposure to air  
Tidal exposure over the 1 m intertidal zone at Rye Pier results in strong difference in communities above the low tide mark compared to those below the low tide mark along Rye Pier.
- Sand scour near the sandy seabed  
There was little evidence of sand scour at the base of the piles at Rye Pier. Dense biological growth below the low tide mark was commonly observed to continue to within centimetres of the sandy seabed.
- Wave action on loosely attached biota  
Loosely attached biota may not persist in shallower areas where effects of wave action are strongest.  
The effects of wave action resulting in growth of larger, loosely attached biota at deeper parts of the Pier is not particularly obvious at Rye Pier, but may contribute to the observation of increased growth from chainage 180 m.
- Light intensity  
Reduction of light intensity with water depth may favour some plants at shallower depths. There was no evidence of this pattern of growth during the July 2021 survey. However, a pattern may become established over spring and summer when seasonal algal growth is likely to develop.

It is possible that seasonal changes in biota on the piles would include substantial increase in abundance and diversity of macroalgae and ephemeral invertebrates on the piles. A pattern of higher abundance of macroalgae on the upper parts of the piles and higher abundance of invertebrates on the lower parts of the piles may be expected.

## 5.2 Ecological Analysis and pile stump height options

The decision to remove or cut off old piles will depend on safety, cost and, in this case, marine naturalist amenity considerations. This section provides guidance on pile stump height that might retain marine ecological amenity for divers, snorkellers and photographers.

### 5.2.1 Chainage 0 to 120 m – Intertidal section

Safety considerations for piles across the intertidal zone may be influenced by the legacy of previous pile replacement programs, which have cut most piles off at the seabed along this section. The ecological value of these piles in this section to divers is considered to be low.

Piles in this section may be cut off at seabed level or extracted entirely.

### 5.2.2 Chainage 120 m to 150 m - Water depth 0 m to 1 m CD.

Safety considerations for piles across the intertidal zone may be influenced by the legacy of previous pile replacement programs, which have left stumps protruding up to 1 m above the seabed in this section.

Pile stump heights left may follow those from previous programs, or standardised to 0.6 m above seabed or be cut off at seabed height or removed entirely depending on Parks safety considerations for this area of bathing waters.

### 5.2.3 Chainage 150 m to 200 m - Water depth 1 m to 2 m CD.

Ecological values for divers along this section are greater than those inshore of chainage 150 m due to greater water depth, and proximity of the new divers landing provided by Parks Victoria. Previous pier repair programs have left stumps protruding more than 1 m above the seabed in this section.

Piles cut off at 0.5 m below chart datum through this section would result in stumps from 0.5 m to 1.5 m above the seabed. This would retain 50% to 75 % of the pile habitat and a greater proportion of the habitat valued by SCUBA divers and photographers who tend to swim along or close to the seabed.

### 5.2.4 Chainage 200 m to 300 m - Water depth 2 m to 3 m CD.

Ecological values for divers along this section are high as a result of the greater water depth enjoyed by divers and new divers landing provided by Parks Victoria located within this section. Previous Pier repair programs have left stumps protruding more than 1 m above the seabed in this section.

Piles cut off at about 0.5 m below chart datum through this section would result in stump levels similar to the lower diver landing and stump heights of 1.5 m to 2.5 m above the seabed. This would retain 75% to 83 % of the existing subtidal pile habitat and a greater proportion of the habitat valued by SCUBA divers and photographers who tend to swim along or close to the seabed.

The addition of the new wooden piles and subsequent colonisation by similar biota will, of course, add to the area of the existing pile habitat and result in a much greater area of pile marine life than exists presently.

## 5.3 Safety, construction and maintenance considerations

The pile stump heights described in Section 5.2 are provided as a guide for Parks Victoria to refine with due consideration to other important factors such as beach goers and bathers' safety, vessel navigation safety, construction feasibility and cost, ongoing maintenance practicality and structural longevity.



## 6 Conclusion

Rye Pier is central to the beach and marine environmental amenity of the Mornington Peninsula. The natural biodiversity values of Port Phillip's nearshore marine environment around Rye are characterised by the clear waters, clean sandy seabed and relative absence of natural reefs.

The piles of Rye Pier provide a solid structure for attachment of plants and animals that are otherwise found on Port Phillip natural reefs located 10s of kilometres from Rye. The growth on the piles of the Pier, the easy access to deep water via the new pier landing, lack of strong currents and sheltered waters during southerly wind conditions provide Rye Pier as an important location for SCUBA divers, marine naturalists and underwater photographer and videographers.

Parks Victoria is committed to maintaining the marine natural history values of the pier to divers when the existing deteriorated wooden structure is replaced by a new, wider wooden structure. This report was commissioned to provide guidance on the value of the piles along the pier alignment to marine naturalists and recommend sections of the pier and heights above seabed that the piles to be replaced may be retained to maintain as much of the existing marine ecological values to divers as possible.

The study established a depth profile along the pier alignment and found that the marine ecological value of the marine biota inhabiting the pier piles for underwater experience increased with increasing distance from shore and increasing water depth. Four distance intervals and corresponding depth ranges were identified and rated with increasing value to divers. The intervals are consistent with the observations of, and values to, local marine naturalists.

CEE provided marine ecological, diver amenity and existing condition-based guidance on the treatment of the redundant existing piles that will be replaced during the planned rebuild of the Pier. The guidance treatment of the four sections is summarised below

- i. Chainage 0 to 120 m – Intertidal section  
Redundant piles may be extracted completely or cut off at seabed level
- ii. Chainage 120 m to 150 m - Water depth 0 m to 1 m CD.  
Redundant piles may be extracted completely or cut off at seabed level or cut off redundant piles at level of stumps that are presently found in this section
- iii. Chainage 150 m to 200 m - Water depth 1 m to 2 m CD.  
Redundant piles should be cut off at around 0.5 m below chart datum \*
- iv. Chainage 200 m to 300 m - Water depth 2 m to 3 m CD.  
Redundant piles should be cut off at around 0.5 m below chart datum \*

Although the area of old pile habitat will be reduced to some extent by these options, most of the amount of habitat usually accessible to divers and photographers will be retained. Importantly, the habitat provided by the Pier will be *increased* with the installation of a similar number of new wooden piles that will be colonised by marine biota in the area.

The process of colonisation and ecological succession will result in the same biota that presently inhabit the Pier pile habitat. The increased number of piles and habitat area is likely to increase the number of species present and increase the value of the Pier to divers.

It is recommended that the new piles be ecologically monitored to provide information and an evidence-base for management of pile replacement programs in the future.