340E Pahoia Road, Whakamarama

For Dave McFarlane

Coastal Processes Impact Assessment

July 2020

REPORT INFORMATION AND QUALITY CONTROL

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1 INTRODUCTION

Dave McFarlane engaged 4Sight Consulting Ltd (4Sight) to undertake a site-specific coastal processes impact assessment for the seawall at 340E Pahoia Road, Tauranga. The subject site is located on the eastern shoreline of the Pahoia Peninsula, approximately 14km northwest of the Tauranga CBD (Figure 1). The seaward edge of the property abuts the Waipapa Estuary of the Tauranga Harbour.

Overall, the property contains three parcels of land. The main parcel (delineated in Figure 1) is approximately 2.3 hectares and comprises of grass lawn; a mixture of planted and natural indigenous shrubland, scrub, forest, and treeland; a driveway, and a large shed with a concrete pad. There are also two smaller land parcels associated with the property which comprise two separate 'islands' of terrestrial vegetation located within the Waipapa Estuary. The seawall which is the focus of this coastal processes impact assessment is only located within the main parcel boundary, and therefore the two smaller land parcels are not considered further in this report.

When the property was purchased in November 2017, the seaward extent of the main property parcel was delineated by a low retaining wall between the tidal habitat and the mown grassland. This original structure comprises uPVC plastic sheet-piling and extended along the full length of the seaward margin of the main property parcel. The owner left the original structure in place and subsequently built a new timber pole retaining wall positioned 0.5m behind (inland), creating a stepped structure. The narrow strip between the two structures was then covered with concrete. Photos of the structure taken during site investigations are presented in Appendix A.

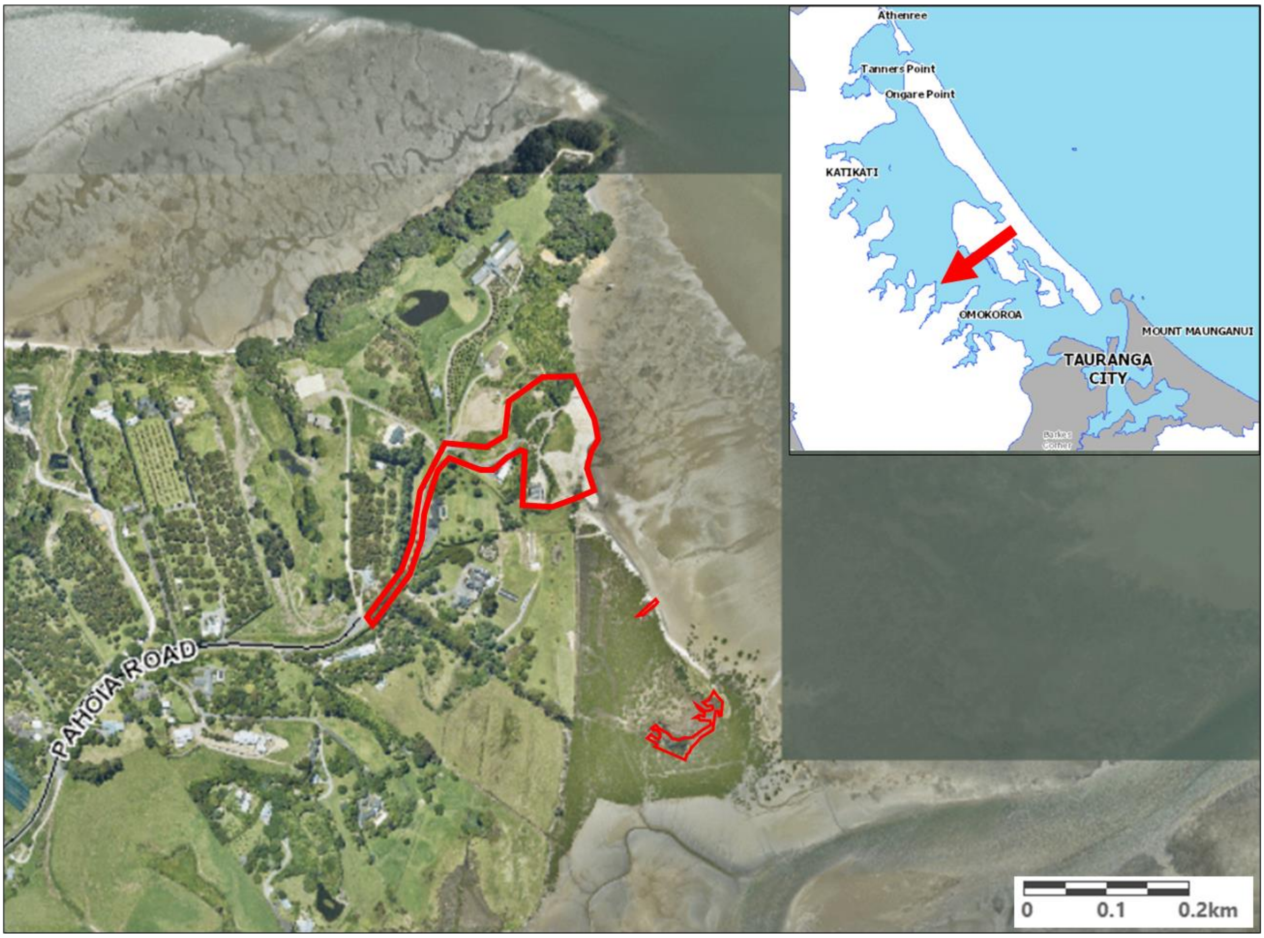


Figure 1: Subject site highlighted by the red polygon and arrow (extent of property boundaries only approximate). Source: Western Bay of Plenty District Council Mapi.

1.1 Scope

The Bay of Plenty Regional Council (BOPRC) has requested a coastal processes impact assessment be undertaken to allow the regulator to understand the potential risks to environment from the existing wall. The purpose of this report is therefore to provide a site-specific understanding of the natural coastal processes operating along this section of the western shoreline of the Tauranga Harbour. Comment will be provided in respect to the suitability of the structure (both the existing uPVC wall and additional new retaining wall) in the context of the local coastal regime and any potential effects on the receiving environment, including those associated with future predicted sea level rise. This report is intended to accompany a retrospective resource consent application for the retaining wall.

2 COASTAL SETTING

The site is situated approximately 400m south of Ngakautuakina Point on the eastern shoreline of the Pahoia Peninsula on the mid-western edge of the Tauranga Harbour. As noted above, the Waipapa Estuary exits to the east of the site with the estuary channel meeting the main harbour channel approximately 1,500m east of the site. The area leading toward the main channel is characterised by open tidal sand flats. South of the subject site there is a small chenier ridge that has allowed for the establishment of mangrove habitat in behind the feature. The main geomorphic features in the area are highlighted in **Figure 2** below.

The site itself is characterised by a low-lying grass area behind the subject seawalls. Based upon a brief analysis of the satellite photo record it appears that the area was further developed between 2003 and 2009 with the extension of the flat grassed area.

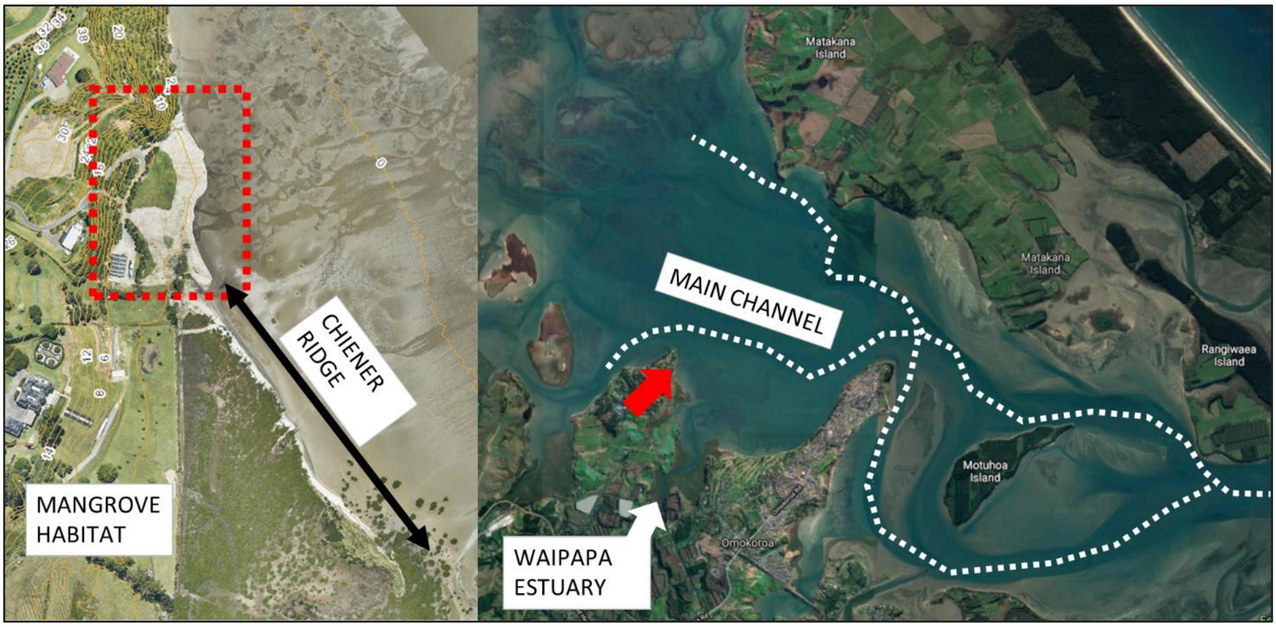


Figure 2: Geomorphic features within the subject area.

3 COASTAL PROTECTION STRUCTURES

It is understood that the original uPVC plastic sheet pile wall was constructed approximately 12 years ago. The height of this wall varies between 0.6-1m above the sand. A structural assessment undertaken by Kirk Roberts Consulting considered the uPVC sheet pile wall to be in a reasonable condition from a durability perspective with no apparent chalking, which can indicate UV damage and degradation to the plastic. It was observed during the site visit that there is vertical rotation of the wall in some places, but it appears that there has been no additional movement following installation of the new timber wall behind. The predicted lifespan of the original uPVC wall is expected to be at least another 15 years[1]. This is reliant on the ground level in front of the wall remaining at the current levels and not reducing.

Evidence of overtopping of the original uPVC wall were observed during the site visit with the presence of *Sarcocornia quinqueflora* (Glasswort) noted just behind the wall. Glasswort lives in contact with seawater and therefore provides a good natural indicator of where the extent of tidal inundation is. It is therefore likely that the uPVC wall is getting overtopped multiple times a month.

The new timber pole retaining wall extends the full length of the seaward margin of the main property parcel. It is positioned 0.5m inland of the original uPVC wall and extends to a higher level (750mm above). There is a concrete strip between the original sheet pile wall and the newer higher-level structure.

The Kirk Roberts report considers the condition of the newer timber wall to be good with the wall apparently experiencing no signs of movement or distress/overloading. As such the structural integrity of the wall is considered to be acceptable. Unlike the wall in front, the timber poles are not immersed in seawater continuously and therefore the durability of the timber wall itself is expected to exceed 20+ years.

Figure 3: Existing uPVC seawall and new timber pole retaining wall fronting the coastal fringe of 340E Pahoia Drive.

[1]McMillan, D. (2020). Retaining Wall/Seawall Structural Assessment. Report prepared by Kirk Roberts Consulting for Dave McFarlane. July 2020.

4 LOCAL COASTAL PROCESSES

In general, the site can be considered relatively low energy due to the protection afforded from its location within a sheltered deep-water harbour. The respective sections below describe the coastal processes operating in the area.

4.1 Tidal Regime

Tidal data has been taken from secondary port data at Omokoroa situated approximately 4.5km southeast of the subject site (sourced from LINZ[2]). The spring tidal range in the area is in the order of 1.8m meaning that it can be considered to be a microtidal coast. The tidal data presented in **Table 1** below is referenced relative to both Chart Datum (CD) and Moturiki Vertical Datum 1953 (MVD-53).

Table 1: Relevant tidal variables given for the Omokoroa tide gauge that have been adopted for the site.

	MHWS	*MHWN*	*MLWN*	*MLWS*	*MSL*	*Spring Range*	*Neap Range*
CD RL(m)	2	1.8	0.5	0.2	1.2	1.8	1.3
MVD-53 RL(m)	1.04	0.84	-0.46	-0.76	0.24	N/A	N/A

4.2 Extreme Water Levels

NIWA recently undertook modelling to determine inundation levels for selected sites around the Tauranga Harbour as part of background technical work to establish defined coastal flood hazard zones for BOPRC. This assessment presents the predicted extent of inundation by spring tides, as well as storm tide and wave setup elevations corresponding to the 2%, 1% and 0.2% Annual Exceedance Period (AEP) events. Consideration is given to present day extreme water levels and a number of future sea level rise (SLR) scenarios as set out in the MfE (2017) guidance[3].

Table 2 below presents a range of extreme water levels for the subject site using the information obtained from NIWA's modelling of coastal inundation for the inner Tauranga Harbour[4]. The elevations presented have been obtained from modelling point 54 and are those resulting from a combination of storm tide and wave set-up.

Table 2: Modelled extreme storm-tide and wave setup elevations for the subject site for present-day and SLR scenarios. All elevations are relative to Moturiki Vertical Datum 1953 (MVD-53).

Return Period	*MHWS-7* [1]	2% AEP (50yr)	1% AEP (100yr)	*0.2% (500yr)*
Current Day (2020)	1.05	2.48	2.67	3.20
+0.6m SLR	1.53	-	3.15	-
+1.25m SLR	2.22	3.59	3.77	4.28
+ 1.6m SLR	2.59	-	4.10	4.60
Notes: 1. *The extent of inundation by spring tides*				

[2] https://www.linz.govt.nz/sea/tides/tide-predictions/standard-port-tidal-levels

[3] MfE. (2017). Coastal hazards and climate change: Guidance for local government. Ministry for the Environment Publication ME1341. Wellington, Ministry for the Environment.

[4] Reeve, G., Stephens, S., and Wadhwa, S. (2019). Tauranga Harbour inundation modelling. Prepared by the National Institute for Water and Atmospheric Research (NIWA) for Bay of Plenty Regional Council. June 2019. NIWA Client Report 2018269HN.

4.3 Wind Climate

Hindcast wind data has been sourced from Metocean View[5]. As can be seen from **Figure 4** below the predominant wind is from the west, with south-westerly winds also considered to be a significant contributor to the local coastal processes regime.

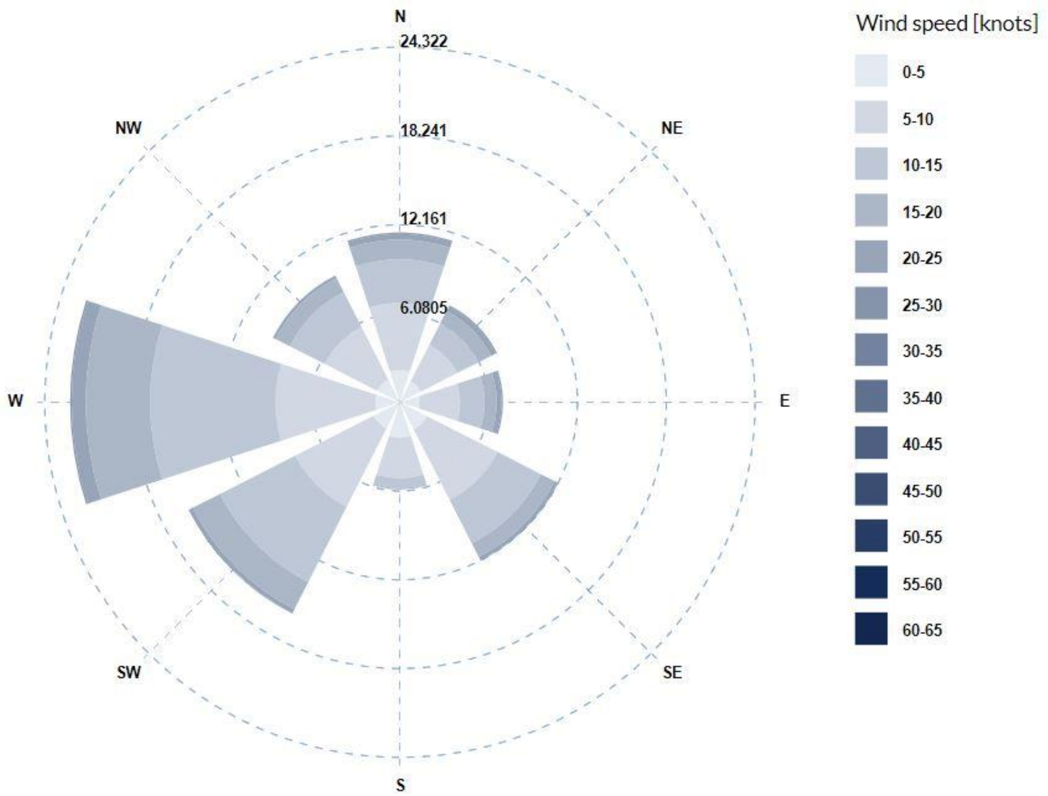


Figure 4: Wind rose for the modelling point closest to the site[5].

4.4 Wave Climate

Due to is inner harbour location the site is not subject to open ocean swell event and only wind waves are considered to be operating at the site. **Figure 5** illustrates some of the significant fetches the site is exposed to. As a check on the wave heights obtained from the modelling point, calculations of the wave height from the predominant westerly wind was undertaken. The greatest fetch distance extends to approximately 5km over reasonably shallow water and was calculated to produce a significant wave of approximately 0.7m under extreme conditions. This is the theoretical wave height based upon the high tide fetch and a 12-hour wave generation period. The generation of wind waves are expected to be significantly impacted by variations in wind direction and open water (due to the tidal cycle) over a storm event. Therefore, it is considered that wave heights in the area are generally under 0.3m and significant wave heights for design purposes are in the order of 0.5m. At the wall itself, wave heights are expected to have been reduced due to the water depth.

[5] https://app.metoceanview.com/hindcast/sites/nz/-37.65/176.1

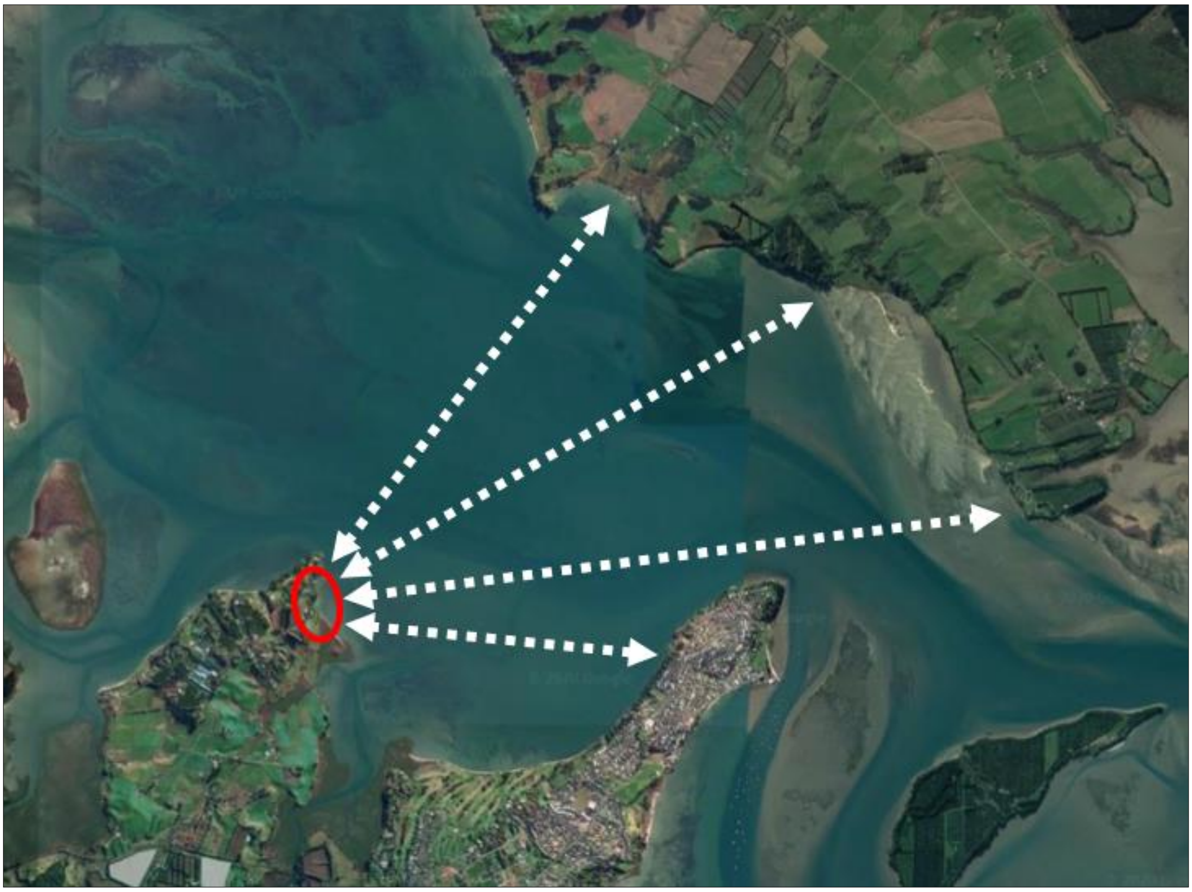


Figure 5: Significant fetch directions for the subject site.

5 DESIGN SUITABILITY - COASTAL PROCESSES

Based on the information supplied by the structural engineer it is understood that the structure is estimated to have approximately 15 years before requiring some maintenance or upgrade. Therefore, an assessment of the design suitability in the context of the local coastal processes has not taken into account future sea level rise projections.

The exact level of the upper wall crest is not known so this assessment is reliant upon LiDAR data and observations from the site visit. It has also been assumed that the LiDAR data was obtained prior to the installation of the timber wall extension above the original uPVC structure. **Figure 6** below shows the location of the RL2m contour on average between 5-10m behind the original structure. The discolouration of the uPVC wall that can be seen in **Figure 3** above indicates that the majority of the structure is subject to tidal waters regularly and that the mean high tide mark is close to the crest of the wall. This is supported by the degree of wash out behind those parts of the wall where recent upgrade works have not yet been undertaken. Therefore, the crest of the recently installed timber retaining wall is assumed to be in the order of RL1.8-2m. Using this assumption and based upon the inundation levels provided in Table 2 above it is expected that that the structure will be overtopped during extreme storm conditions.

Moving beyond the 15-year lifespan for the structure, any future maintenance or upgrade works would need to take into account future sea level rise projections. This could be achieved through raising the crest height and/or planting of suitable salt-tolerant species.

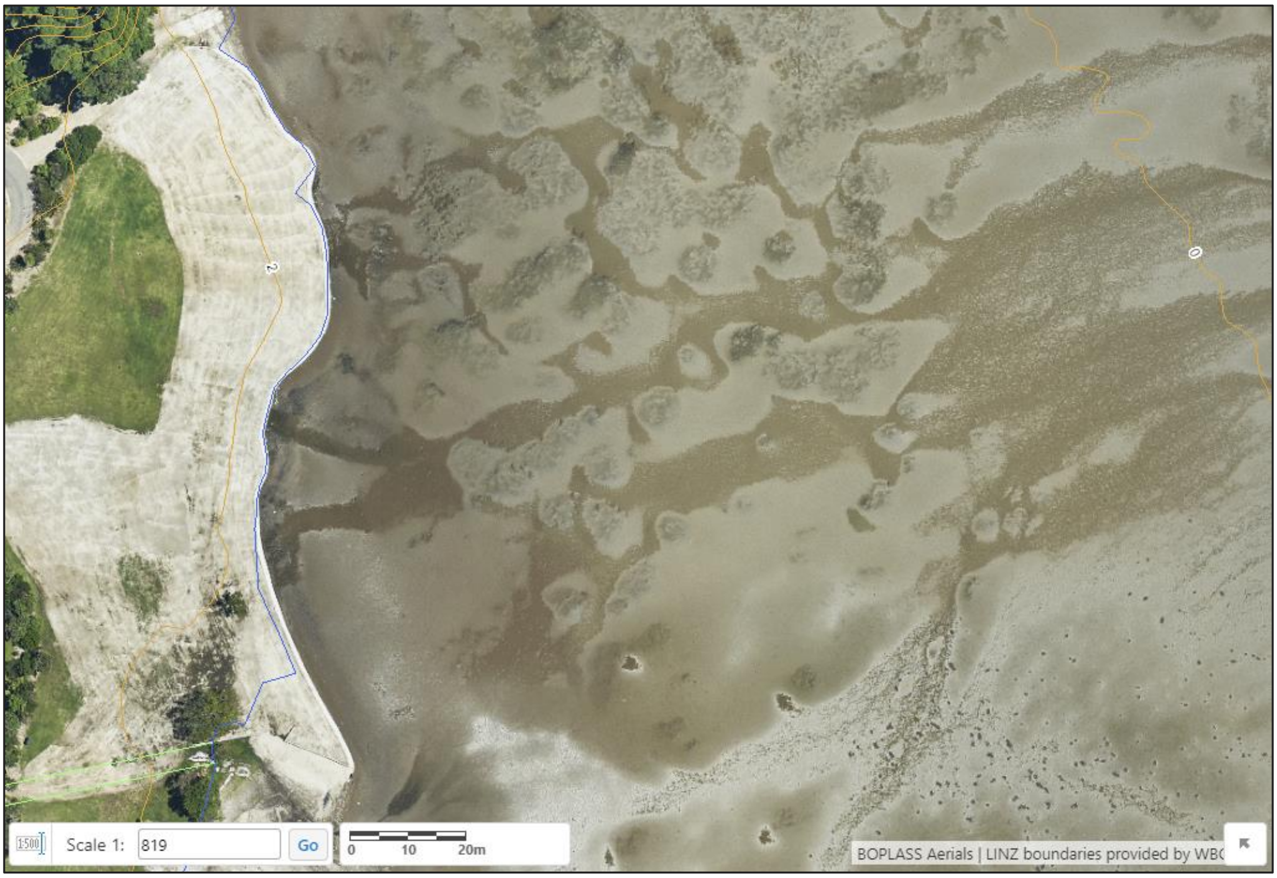


Figure 6: Contour map of the site obtained from the Western Bay of Plenty Mapi site.

The structural assessment highlighted that the integrity of wall was reliant upon sand levels in front of the structure remaining at the same level. Fluctuations in this level can be expected dependent upon the variance in weather conditions, for example increased wave activity associated with storm events which will result in reflection (due to the vertical nature of the structure) and a lowering of sand levels in front of the wall. However, given the relatively low energy receiving environment and wave energy operating at the site, scour associated with reflection is expected not to exceed more than 150mm. It is noted within the wider setting there is no evidence of significant sediment transportation. Further, given the uPVC wall has been place for approximately 12 years it is anticipated that the geomorphology and sediments within the vicinity have large adjust to its presence.

Only minor amount of drainage was noted through the structure during the site visit and the structural assessment did not directly address the issue, but it is assumed this was taken into account in the assessment of the 15+ year lifespan. However, beyond the structure's anticipated lifespan any upgrade of maintenance undertaken will need to allow for increased drainage capacity as anticipated sea-level rise will result in increased ground water pressures acting upon the structure.

6 COASTAL PROCESSES IMPACT ASSESSMENT

As mentioned above the uPVC structure has been in place for approximately 12 years and based upon analysis of the satellite imagery and observations on site there have been no demonstrable adverse effects on the local coastal processes regime or adjoining geomorphic features (**Appendix A** and **Figure 7**).

It is understood that recent works included an extension and small reclamation to the southern extent of the seawall. As with most coastal protection structures, this has the potential to cause some effects to the area immediately south. This potential has been mitigated to some degree by the return design and tethering the structure back into the ground. Further, the potential for end effects is reduced by the inclusion of a small deflection groyne at the end of the wall and small waterway area at which the structure terminates at. The small deflection groyne will act to push any additional turbulence created by the vertical nature of the seawall toward more open waters instead of being focused around the end of the structure toward unarmed areas of shoreline.

The small waterway appears to be draining the area behind the Chenier Ridge (**Figure 8**) and provides a degree of natural turbulence which the surrounding environment has adapted to. This will also serve to absorb any additional turbulence that is generated from the seawall.

As noted above, there are no discernible effects on the Chenier Ridge or mangrove habitat observed during the site visit or within the air photo/satellite imagery analysis. These types of environments are thought to be relatively resilient; the Chenier Ridge is a transgressive feature, slowly rolling landward as it is overtopped by storm events and the mangrove habitats are able to absorb low wave energies and the root matting design to retain sediments.

In consideration of the above, the effects from the seawall are likely to continue to be negligible over the next 15 years, assuming the structure remains in a similar condition as it is currently.

Figure 7: Chenier Ridge and mangrove habitat immediately south of the subject site

Figure 8: Southern termination point of the seawall with small rock deflection groyne.

Figure 9: Small waterway immediately south of the recent seawall extension.

7 CONCLUSIONS AND RECOMMENDATIONS

Given the majority of the seawall has been in place for approximately 12 years it is considered that the local coastal processes regime has largely adjusted to its presence. Further, the potential for any adverse effects is considered to be low due to:

- The relatively low energy coastal processes regime;
- The design of the southern point of the structure; and
- The resilience of the receiving environment.

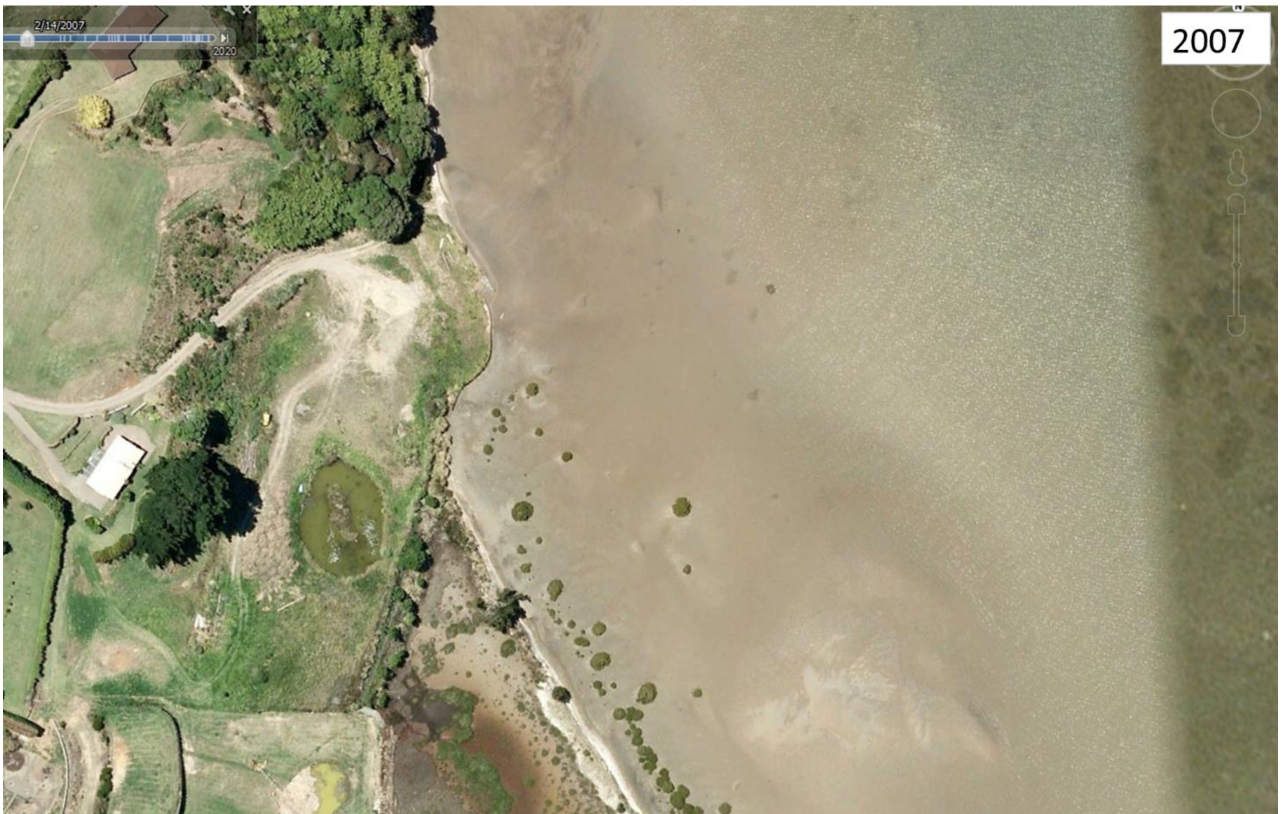
Whilst the structural assessment estimates the existing uPVC structure has a lifespan of approximately 15 years, it is recommended that a condition assessment and monitoring programme be established to enable the detection of any potential structural failure. Given the relatively low energy receiving environment it is anticipated that this could occur on a two-year cycle.

Any future maintenance or renewal works beyond the 15-year lifespan will need to take into account the potential impacts of climate change and sea level rise.

Appendix A:

Representative Aerial/Satellite Imagery


2003
Image Bay of Plenty TA's
Google Earth
2003
Imagery Date: 12/1/2002 37°37'37.05" S 176°00'52.32" E elev 22 m eye alt 378 m


2/14/2007
2020
2007
Image Bay of Plenty TA's
Google Earth


2009
6/16/2009
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PRESENT DAY
Scale 1: 1,638 Go
0 20 40m

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