



Decolonised [dē-kōl'e-nīz'ed]

verb

Cities that are equitable places for *all* whānau, reflecting Māori values and identity.

PORIRUA'S PHYSICAL ENVIRONMENT

This profile details the location and physical geography of Porirua, before moving onto key environmental issues within the area. These environmental issues are the result of the city's history, particularly relating to settlement patterns and the development of Porirua City. The Porirua Harbour is at present severely degraded and this report explains the factors that led to this situation. It also details current initiatives aimed at restoring the harbour to its prior condition. Current issues related to Porirua's waterways are later discussed, explaining how this impacts marine life. This is followed by a focus on terrestrial biodiversity decline and how this situation is beginning to improve. Arsenic is mentioned as a contemporary environmental issue caused by the burning of treated firewood. The final section of this report explains the natural hazards in Porirua and the City's emergency management.

LOCATION AND PHYSICAL GEOGRAPHY

The Porirua landscape extends over roughly 21,300ha of land (Ammundsen, 2015). This area ranges from Pukerua Bay in the north and 28km south to Johnsonville, and from Titahi Bay on the west coast and 15km east to Haywards Hill (Ammundsen, 2015).

The region is characterised by rolling topography, with some moderately steep areas and other small planes lying at the base of valleys. The landscape in Porirua has suffered dramatic modifications as a result of human settlement and activity (Ammundsen, 2015). The most significant changes have stemmed from land reclamation surrounding the harbour for infrastructure and urban development, as well as the reformation of stream channels to mitigate flood risk (Ammundsen, 2015). The following sections will detail the significant impacts that both land reclamation and general settlement has had on both the marine and terrestrial environment and its inhabitants.

PORIRUA HARBOUR

The Porirua harbour has two branches, Pauatahanui Inlet which is the larger of the two at 470 hectares and Onepoto Arm which is half the size at 240 ha (Porirua City Council et al., 2012). "The catchment covers 185km² comprising pasture (45.8%), native forest and scrub (15%), exotic forest and scrub (22.8%), and an increasing proportion of urban development (13.8%)" (Porirua City Council et al., 2012, p. 2). The harbour is an important 'resource' for Porirua and the wider region. It's appreciated as a source of identity; a cultural resource, recreational resource, a source of mana, an economic resource and also an ecological resource (Porirua City Council et al., 2012). As the "largest estuary in the lower North Island" (Porirua City Council et al., 2012, p. 2) the harbour plays an important role in the ecology of Porirua and the wider region (Porirua City Council et al., 2012). The Pauatahanui Inlet is an important area for many 'threatened' and 'at risk' wetland bird species. The harbour in general has significant seagrass cover and a large cockle population (Porirua City Council et al., 2012).

The historical, and continuing, development of Porirua has severely impacted the health of the Porirua harbour. As discussed in the historical section, this area was initially settled by Māori and at this time it was characterised by abundant resources such as food and construction materials (Porirua City Council et al., 2012). In the early 1800s when Europeans began to build a settlement, large areas of forest were converted into pasture and farmland (Porirua City Council et al., 2012). Sedimentation in the harbour and the changes that happened at the head of the Pauatahanui harbour arm can be attributed to this mass deforestation and its associated erosion (Porirua City Council, n.d.-d). Land reclamation was also a major contributor as “many thousands of tonnes of soil were deposited into the harbour” in this process (Porirua City Council, n.d.-d, p. 1). Important ecological areas such as spawning and feeding grounds have been lost due to modifications made to the edges of the harbour as well as streams (Porirua City Council et al., 2012).

The infrastructure that accompanied this settlement also played a role in the harbour’s degradation. The construction of State Highway 1 and the main railway line along the harbour’s edge, means that pollution from vehicles e.g. exhaust fumes, travels via storm water into the harbour (Blaschke, Anstey, & Forsyth, 2009). The Porirua Hospital also impacted on the water quality of the harbour where at its peak of 2,000 patients, all of the raw sewage was being pumped directly into the Porirua stream or the harbour (Porirua City Council et al., 2012). The once abundant shellfish and sea resources have frequently been contaminated and are not fit for human consumption in certain parts of the harbour (Porirua City Council et al., 2012).

A lack of environmental legislation has allowed for the degradation of the Porirua Harbour. From the 1940s complaints were made over raw sewerage and other contaminants entering into the harbour, however no action was taken and by 1960 “the Porirua arm of the harbour had been significantly affected by the impacts of water pollution, reclamation and various public works” (Takapūwāhia Community & Porirua City Council, 2014, p. 10). Despite Ngāti Toa’s attempts and requests to have their interests recognised (Native Land Court order 1883, Petition in 1960) they were unable to “play a meaningful role in the management of the harbour” (Takapūwāhia Community & Porirua City Council, 2014, p. 10). Instead they watched as important breeding grounds were degraded and their communities were plagued with sickness due to contaminated kaimoana. Applications seeking compensation have been ignored (Takapūwāhia Community & Porirua City Council, 2014).

In an attempt to remedy this situation, The Porirua Harbour and Catchment, Strategy and Action Plan has been developed by “Porirua City Council, Greater Wellington Regional Council and Wellington City Council in partnership with Ngāti Toa Rangatira, and with the support of other agencies and the community” (Porirua City Council et al., 2012, p. 6). It aims to identify the risks and make a plan to improve the current situation (Porirua City Council et al., 2012, p. 6). This plan is based on research that has been undertaken in the harbour for the last 30 years and identifies the three main factors causing harm to the harbour, these being identified as excessive sedimentation rates, pollutants and ecological degradation (Porirua City Council et al., 2012).

SEDIMENTATION

Sedimentation is a process which occurs naturally in estuaries. However the issue in the Porirua Harbour is that sediment accumulation rates from the period of 1974 to 2009 appear to be 6 times the rate for a healthy estuary (Porirua City Council, Greater Wellington Regional Council, Wellington City Council, & Ngāti Toa Rangatira, 2012). The source of this sediment is both terrestrial and marine (Porirua City Council et al., 2012). The marine source is sand that has moved into the shelter of the harbour with the tides and currents and has remained there (Porirua City Council et al., 2012). The terrestrial source is the major source of sediment in the harbour and is caused by erosion, development and earthworks (Porirua City Council et al., 2012). Sedimentation is detrimental as it affects a variety of marine life, from shellfish to sea grass and causes concern for the ability of the harbour to foster healthy fish populations (Porirua City Council et al., 2012). Another concern is that because the sedimentation reduces the amount of water that is able to move in and out of the harbour, it acts to hinder the harbour’s ability to flush out pollutants (Porirua City Council et al., 2012). Sedimentation is also impacting on the recreational use of the harbor. It

has lost much of its visual appeal and areas of the harbour have become unnavigable in boats (Porirua City Council et al., 2012).

POLLUTION

A variety of pollutants have been identified within the harbour. These include elements such as heavy metals, pesticide residue (such as DDT), litter, chemicals (such as those from vehicle exhausts) and often excess nutrients (from agricultural runoff) (Porirua City Council et al., 2012). Pollutants are frequently discharged into the streams and harbour from the stormwater system (Porirua City Council et al., 2012). Each pollutant has differing impacts however as a whole, these pollutants have made areas in the harbour inaccessible for swimming (Porirua City Council et al., 2012). In addition, excess nutrients have led to the growth of 'nuisance' algae and which deplete the harbour of oxygen, impacting fish and invertebrate populations (Porirua City Council et al., 2012).

ECOLOGICAL DEGRADATION

Estuaries are incredibly important for the local ecology in Porirua and also the wider region. They are often seen as 'productive ecological communities' (Porirua City Council et al., 2012). Sedimentation and pollution as well as harbour modifications (e.g. land reclamation) have reduced the health of ecologies within the harbour (Porirua City Council et al., 2012). Porirua Harbour is important as it is a core site for seagrass in the lower North Island which is currently in decline (Porirua City Council et al., 2012). Seagrass is significant as it "provides a habitat which is important to feeding, spawning, and acts as a nursery and refuge for marine invertebrates, fish and birds" (Porirua City Council et al., 2012, p. 9). Despite the loss of habitat and heavy of pollutants in the harbour, research has found that the harbour as a whole still maintains the ability to regenerate. Future improvements to the ecological health of the harbour are very possible if actions are taken now (Porirua City Council et al., 2012). Reducing sedimentation rates, reducing pollutant inputs, and restoring ecological health are the core objectives of the Porirua Harbour and Catchment Strategy (Porirua City Council et al., 2012).

It is also important to note that climate change and sea level rise is expected to impact the harbour (Porirua City Council et al., 2012). While there is uncertainty over what effects will be felt, there is a concern that higher than typical rainfall could lead to increased erosion and sedimentation (Porirua City Council et al., 2012).

WATERWAYS

"The Porirua catchment is a low lying valley between the Wellington and Ohariu faults and the Wellington and Porirua Harbour" (Blaschke et al., 2009, p. 1). The Porirua Stream is a core part of this catchment and feeds into the harbour at the Onepoto Arm (Blaschke et al., 2009). It is recognised as a 'significant indigenous ecosystem' as it "provides a habitat for threatened or endangered indigenous fish species & habitat for six or more indigenous fish species" (Blaschke et al., 2009, p. 13). These include the giant kokopu, the longfin eel, and inganga (one of five fish which make up the whitebait catch) (Blaschke et al., 2009).

As of 2008 the water quality within this stream was poor. This was mainly due to high levels of faecal bacteria, nutrient concentrations and water clarity (Blaschke et al., 2009). Research examining the role that storm water played in urban streams in the region, showed that storm water was a significant source of a variety of contaminants such as heavy metals and pesticides (Milne & Watts, 2008). Often these built up in the sediment and some were found to be at detrimental levels to the ecosystems within the streams which then flow into the harbour (Milne & Watts, 2008).

Urban development has also meant that often buildings back onto streams making them inaccessible and hence they can be areas in which litter accumulates and invasive plant species or pests thrive (Blaschke et al., 2009). Another issue related to the city's development is the physical flood barriers which act as an obstacle for native fish migration (Blaschke et al., 2009). These structures are needed as development has occurred on the natural flood plains (Blaschke et al., 2009). Roads and buildings have been built in low

lying areas and close to the stream so there is a limited area for the stream to flow through (Blaschke et al., 2009). These developments have also reduced the permeability of the land meaning that flood barriers are needed to reduce the potential for flooding (Blaschke et al., 2009). However, flood barriers cause changes in the stream habitat, hinder fish migration and spawning (Blaschke et al., 2009). Even elements such as the way that the stream flows or where there is still water, means that habitats are not available for certain species (Blaschke et al., 2009).

The degradation of the Porirua Harbour has impacted on Ngāti Toa's ability to practice aspects of their culture. The iwi has been unable to conduct traditional practices such as the gathering of kaimoana due to contamination. This has meant that these skills or knowledge have not been transmitted to later generations (Takapūwāhia Community & Porirua City Council, 2014). Harbour modifications and further environmental degradation in the harbour has meant that Ngāti Toa have also been unable to monitor taonga species (Takapūwāhia Community & Porirua City Council, 2014). The iwi have been unable to provide their visitors with kaimoana from their rohe, and the iwi sees the current state of the harbour as compromising the "mana of the iwi and the mauri of the harbour" (Takapūwāhia Community & Porirua City Council, 2014, p. 11).

TERRESTRIAL BIODIVERSITY

Much of the biodiversity of this area was lost as a result of settlement, development and associated deforestation (Blaschke et al., 2009). In the past Porirua was home to various vegetation types such as forest canopies and flood plains but almost all of the forest in the low land was turned into farmland and urban areas (Blaschke et al., 2009). However, some pockets of biodiversity remain and are regenerating native timber and bush (Blaschke et al., 2009). These are in sites such as the Porirua Scenic Reserve, and there are reports that these pockets are significant bird habitats (Blaschke et al., 2009). Forest parks and sanctuaries nearby foster the migration of birds back into these areas such as birds migrating back to live in Porirua from Kāpiti Island (Blaschke et al., 2009).

Areas of the coast also provide important habitats for threatened species of birds, geckos and plants (Steer, 2015). There is predator control occurring in many of these reserves, often carried out by community groups with funding from the GWRC (Blaschke et al., 2009). They target not only pests such as possums and rabbits but also invasive plants (blackberry posing a particular problem in the area) (Blaschke et al., 2009). Blaschke et al. highlight that while the majority of the original vegetation has been lost, "the catchment is showing some promising signs of recovery of terrestrial biota" (2009, p. 20). This can be seen by a greater variety and quantity of birds seen or heard in the area, an increased commitment to set aside land for native vegetation to regenerate etc. (Blaschke et al., 2009). Pest management is seen to be a major contributing factor in these improvements (Blaschke et al., 2009).

ARSENIC

Arsenic has become a health and environmental issue for the region recently with the results of a yearlong study in Wainuiomata finding that arsenic in the atmosphere was exceeding national guidelines (Greater Wellington Regional Council, 2013). Greater Wellington Regional Council and GNS science collaborated to conduct this study which demonstrated that while national guidelines are 5.5ng/m³ the test areas annual average showed 7.1ng/m³ (Greater Wellington Regional Council, 2013). These results are likely transferrable to other areas in the region which are characterised by still air and residential fireplaces, such as Porirua (Greater Wellington Regional Council, 2013).

The burning of chrome, copper and arsenic (CCA) treated wood is believed to be the culprit (Greater Wellington Regional Council, 2013). Timber is often treated with arsenic which acts as a preservative. However when this is used as firewood it can have serious health and environmental consequences such as increased risk of lung cancer (Greater Wellington Regional Council, 2013). The burning of CCA treated wood has been illegal for many years however it still continues to be burnt (Greater Wellington Regional Council, 2013). The Porirua City Council monthly newspaper sought to highlight this issue by reminding residents of the danger of burning treated firewood and to avoid burning it as a cost saving heating measure (Porirua

City Council, 2013).

EMERGENCY MANAGEMENT

Porirua faces multiple different hazards. These include severe weather such as wind, thunderstorms, heavy rain and in contrast to this, drought and extreme heat (Porirua City Council, n.d.-e). Each of these hazards have their own associated risks and damages (Porirua City Council, n.d.-e). Flooding is a core hazard in Porirua, and can occur due to heavy rain, blockages, high tides and storm surges (Porirua City Council, n.d.-e). Floodwaters can cause a lot of damage as they frequently contain debris, such as branches, rocks, and sewage, and can take months to clean up (Porirua City Council, n.d.-e). Landslides may be triggered by heavy rainfall or earthquakes and can impact on transport routes as well as houses located on the hillsides (Porirua City Council, n.d.-e).

North-westerly and southerly winds can bring sustained wind speeds of 100km/hr and gusts of 150km/hr in exposed places (Porirua City Council, N.D-a). Strong winds can damage infrastructure and bring down trees and act as a hazard for drivers (Porirua City Council, N.D-a). Fires are another hazard which are mostly caused by human action (deliberate or unintentional) or may be triggered by other hazards i.e. earthquakes, lightning, etc (Porirua City Council, n.d.-e). Fires are most common in the drier seasons between November and March and can cause death, injury, and damage to housing and infrastructure as well as impacting on the area's ecosystems (Porirua City Council, n.d.-e).

Porirua is in a seismically active zone next to the Australian and Pacific tectonic plates (Porirua City Council, n.d.-e). Earthquakes can cause liquefaction, surface fault ruptures (big cracks in the ground), landslides, and tsunamis (Porirua City Council, n.d.-e). Porirua Harbour and Pauatahanui are likely to experience amplified effects of an earthquake due to their low lying geography (Van Halderen, Peterson, Fountain, & Allan, 2016) and swampy



Figure 2 Porirua tsunami evacuation zones map, Reproduced with permission (Wellington Regional Emergency Management Office, n.d.)

Forsyth, 2010).

While there is a low threat of tsunami from distant quakes, a localised quake could generate a significant tsunami which could impact Porirua. There is evidence of a 15m high tsunami dating from the 14th or 15th century along Porirua's western coast (Porirua City Council, n.d.-e). See tsunami evacuation zones in figure 2.

Wellington Regional Emergency Management Office provides Civil Emergency Management services across the Wellington region (Porirua City Council, n.d.-c). The Porirua City Council website has a variety of resources to encourage its residents to be prepared in case of emergency such as household and community water and supplies checklists, an awareness of the hazards and the location of civil defence centres (Porirua City Council, n.d.-c). Porirua has 8 Civil Defence Centres; Pukerua Bay School, Plimmerton School, Pauatahanui School, Discovery School, Papakowhai School, Cannons Creek School, Tairangi School, and Titahi Bay School (Porirua City Council, n.d.-b).

In terms of water management, a review in 2010 demonstrated that Porirua City as well as other cities in the region would be likely to run out of water in the event of a large earthquake (Greater Wellington Regional Council, 2014). This concern has been addressed in the Council's long term plan and various options are being considered (Greater Wellington Regional Council, 2014).

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