

Estuarine systems in the lower North Island/Te Ika-a-Māui

Ranking of significance, current status and future management options

Matt Todd, Helen Kettles, Claire Graeme, John Sawyer, Amber McEwan and Lynn Adams





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Due to the diversity of information contained in this report, the process for developing it was very much a collaborative effort. It involved many people with broad or specific knowledge about many different disciplines, including ecology, botany, zoology, places and history.

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CONTENTS

| Exe | ecutive summary | 3 |
|------|--|-----|
| Intr | roduction | 4 |
| 1. | Manawatū River | 21 |
| 2. | Wairarawa Stream | 33 |
| 3. | Hōkio Stream | 38 |
| 4. | Waiwiri Stream | 46 |
| 5. | Ōhau River | 51 |
| 6. | Waikawa Stream | 59 |
| 7. | Waitohu Stream | 67 |
| 8. | Ōtaki River | 75 |
| 9. | Mangaone Stream | 83 |
| 10. | Kukutauaki Stream | 89 |
| 11. | Waimeha Stream | 94 |
| 12. | Waikanae River | 101 |
| 13. | Wharemauku Stream | 113 |
| 14. | Whareroa Stream | 118 |
| 15. | Wainui Stream | 125 |
| 16. | Taupō Stream | 131 |
| 17. | Te Awarua-o-Porirua Harbour | 137 |
| 18. | Mākara Stream | 167 |
| 19. | Kaiwharawhara Stream | 175 |
| 20. | Korokoro Stream | 182 |
| 21. | Te Awa Kairangi/Hutt River | 187 |
| 22. | Waiwhetū Stream | 198 |
| 23. | Parangarahu Lakes | 205 |
| 24. | Wainuiōmata River | 215 |
| 25. | Lake Ōnoke and lagoons | 221 |
| 26. | Whāngaimoana Stream | 244 |
| 27. | Cape Palliser streams (Mākotukutuku, Pararaki and Ōtakaha) | 250 |
| 28. | Ōpouawe River | 255 |
| 29. | Āwheaiti Stream | 260 |
| 30. | Āwhea River | 264 |
| 31. | Ōterei River | 270 |
| 32. | Rerewhakaaitu River | 276 |
| 33. | Pāhāoa River | 281 |
| 34. | Kaiwhata River | 286 |
| 35. | Waikaraka Stream | 292 |
| 36. | Patanui Stream | 296 |
| 37. | Waioronu Stream | 301 |
| 38. | Motuwaireka Stream | 306 |

| 39. | Whareama River | 312 |
|-----|--|-------|
| 40. | Otahome Stream | 319 |
| 41. | 'Humpy' Stream | 324 |
| 42. | Ngākauau Stream | 328 |
| 43. | Whakataki River | 333 |
| 44. | Ōkau Stream | 339 |
| 45. | Mātaikona River | 345 |
| 46. | Ōwāhanga River | 351 |
| 47. | Ākitio River | 356 |
| 48. | Waimata River | 362 |
| App | pendix 1 | |
| | Hume et al. (2007) classification of New Zealand's estuarine systems—the five classes of estuarine | |
| | systems represented in this region | 366 |
| App | pendix 2 | |
| _ | Sites that were excluded from the report | 368 |
| App | pendix 3 | 000 |
| π | Scoring system used to rank the relative importance of estuarine sites | 369 |
| App | pendix 4 Criteria scores for individual estuarine systems in the Lower North Island (Te Ika-a-Māui) | 370 |
| Apr | pendix 5 | |
| | List of the 34 estuarine sites assessed for risks by Greater Wellington Regional Council | 372 |
| App | pendix 6 | |
| | Criteria for listed threat classifications (adapted from Townsend et al. 2008) | 373 |
| App | pendix 7a | |
| | Native plants mentioned in the text and their threat status | 374 |
| App | pendix 7b | |
| | Exotic plants mentioned in the text | 376 |
| App | pendix 8 | |
| | Native animals mentioned in the text and their threat status | 378 |
| App | pendix 9 | - 0 - |
| _ | Site land status and existing rankings explanations | 383 |
| App | pendix 10 | 000 |
| π | Habitat classification as per Atkinson (1985) | 386 |
| App | pendix 11 Reference list for the entire report | 388 |
| | reference has for the entire report | 200 |

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Ranking of significance, current status and future management options

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Executive summary

Estuarine ecosystems, where saltwater meets freshwater, are uncommon ecosystems that are of high value and under increasing pressure from a range of threats. With the growing awareness of their importance and the need to conserve them, this document has been produced as a resource for all those with an interest in estuarine ecosystems, including conservation managers, landowners, tangata whenua, community groups, resource managers, scientists and recreational users. A large number of organisations and individuals from these interest groups have contributed valuable knowledge to this document, making it a highly practical resource. It also complements online resources that have been developed to assist community restoration aspirations for estuarine systems around New Zealand.

This document is the first attempt to bring together a large amount of information on the estuarine ecosystems that occur in the lower North Island (Te Ika-a-Māui) of New Zealand. We assess the current state and future potential of 48 sites from the Manawatū river mouth on the west coast to the Waimata river mouth on the eastern Wairarapa coast. We also present a ranking system that was developed to guide decision making about priorities for their ongoing management.

The information within this report was obtained through a combination of site visits (during 2006 and 2009, with some sites revisited in 2015), a literature review and expert/local knowledge. Although the main site visits were undertaken several years prior to the publication of this report, the information is deemed to be current based on expert/local knowledge.

There are four broad types of estuarine systems within the study area that have different physical characteristics and functioning, and consequently varied values and management needs. Each distinct estuarine site is presented as a standalone chapter to be read in conjunction with the introduction and appendices. Each site chapter contains information on the catchment characteristics, land status, significant biota and habitats, as well as maps, comments on recreational values, pressures, and existing management and conservation strategies. Also included are some suggestions for future ecosystem restoration initiatives.

While some information in the report is from recently published reports, much is based on historic literature or expert/local knowledge, and so is qualitative in nature. This is not intended to be a detailed analysis of the information available for each site, but rather to act as a resource for further conversations about these estuarine ecosystems.

The sites range in size from 1 to 870 hectares, with 42% being less than 3 hectares. In total, 58 Threatened and At Risk species were recorded across the 48 estuarine sites: 14 plants, 28 birds, 9 fish, 3 reptiles and 4 invertebrates. The average number at individual sites was 14 (range = 3–35), but 11 sites had more than 20. As uncommon ecosystems, all estuarine sites (even the small ones) are valuable, particularly as havens for threatened plant species. Nonetheless, the estuarine sites were rated and ranked for conservation and restoration significance using a range of both absolute (number of Threatened/At Risk species present) and assigned (ecosystem, social, restoration potential and pressures) values. No overall ranking was given, however—rather, the information can be used to inform conversations for a range of purposes and at a range of project scales, from single estuarine sites through to regional management. This document also makes no attempt to compare these estuarine sites with other estuarine or similar sites in other parts of New Zealand—all rankings refer strictly to the 48 estuarine sites contained within the study area.

Many, but not all, of the top-ranked estuarine systems are currently being actively managed by agencies. There are 14 coastal restoration groups and 11 groups focusing on catchment restoration. There is also great potential for citizen science at these sites.

Introduction

There is a growing awareness of the value of estuarine systems and the need to conserve them in New Zealand and globally. These nationally rare ecosystems (Williams et al. 2007) are home to a range of threatened and at risk species, and provide a range of benefits that directly or indirectly contribute to human wellbeing, such as fisheries, climate change mitigation and adaptation, nutrient cycling and recreation.

However, estuarine ecosystems are under increasing pressure as people spend more time on the coast, weeds invade, flow hydrodynamics change (in response to flow alteration in the catchment and at/near river mouths) and water quality declines. Even as early as 1976, one-third of the estuarine systems in New Zealand were considered polluted (McLay 1976), and this is continuing today (Chagué-Goff et al. 2000). Furthermore, these pressures will only be exacerbated in the future, as climate change is likely to have a large impact on estuarine systems through the modification of catchments, acidification, temperature changes and sea level rise (Kettles & Bell 2016).

The Department of Conservation (DOC) is charged with the conservation of New Zealand's indigenous biodiversity and has a particular role in estuarine conservation in relation to implementation of the New Zealand Biodiversity Strategy (DOC & MfE 2000) and the New Zealand Coastal Policy Statement (DOC 2010), and the protection of threatened species and freshwater fish and their habitats. DOC also manages a large number of estuarine reserves.

DOC's Wellington Conservation Management Strategy (DOC 1996) identified estuarine systems as a priority for conservation management. This report builds on a programme of work that focused on assessing the condition and management requirements for ecosystems, particularly threatened ecosystems, and follows on from similar work on coastal foredunes (see Milne & Sawyer 2002).

Many communities are actively restoring estuarine systems and catchments around New Zealand. Māori place enormous value on estuarine systems, which are considered taonga (treasures), mahinga kai (food-gathering places), highways and places where people gathered. This report seeks to further raise awareness of the values and restoration potential of estuarine systems in the lower North Island and their national importance. Further improvements to estuarine systems will require catchment-wide management and cooperation from a wide range of people and communities. Thus, the provision of information about these sites will aid management decisions in the future.

The ecology of estuarine systems

Estuarine systems represent dynamic, rich ecosystems that are shaped by the ever-changing processes of tides, waves, wind and storms. The diverse plants and animals in these systems are often endemic species that are nationally rare and threatened, and so comprise unique communities. Furthermore, although estuarine systems cover only a small area globally (0.35%), Costanza et al. (1997) estimated that they contribute towards c. 12.4% of all the world's ecosystem services (benefits to humans), including fisheries, climate change mitigation and adaptation, nutrient cycling and recreation.

Inputs are received from the freshwater aquatic ecosystem, the coastal marine ecosystem and the adjacent terrestrial ecosystem, which results in a cocktail of nutrients that makes them one of the most productive ecotypes on the planet (Perkins 1974). Indeed, estuarine systems are four times more productive in plant matter than a rye grass pasture and 20 times more productive than the open sea (Knox 1980). Because they are extremely rich in organic matter and nutrients, they provide food to sustain a network of animals such as zooplankton, shrimps, amphipods, crabs, bivalves and snails which, in turn, sustain fish and birds. Estuarine systems play an important role as nursery grounds for a range of commercial and recreational fish species (Morrison et al.

2002; Francis et al. 2005), and so people gather food either directly from the estuarine systems or from the fisheries they support.

Another important feature of estuarine systems is saltmarsh, which represents a wetland class¹ that includes estuarine habitats of mainly mineral substrate in the intertidal and subtidal zones, as well as habitats in the supratidal zone such as wet coastal platforms. Saltmarsh comprises non-vegetated habitats such as mudflats through to the full range of vegetation types that are typical of the intertidal zone, including herbfield, rushland, scrub and mangrove scrub or low forest (Johnson & Gerbeaux 2004). Native saltmarshes in the Wellington region most commonly consist of rushes (e.g. oioi, wīwī, and sea rush) or sedges (e.g. pūkio, pūrua grass and three-square) in conjunction with shrubs (particularly saltmarsh ribbonwood) and flax, with raupō reedland becoming prominent at the interface of the tidal wedge and freshwater inputs. These habitats are restricted to the intertidal zones and the margins of the estuarine system, and are often associated with herbfields (e.g. containing glasswort, remuremu and saltgrass), which usually occupy the lower and mid-ranges of the intertidal zone.

Intertidal sandflats and mudflats provide important substrate for marine invertebrate populations which, in turn, attract fish and birds to feed. Estuarine and marine wildlife utilise the marginal saltmarsh vegetation for a range of purposes, e.g. as a food source, as a safe retreat, or for spawning and breeding.

Seagrass is a submerged estuarine grass-like plant that creates a unique ecosystem on the bed that is highly productive, has an important role in food webs and creates critical habitat for a variety of animals (e.g. as shelter from predation, and breeding, nursery and feeding areas).

Estuarine systems are sensitive and consequently have been greatly impacted by human activities, with little of the original estuarine vegetation remaining due to encroaching settlement or farming. Changes in the surrounding land-use practices in their catchments have also had a large effect on water quality. For example, the increase in sedimentation as a result of deforestation and farming has led to the accumulation of suspended fine sediment in estuarine systems, which can reduce the diversity and abundance of marine invertebrates by clogging their gills, reducing the quality of the food supply and decreasing the survival of juveniles. And suspended fine sediments can also affect fish by delaying hatching, increasing respiration and reducing feeding (Morrison et al. 2009). Urbanisation around estuarine systems has also had a significant impact through increased sedimentation and contamination, particularly from heavy metals (Abrahim & Parker 2002, 2008).

Since introduced mammalian predators are widespread throughout New Zealand's indigenous habitats, it must be assumed that there will also be established populations of feral predators and browsers in and around all estuarine environments. Mammals can have significant impacts on native wildlife through predation (on adults, juveniles or young/eggs), disturbance (particularly during the breeding season when birds are on nests) or the alteration of habitat (especially by browsers). Feral predators include rats (especially ship rats and Norway rats), mice, possums, mustelids (stoats, ferrets and weasels) and hedgehogs, while domestic predators (which can also become feral) include cats and dogs. On occasion, uncontrolled domestic stock can also cause trampling and habitat damage (particularly through browsing), and other browsers, such as rabbits and hares, can damage regenerating native vegetation in wetlands and adjacent pasture and dunes, which can allow competing ecological weeds to flourish, impairing the regrowth of native vegetation. People can also have significant direct impacts through disturbance, trampling and vehicle damage.

More detailed information on the roles that various native species play in these ecosystems, and the impacts of human activities on these species and their habitats, are provided in more general publications. For further reading on the general ecology of New Zealand estuarine systems, see Morton & Miller (1968), Bradstock (1985), Heather & Roberston (1996), Johnson & Gerbeaux (2004) and Jones & Marsden (2005).

¹ A distinctive combination of substrate factors, the water regime, and consequent factors of nutrient status and pH (Johnson & Gerbeaux 2004).

Goal for the conservation of estuarine systems

The protection and restoration of estuarine systems requires a catchment-level perspective and so can only be achieved with an interagency-community approach in which parties work together.

Different players in estuarine management have different roles. For instance, regional councils (GWRC and Horizons Regional Council) write Coastal Plans under the Resource Management Act, which provide overarching rules under which activities are managed, and also have responsibilities for flood control, water management below the MHWS and discharges to water. District and city councils are responsible for managing land use (inland of MHWS). DOC manages some Crown reserve areas and whitebaiting, protects high-value species and habitats (both via legal channels and advocacy), and provides support to the Minister of Conservation in his/her role with the New Zealand Coastal Policy Statement (NZCPS). In relation to freshwater management the Ministry for the Environment have an overview role as the agency responsible for the National Policy Statement for Freshwater Management (MfE 2014). Duck shooting is controlled by the Fish & Game Council. Iwi have legal responsibilities via Treaty Settlements at some estuarine sites and also the overarching responsibility of kaitiakitanga that comes with mana whenua. Landowners and wider communities are often also closely associated and interested in estuarine areas, and there are numerous active caregroups. The health of estuarine systems is therefore dependent on an integrated approach, which links agencies to iwi and communities, and a catchment level view from the mountains to the sea (Ki uta ki tai).2

One of DOC's 'Stretch Goals' is to restore 50 freshwater ecosystems from 'mountains to sea' (DOC 2015). Estuarine systems are fundamental to this, as they are the gateways to the sea and act as a barometer for the health of a catchment.

DOC wants to ensure the long-term ecological integrity of these ecosystems. As part of this, it is important to provide representative in situ protection of estuarine ecosystems throughout their range and to restore degraded estuarine systems at key sites.

To achieve this goal, DOC aims to:

- Describe the status of estuarine systems.
- Explore and describe options and priorities for their protection and restoration.
- Effectively work with others to enable this to be achieved efficiently in terms of overall effort and resources.

This report helps with the conservation of estuarine systems by:

- Providing baseline information about the state of estuarine sites in the lower North Island (Te Ika-a-Māui).
- Collating information about these places into one document that can be used by a range
 of stakeholders, including iwi, hapū and whānau, conservation organisations, landowners,
 and any other interested parties in the community, for a variety of uses, including habitat
 enhancement, protection and management.
- Supplying information to generate increased discussion about estuarine systems in these regions and options for what could collectively be done to protect, restore and conserve them

This report forms part of a wider programme of information-based and operational work that is currently underway to achieve this conservation goal. As part of this, the 'Our Estuaries' hub has been developed for the wider community, which includes online information about restoring, monitoring and experiencing estuarine systems (www.doc.govt.nz/estuaries).

² There are examples of established interagency catchment approaches at some of the sites outlined in this report, e.g. the Porirua Harbour and Catchment Interagency Group, and the Manawatu River Accord. GWRC has identified five catchment areas where they are setting up advisory groups called Whaitua committees to enable an integrated management approach to fresh and coastal water quality (www.gw.govt.nz/whaitua-committees/). These committees will be progressively established for the Wairarapa Coast, Ruamāhanga Valley, Wellington/Hutt Valley, Te Awarua-o- Porirua Harbour and Kāpiti Coast Whaitua.

Scope of the report

This report is an ecological inventory of the conservation values of 48 estuarine sites in the lower North Island (Te Ika-a-Māui) of New Zealand (Fig. 1). The area covered reflects the historic administrative boundaries of DOC's former Wellington Hawke's Bay Conservancy³, the northern boundary of which is delimited by the mouths of the Manawatū River in the west and the Waimata River (south of Herbertville) in northern Wairarapa in the east. It includes the entirety of the administrative area of the Greater Wellington Regional Council (GWRC) and its component local authorities, along with Horowhenua District Council and parts of Tararua District Council, both of which fall within the boundaries of Horizons (Manawatū-Wanganui) Regional Council. The place names used in this report reflect local iwi traditions and tikanga, and have been verified by an expert in te reo Māori. Consequently, they may differ from official place names.

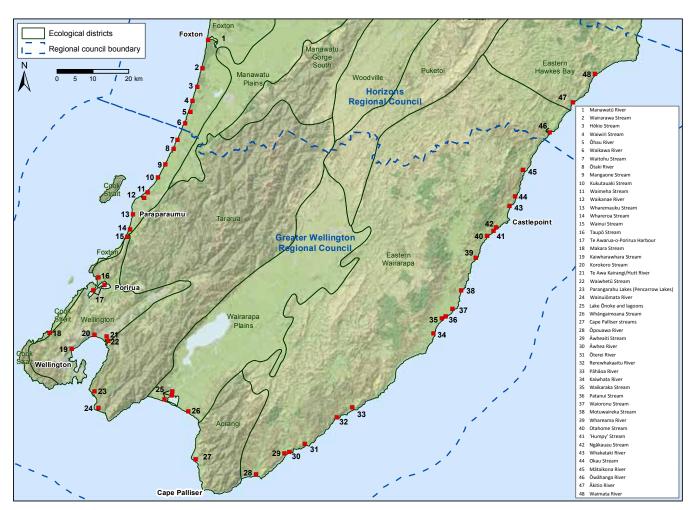


Figure 1. Locations of the estuarine systems in the lower North Island (Te Ika-a-Māui) reported on in this document.

For the purposes of this report, the term 'estuarine system' is defined as 'a partially enclosed coastal body of water that is either permanently or periodically open to the sea in which the aquatic ecosystem is affected by the physical and chemical characteristics of both runoff from the land and inflow from the sea' (Hume et al. 2007). For further discussion around definitions of the terms used, see the 'Estuarine classification' section below.

Where water bodies vary in their characteristics depending on how recently they have been open to the sea, a mixture of lake and estuarine objectives may need to be used in their management. Consequently, this report also includes information on lagoons that have a range of connections

³ The Wellington Hawke's Bay Conservancy, disestablished in 2012, was one of 12 administrative units of DOC.

with the sea as, based on sea-level rise predictions (IPCC 2013), intermittent connections are likely to become more frequent and in some cases permanent in the future.

Stream and river mouths can be open habitat areas, or temporarily closed areas where the sea water is diluted by land drainage and tidal effects are less evident. In their natural state, they are often bordered by wetlands, but the key characteristic of all estuarine environments is the mixing of fresh and saline waters in the coastal environment.

The information collated in this report focuses on the habitats, plants and animals that occur at the estuarine sites, as delimited by the extent of the mean high water spring tide level (MHWS)⁴. Since this is not accurately known for most estuarine systems, in many cases it has been estimated based on biological indicators of brackish conditions, which include inanga spawning sites, mud crab holes and the presence of neighbouring freshwater species such as raupō.

This inventory includes information from reports written by DOC and numerous other agencies, national biodiversity databases, qualitative field surveys undertaken by Claire Graeme (during 2006) and Matt Todd (during 2009), local expertise, and personal knowledge from a range of people.

Methodology

Estuarine classification

The classification of different types of estuarine systems helps us to make assessments of their significance and comparisons for management purposes. Estuarine systems have been defined by several authors (e.g. McLay 1976; Johnson & Gerbeaux 2004; Hume et al. 2007). However, although these authors are generally in agreement at the system level, they use different definitions and terminology for each type of estuarine system, which can create confusion. For example, there is often a synonymy in common language between 'estuarine system' and 'estuary' (which is a type of estuarine system in some classifications); and the term 'lagoon' is commonly used around the country but sometimes applies to a variety of categories of estuarine system, depending on the location. Therefore, for the purposes of this report, we chose to use Hume et al.'s (2007) classification, which provides a detailed framework for classifying New Zealand's estuarine systems.

Hume et al's (2007) classification is a hierarchical system that is based on broad-scale physical components of the landscape or climate, oceanic and riverine conditions, and catchment characteristics that cause or 'control' similarities and differences in the physical and biological characteristics of estuarine systems. Based on hydrodynamic processes (which exclude catchment factors), Hume et al. (2007) defined eight classes of estuarine systems (Fig. 2; Appendix 1), four of which are represented in this region (Table 1). Hume et al. (2007) only categorised some of the estuarine sites contained in this report. Therefore, the other sites have been given a classification based on the characteristics that were observed during site visits. In doing this, we have also reclassified the Waikanae estuarine site as Category B (Table 1).

Hume et al.'s (2007) classification is generally useful for separating out the types of estuarine systems. However, there are numerous examples where sites differ in a key characteristic from the classification descriptions (Appendix 1). These fall into three groups:

- 1. Category A sites in which the blocked mouth is seldom breached, and so there is a low tidal influence, but there are relatively large river freshwater inputs. The resultant lake is often elongate in shape and usually runs perpendicular to the open coast shore. Due to the low level of salinity in the water, this type of system is referred to in this report as a 'brackish lake'.
- 2. Small Category A sites in which the blocked entrance is seldom breached, and so there is a low tidal influence, but the freshwater inputs are not large enough to lead to the formation of a lake. This type of system is referred to in this report as a 'blocked stream mouth'.

⁴ This is defined by Bell (2007) as the average of pairs of successive high waters in a 24-hour period in each semi-lunation (approximately every 14 days) at new and full moon.

3. Category B sites that hydrodynamically fit the description given by Hume et al. (2007), but which characteristically a lso have a dynamic tidal pool and sandspit present (which visually could be confused with a lagoon). The tidal pool may be blocked, but seldom for long periods. Breaching of the spit may occur at any point, depending upon hydrological and climatic conditions. The tidal input is typically moderate to high, but may be reduced during times of blockage. Similarly, the degree of flushing may vary, as tidal water can become trapped in the pool by changing conditions. This type of system is referred to in this report as a 'tidal pool'.

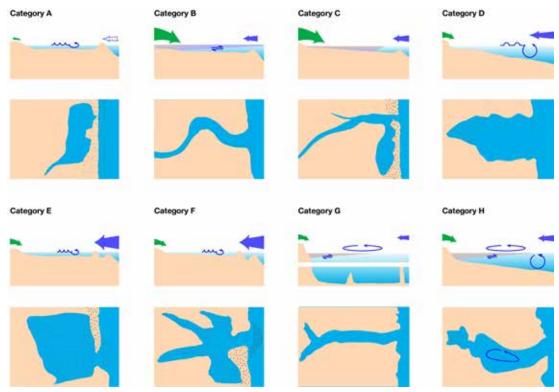


Figure 2. Schematic drawings of the eight hydrodynamic classes of estuarine systems showing their dominant morphometric and oceanographic properties (from Hume et al. 2007). See Appendix 1 for details of their characteristics.

Table 1. The lower North Island (Te Ika-a-Māui) estuarine categories. These are based on the classification of Hume et al. (2007), with revised descriptors: * 'brackish lake', ^ 'blocked stream mouth', + 'tidal pool' (see the 'Estuarine classification' section for explanations).

| ESTUARINE CLASSIFICATION (Hume et al. 2007) | SITES AS ASSESSED BY HUME ET AL. 2007 | SITES ASSESSED IN THIS REPORT |
|---|--|---|
| Category A | Āwhea, Ōterei, Parangarahu Lakes, Wainuiōmata | Āwhea*, Kaiwhata*, Ōterei*, Parangarahu Lakes, Rerewhakaaitu*, Wainuiōmata*, Waimata*, Waioronu^ |
| Category B | Ākitio, Manawatū, Mātaikona, Motuwaireka, Ōhau, Ōwāhanga, Pāhāoa, Patanui, Waikawa, Whareama | Ākitio+, Āwheaiti+, Cape Palliser+, Kukutauaki, Hōkio, 'Humpy'+, Te Awa Kairangi/Hutt, Kaiwharawhara, Korokoro, Mākara, Manawatū, Mangaone, Mātaikona+, Motuwaireka+, Ngākauau+, Ōpouawe, Ōwāhanga, Pāhāoa+, Patanui+, Taupō, Ōhau, Ōkau, Otahome+, Waikanae++, Waikaraka+, Waikawa, Waimeha, Wainui, Wairarawa, Waitohu, Waiwhetū, Waiwiri, Waremauku, Whakatiki+, Whāngaimoana+, Whareama, Whareroa |
| Category C | Lake Ōnoke, Ōtaki | Lake Ōnoke and lagoons, Ōtaki (Rangiuru lagoon) |
| Category D | Waikanae | |
| Category E | Pāuatahanui Inlet | Te Awarua-o-Porirua Harbour |

Site selection and survey

This report does not aim to detail the ecology of estuarine systems and the impacts of human activities on them. Rather, it is our intention to complement the existing general literature by collating information on specific estuarine sites (e.g. species present, values, habitats and threats).

A list of candidate sites (including a range of coastal lakes and river mouths) was assembled for initial consideration. Each of these sites was assessed for estuarine functionality, i.e. displayed evidence of some degree of tidal flushing or the known presence of vegetation or wildlife that are commonly found in saline habitats. Those sites that were known to undergo negligible tidal influx (generally because the tide is prevented from entering the waterway either by the topography and slope of the discharge (e.g. the Wharekauhau River), or by an artificial barrier (e.g. Ōwhiro Stream)) were removed from the study, as were waterways that had undergone such a high degree of modification that no natural habitat remained in the tidal zone (e.g. the Waimāpihi Stream in central Wellington). Finally, a few remote sites were removed from the study because we were unable to obtain permission for access across neighbouring properties⁵. This left a total of 48 estuarine sites for inclusion in the survey (Fig. 1).

Each of the 48 sites was surveyed on foot between early January and late March 2009. During each site visit, a visual assessment was undertaken and lists were made of those plant and animal species that could be identified at the time. Photographs were taken of the site and surrounding environment, and of rare, significant or unidentified species. Subsequent visits were made to many of the sites between 2009 and 2015. Site visit data were collated and additional information was obtained by undertaking a literature search, checking database reports, and talking to experts and local stakeholders (e.g. residents, landowners and community restoration group representatives). An individual chapter has been produced for each site and these were checked to ensure that they were as up to date as possible at the time of publication.

Site rankings

A series of criteria were developed as part of this project to assess the relative conservation value of each estuarine site in the region (see Box 1).

The estuarine sites were rated and then ranked for conservation significance using a range of both absolute (number of Threatened/At Risk species present) and assigned (ecosystem, social, restoration potential and pressures) values.

All estuarine sites are valuable and under pressure, and so are worthy of conservation attention. For example, protecting even the smallest of sites can be critical for safeguarding rare and threatened plants species (Richardson et al. 2015). However, some sites include larger areas of intact habitat and/or contain a greater range of native biodiversity, and could therefore be regarded as having a higher conservation value than others when planning for specific conservation objectives at a regional level. Furthermore, some sites may have more intact native catchments, which also increases their value due to reduced pressures. Therefore, we have also ranked estuarine sites based on the level of pressures that impact on their integrity and the potential for improving their condition. Due to the large social component associated with estuarine systems, we have also provided an indication of social value; however, we acknowledge that this is the most subjective of the criteria.

No overall ranking is given for the sites. Rather, the rankings are provided as a tool to inform management priorities (both at a specific location and at a regional level) and to promote discussion on options for restoration. For example, even though Patanui is a small estuarine system, it has few pressures and a high restoration potential, while Waikanae has high value (ecologically and socially) and high restoration potential. Even the small, modified sites are valuable when placed in context and considering the reduced availability of habitat for the species that are adapted to live in these conditions.

⁵ For a list of sites excluded from the report see Appendix 2. Because not all candidate sites were able to be visited, the final list does not represent all estuarine sites within the study area.

BOX 1: CRITERIA USED TO RANK THE RELATIVE IMPORTANCE OF ESTUARINE SYSTEMS

- Threatened species: The number of Threatened species present at the estuarine site. Numeric data are presented.
- Threatened/At Risk species: The number of Threatened and At Risk species present at the estuarine site. Numeric data are presented.
- Ecosystem value: The scale and degree of the ecological integrity of the estuarine system, combined with the regional rarity of the habitats it contains. Sites are given a score from 1 (low value) to 5 (high value). They must fulfil two out of three criteria (size, intactness, and habitat rarity) to achieve a particular score.

'Ecological integrity' is considered a measure of the 'healthy functioning state' of a system. Ecosystems and communities have high ecological integrity when all the indigenous plants and animals that are typical of the place are present, together with the key ecosystem processes and features that sustain functional relationships between all these components (Lee et al. 2005). Biotic features should include a high indigenous species occupancy and dominance, the presence of individual indigenous species that are known (or assumed) to have functional importance, a low diversity and abundance of invasive species, and the presence of indigenous communities in a range of serial states. Ecosystems that have high ecological integrity will persist in the long-term.

'Rarity' is a measure of the frequency of occurrence of an ecosystem in a particular ecological context—in this case, at the scale of the lower North Island (Te Ika-a-Māui) and its constituent ecological regions. Sites that contain ecosystems that are only found at a few other sites will have greater conservation value than those that contain commonly occurring ecosystems.

As such, note that a site with low ecological integrity can rank high due to its rarity of habitats.

- Social value: The presence of historic, customary or recreational values held by the local and wider community. Sites are given a score from 1 (minimal social value) to 5 (highly significant social value).
- Restoration potential: The degree to which estuarine ecosystems are capable of reflecting the known biological diversity and ecological patterns and processes that they originally supported (adapted from DOC & MfE 2000). Sites are given a score from 1 (poor chances of success) to 5 (excellent chances of success). This ranking is conferred relative to the extent to which ecosystem functions and processes have been modified in the past, and is a measure of how easily the original (or otherwise desired) components of the indigenous ecosystem can be reinstated or replaced. This encompasses direct restoration opportunities within the estuarine system. Examples of restoration strategies include protection of the site by fencing, removal of hard edges, planting of appropriate native vegetation and installation of nesting shelters or feeding stations for birds. Importantly, estuarine ecosystems can be easier to restore than forests, as habitat can re-establish naturally and relatively quickly if there is tidal flow to the site and pressures such as weeds are removed. Note that a low score does not necessarily mean that the site has low restoration potential, as scores are relative to other sites.
- Pressures: The variety and severity of disruptions to the ecological integrity of the ecosystem and the likelihood of elimination or reduction. Sites are given a score from 1 (high pressures) to 5 (low pressures).

These existing 'pressures' are scored according to their current or potential impact on the ecosystem. They may be the ongoing consequence of historic ecosystem modifications and can arise from within the estuarine system or from the surrounding catchment. The pressures can have negative effects on any restoration efforts in the ecosystem and are likely to require ongoing management. Examples include invasive species and sedimentation. As this is a complicated matrix, the scoring is based on t opinion.

Note: Details of the scoring system are contained in Appendix 3. Results of the individual estuarine site scores for each category are presented in Appendix 4.

Also note that the ranking of sites has been carried out in the context of only those sites that were evaluated, which did not include sites in the north of the Horizons (Manawatū-Wanganui) region. Rankings would be different if assessed on a region by region basis, and so this document makes no attempt to create comparisons with similar sites in the rest of New Zealand. This assessment complements the risk assessment work that was previously undertaken at 34 estuarine sites by GWRC (see Appendix 5).

Table 2 presents the top-ranked estuarine systems (plus data for each criterion), details around which are provided in the appendices. Many of the top-ranked sites have been assessed as either nationally or regionally significant by management agencies and are being managed to maintain their values, i.e. as Ecosystem Management Units (DOC), Priority A Wetlands (Horizons) or Key Native Ecosystems (GWRC).

Table 2. Top-ranked estuarine sites based on each of the measured criteria (for full scoring, see Appendix 4).

| 1 Manawati 2 Waikanae 3 Lake Ōnoł 4 Ōhau (12) 5 Waitohu (1 6 Ōtaki (9) 7 Te Awarua 8 Waikawa (| Manawatū (15)★★★ Waikanae (13)★ Lake Ōnoke and lagoons (12)★ Ōhau (12) Waitohu (10)★ Ōtaki (9)★ Te Awarua-o-Porirua (9)★ Waikawa (7)★ | Manawatū (35) ★★ Waikanae (34)★ Lake Ōnoke and lagoons (32)★ Te Awarua-o-Porirua (29)★ | Manawatū (5) 🖈 🦘 | Manawatū (5) ★★ | Patanııi (5) | Parangarahu Lakes (5) ★ |
|--|---|--|------------------------------|------------------------------|------------------------|-------------------------|
| | nae (13)★ Jnoke and lagoons (12)★ (12) hu (10)★ (9)★ rarua-o-Porirua (9)★ | Waikanae (34) * Lake Önoke and lagoons (32) * Te Awarua-o-Porirua (29) * | | | (2) 151 1515 | |
| | Önoke and lagoons (12)★ (12) hu (10)★ (9)★ varua-o-Porirua (9)★ wa (7)★ | Lake Önoke and lagoons (32)★ Te Awarua-o-Porirua (29)★ | Waikanae (5) 🖈 | Te Awa Kairangi/Hutt (5) | Waioronu (5) ★ | Wainuiōmata (5)🌟 |
| | (12) hu (10)★ (9)★ rarua-o-Porirua (9)★ | Te Awarua-o-Porirua (29)★ | Lake Ōnoke and lagoons (5) 🜟 | Lake Ōnoke and lagoons (5) ★ | Motuwaireka (5)★ | Rerewhakaaitu (5) |
| | hu (10)★ (9)★ rarua-o-Porirua (9)★ wa (7)★ | Öb211 (98) | Ōhau (4) | Te Awarua-o-Porirua (4) | Waiwiri (4) | Patanui (5)★ |
| | (9)★ rarua-o-Porirua (9)★ rwa (7)★ | Oliau (20) | Waikawa (4) | Kaiwhata (4) | Ōhau (4) | Kukutauaki (4) 🜟 |
| | arua-o-Porirua (9)★ awa (7)★ | Waitohu (25)★ | Waitohu (4)★ | Cape Palliser (4) | Waikawa (4) | Whareroa (4)🌟 |
| | ıwa (7)★ | Parangarahu Lakes (22)★ | Te Awarua-o-Porirua (4) | Hōkio (4) | Waitohu (4) ★ | Whāngaimoana (4) 🜟 |
| | | Mākara (22)★ | Mākara (4) 🜟 | Waikanae (4) | Ōtaki (4)★ | Cape Palliser (4) |
| 9 Parang | Parangarahu Lakes (7)★ | Ōtaki (22)★ | Patanui (4)★ | Waiwhetu (4) | Waikanae (4)★ | Waioronu (4)★ |
| 10 Motuw | Motuwaireka (7)🌟 | Wainuiōmata (20)★ | Whareama (4) | Ōtaki (4)★ | Whareroa (4)★ | Whakataki (4) |
| 11 Whare | Whareroa (4) ★ | Motuwaireka (20)★ | Hōkio (3) | Waiwiri (4) | Mākara (4)★ | Mātaikona (4) |
| 12 Mākara (6) | ra (6) | Te Awa Kairangi/Hutt (19) | Ōtaki (3)★ | 22 sites (3) | Parangarahu Lakes (4)* | 25 sites (3) |
| 13 Te Awa | Te Awa Kairangi/Hutt (6) | Waikawa (19) | Whareroa (3)★ | | Wainuiōmata (4) 🜟 | |
| 14 Wainui | Wainuiōmata (6) | Wharemauku (18) | Wainui (3)★ | | Whāngaimoana (4)🌟 | |
| 15 Hōkio (5) | (2) | Mātaikona (15) | Te Awa Kairangi/Hutt (3) | | Āwhea (4) | |
| 16 Whare | Wharemauku (5) | Whareroa (15)★ | Parangarahu Lakes (3) 🜟 | | Ōterei (4) | |
| 17 Whare | Whareroa (5) | Ōterei (15) | Whāngaimoana (3)★ | | Waikaraka (4) | |
| 18 Āwhea (5) | a (5) | Āwhea (15) | Cape Palliser (3) | | Otahome (4) | |
| 19 Öterei (5) | i (5) | Hōkio (15) | Ōterei (3) | | 'Humpy' (4) | |
| 20 Whare | Whareama (5) | Ākitio (15) | Waikaraka (3) 🜟 | | Whakataki (4) | |
| 21 Öwäha | Ōwāhanga (5) | Whakataki (14) | Waioronu (3) | | Mātaikona (4) | |
| 22 4 sites (4) | s (4) | Whareama (14) | Ōkau (3) | | 19 sites (3) | |
| 23 | | Wainui (13) | Otahome (3) | | | |
| 24 | | Öpouawe (13) | Whakataki (3) | | | |
| 25 | | 5 sites (12) | Mātaikona (3) | | | |
| 26 | | | Motuwaireka (3) | | | |
| 27 | | | 18 sites (2) | | | |

Important note: For the reasons given in the body of this report, all estuarine sites are valuable and under pressure, and consequently warrant conservation. Therefore, the rankings of various components provide information to be used in dialogue about restoration priorities for these rare ecosystems at a local or regional scale

Priority sites for management agencies:

Key Native Ecosystem (Greater Wellington Regional Council)
 Priority A Wetland (Horizons Regional Council)
 Ecosystem Management Unit (Department of Conservation)

Outline of information in individual site chapters

Each of the 48 estuarine systems included in this report is presented in its own chapter, which includes the following information: site description, conservation values, catchment properties, threats, conservation management and references⁶. Some complex sites (e.g. Te Awarua-o-Porirua Harbour) are split into sub-sections in order to effectively describe the significant components of the estuarine system. The intent is that each chapter is standalone, but should be read alongside the overarching text and appendices.

Common names have been used throughout the text for brevity. A full list of species mentioned in the text, their taxonomic names and threat classification⁷ are included in Appendices 7A and B (plants) and 8 (animals).

Site description

The site description consists of a purely physical description of the survey site, as seen at the time of the site visit. This provides a measure of the context for the survey data and any recommendations that may arise.

Table A in each chapter includes objective details of the estuarine site. While most of the attributes included within these tables are self-explanatory, the details for some, including abbreviations, are provided in Appendix 9.

The area of the estuarine site was determined as the area of habitat (in hectares) that fell within the limits of MHWS. For significant sites, this value could often be obtained from local authorities or regional councils. Where this information was not available, an estimate was made using both visual and mapping resources based on habitat type, vegetation composition and landform. It should be noted that the determination of MHWS can be a subjective process, even when reported in official figures; therefore, this value was determined using the best information available and should be considered an estimation.

Land status (tenure) provides an indication of the protection status of different areas and habitats in and around the ecosystem, along with the agencies or landowners who manage them. In general, areas administered by DOC or regional councils will have a degree of legal protection for native habitat; parks or local purpose reserves managed by local councils will have guaranteed public access; and private land will be managed according to the priorities of the landowner. It should be noted that in many places, the determination of tenure is a complex issue, as boundaries may be poorly defined in both the physical and legal sense. In such situations, tenure was determined using the best information available, but it is acknowledged that such information may not be entirely accurate. The types of tenure and the associated protection statuses are listed in Appendix 9.

Existing rankings provide an indication of the conservation value of a habitat, as identified by one or more of a range of different surveys. See Appendix 9 for more information on these rankings.

For the purposes of surveying New Zealand's Protected Natural Areas, 268 Ecological Districts were identified (McEwen 1987) based on landscape and ecological features, which were further grouped into 68 Ecological Regions. These regions and districts highlight the similarities of composition, form and function within and between natural ecosystems within their boundaries. Therefore, any ecosystem site within a particular ecological district could be expected to exhibit a particular set of environmental and habitat characteristics, and any observed deviation from these is of interest. There are 13 Ecological Districts lying within the boundaries of this report (Fig. 1), seven of which are of relevance as they include coastal ecosystems (Beadel et al. 2004).

The estuarine classification used followed Hume et al. (2007), and was largely defined by the hydrology of the system. See 'Estuarine classification' section above for further detailed information.

⁶ A combined reference list for the entire report is provided in Appendix 11.

⁷ The criteria for the listed threat classifications are provided in Appendix 6.

The dominant terrestrial habitat types were described following Atkinson (1985) and/or the recommendations of Johnson & Gerbeaux (2004) for wetlands, as interpreted by Stevens & Robertson (2012). The system used delimits a total of 20 habitat structural classes, based on the percentage cover of the dominant vegetation type or substrate (see Appendix 10), and was developed specifically for New Zealand natural habitats, although it has also been adapted for international use. Dominant marine habitats are classified simply as subtidal (seabed and the water column), sandflats or mudflats (depending on the dominant sediment grain size).

Conservation values

Ecological

This section briefly outlines information regarding any significant indigenous habitats and species (plants and animals) that were present at the site or known to directly utilise the area. Conservation values are also sometimes detailed for areas adjacent to the study site where the habitat acts as a natural buffer and therefore enhances the integrity of the estuarine system, e.g. the presence of pīngao or kōwhangatara in adjacent dune systems.

Table B in each chapter provides a list of that indigenous species that may currently be found in the estuarine site (i.e. within the limits of the MHWS) or immediate environs. The plant and terrestrial invertebrate lists are restricted to Threatened/At Risk species due to the large amount of time it would take to generate a full list (for the criteria for the listed threat classifications, see Appendix 6). By contrast, all bird and fish species that were recorded are shown, while only conspicuous marine invertebrate species are listed.

The lists of indigenous animals (birds, fish, aquatic invertebrates and lizards) were generated from a variety of sources, including Ornithological Society of New Zealand (OSNZ) surveys, the Atlas of Bird Distribution (Robertson et al. 2007), databases (including DOC's BioWeb, eBird5 and the New Zealand Freshwater Fish database), records made during this survey and local experts' knowledge. These should not be considered comprehensive. Birds that are less specifically associated with estuarine systems have been excluded from the species lists, e.g. arctic skua, blue penguin, fantail, grey warbler, shining cuckoo and tūī. Gannets, although primarily coastal, are included in the species lists where they enter estuarine waters to feed. For all species, only those that have been recorded within the last 20 years have been listed; however, historic records of significant species are noted in the text.

Unless otherwise referenced, all freshwater fish presence/absence data were obtained from the New Zealand Freshwater Fish Database (see Richardson 1989). Information on freshwater species is also included in this report because many native fish species are diadromous (migrate between freshwater and the sea) and therefore must pass through estuarine environments to complete their life cycle. Very little detailed aquatic fauna survey work has been carried out for the majority of the estuarine systems included in this report, the exception being Te Awarua-o-Porirua Harbour, and Whareama and Te Awa Kairangi/Hutt Rivers. A range of small coastal marine species such as sprat, smelt and yellow-eyed mullet are likely to enter estuarine systems, while larger species such as kahawai and stingrays may be present periodically but are not recorded in the native species tables. As a result, the list of aquatic animals is minimal and this has been identified as a gap in this report.

Many of the larger estuarine systems were methodically surveyed on four separate occasions by OSNZ, providing an estimation of the bird species that commonly using estuarine systems. These OSNZ surveys were unlikely to detect rare birds, secretive birds or those that visit periodically. There is also some debate on whether the black swan should be considered introduced or native, as 100 birds were introduced c. 1864, but it is also likely that many arrived unassisted given the extent of the population (Heather & Robertson 1996). Recognising this uncertainty, we have included this species in the text and species tables throughout this document.

No formal survey work has been undertaken for lizards or invertebrates in or around estuarine ecosystems in the study area, and so records of such largely originate from isolated observations. Lizard data were collated from DOC's herpetofauna database, with only those species that were known to be present at the site included. Other records may exist within a few kilometres, however, and it is likely that these records are incomplete.

The native and exotic plants that are mentioned in the text are listed in Appendix 7A & B, and the native animals mentioned in the text and their threat status are listed in Appendix 8.

As well as flagging management opportunities, this report highlights some information gaps for agencies and the wider community to consider. There are many opportunities for citizen scientists to get involved, e.g. in helping with species lists. There are also several useful web resources, such as ebird (www.ebird.org), the 'Our Estuaries' find out more section (www.doc.govt. nz/estuaries) and NatureWatchNZ (www.naturewatch.org.nz).

Recreational

Recreational values are also included to outline some of the roles that the described estuarine site has in the local or wider community. This report does not attempt to convey all the human values for each site, but attempts to capture at least some of them in acknowledgement that these values are an important component of the natural and social landscape. We have also included a combined social ranking of the sites (historic, customary and recreational) based on our knowledge of the places and feedback from others.

Catchment properties

Since estuarine systems are ultimately affected by environmental factors in other parts of the catchment system, which are often a significant distance from the survey site itself, a brief description of the catchment and its properties is provided in this section, focusing particularly on activities or factors that may affect the water quality and/or conservation values at the survey site. Much of this information was obtained either directly from local or regional councils, or from MacDonald & Joy (2009).

Water quality data are included where these were available, usually in the form of Water Quality Index (WQI) scores. WQI scores are generated by GWRC, who regularly monitors a number of freshwater sites in the region, many of which are in the catchments of the estuarine systems discussed in this report. They are derived from the median values of six variables: visual clarity (black disc), dissolved oxygen (% saturation), dissolved reactive phosphorus, ammoniacal nitrogen, nitrite-nitrate nitrogen and Escherichia coli (E. coli).

Stream monitoring sites are given one of four possible WQI scores, which are allocated as follows:

Excellent: Median values for all 6 variables comply with guideline values

Good: Median values for 5 of the 6 variables comply with guideline values, of which dissolved oxygen is one variable that must comply

Fair: Median values for 3 or 4 of the 6 variables comply with guideline values, of which dissolved oxygen is one variable that must comply

Poor: Median values for < 3 of the variables comply with guideline values

Where catchment properties impact negatively on the estuarine ecosystem, these effects are expanded on in the 'Threats' section (see below).

Threats

Any factors that negatively impact on the integrity of the indigenous ecosystem, including the long-term viability of any plant or animal population, are outlined in this section, along with the potential effects of such impacts.

The two greatest threats to estuarine systems in general are sedimentation (Morrison et al. 2009) and climate change (Kettles & Bell 2016), but a range of other threats can dominate at specific locations.

General threat factors that may apply to all of the surveyed estuarine sites are not detailed in each section. These include the potential introduction of ecological weed or exotic animal species and the potential for catastrophic events (e.g. floods, fires, and oil spills). Local government may have bylaws in place regarding the lighting of fires in some of the places in this report. Fires can spread from beach fires via driftwood and coastal escarpments into estuarine vegetation and cause significant damage to values.

The sediment quality guidelines mentioned in the report were developed specifically for Australia and New Zealand (ANZECC & ARMCANZ 2000). These 'Australia and New Zealand Environment and Conservation Council (ANZECC) guidelines' provide low and high values to assess the potential ecological effects of contaminants in estuarine systems. The low trigger values indicate concentrations where the onset of biological effects could possibly occur and provide an early warning. The high values are indicative of concentrations where significant biological effects are expected. They are not pass or fail numbers, but rather are used as one part of the evaluation of potential effects of contaminants on the benthic biota.

Climate change impacts on many estuarine ecosystems will likely result from a combination of changes to catchment weather patterns and erosion, temperature and acidification, and sea level rise. Long-term planning is required to mitigate these impacts, particularly in relation to preventing 'coastal squeeze'. Planning for setback zones to allow these ecosystems to move inland as they adapt to a changing sea level is one practical solution. Currently, no assessments for future-proofing estuarine ecosystem values in response to climate change have been undertaken for the sites included in this report.

Conservation management

Current

The 'Current' subsection provides a brief outline of any stakeholders engaged in conservation management of the site, along with any active management strategies in place. In some cases, particularly for large estuarine systems in the vicinity of significant population centres, management is intensive and complex, with many organisations occupying overlapping roles. Where the details of such relationships are beyond the scope of this report, further reading is recommended. In other cases, there is apparently little management taking place, particularly where the environmental values of a site have already been degraded. However, some conservation management initiatives may not always be immediately apparent to the observer.

Theoretically, all waterways throughout the country should be subject to the principles of the Queen's Chain. This is the popular term for the network of publicly owned land along the banks of rivers, the shores of lakes and the coastline, specifically for the purposes of public access, established by Royal Decree in 1840. In practical terms, this currently includes public roads, esplanade and coastal reserves, and marginal strips, as well as the beds of waterways. Unfortunately, this network has become greatly fragmented by subsequent legislation.

There are a range of options for restoring estuarine ecosystems, which are outlined in this section of each chapter, including planting catchment riparian margins, fencing estuarine

margins, legal protection, weed and pest control, and reestablishing the natural hydrological connection with the sea and allowing nature to take its course.

Potential

The 'Potential' part of this section outlines any known planned initiatives by existing stakeholders, and highlights opportunities to implement strategies aimed at enhancing the natural habitat that may not already be in place. The ideas suggested in this report are aimed to invoke discussion amongst stakeholders.

It should also be noted that 'conservation management' is a term that in some cases may cover divergent objectives. The goals may include restoration of a degraded habitat, protection of a threatened species, control or removal of a biodiversity threat, the promotion of an environmental value, or the augmentation of a natural resource for cultural or recreational purposes. Often the strategies implemented to achieve one particular goal are likely to assist with others by default, but occasionally conservation initiatives may be mutually incompatible. For example, in most of the Wellington region the original native saltmarsh habitat was composed largely of rushland and sedgeland, with some shrubland and herbfield, and it is this habitat type that is most commonly referred to in the concept of 'saltmarsh restoration'. However, Taylor & Kelly (2001) clearly demonstrated that the optimal habitat for inanga to spawn consists of muddy banks with swards of the exotic grass tall fescue, and that this habitat type is preferred over the native rushland. Similar incompatibilities may exist with the pursuit of environmental management such as flood control, which may actually cause inadvertent habitat modification or destruction elsewhere. Therefore, a wider ecosystem perspective is needed to develop management objectives that achieve multiple outcomes.

References

A reference list is provided at the end of each section. In addition, references for the entire report are listed in Appendix 11.

Next Steps

As mentioned previously, one of DOC's Stretch Goals is that 50 freshwater ecosystems are restored from 'mountains to sea', which includes the conservation and restoration of estuarine ecosystems. DOC has worked with a range of stakeholders and interested parties to produce this report, and intends to continue using a collaborative approach to achieve this goal. Many agencies and groups are doing great work and achieving much in relation to the goal already. We hope that this report will continue to encourage a shared dialogue about the future of our estuarine systems.

Māori place enormous value on estuarine ecosystems. As well as being taonga and mahinga kai, they are regarded as part of the landscape of tribal territory and the history is rich at these places. We acknowledge that importance and suggest that the collation of values that are of relevance to Māori is a piece of work that deserves attention in its own right. Such information will be added to a future update of this report.

⁶ http://www.gw.govt.nz/whaitua-committees/

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1. Manawatū River

1.1 Site description

The Manawatū River mouth is a large estuarine area, some 4 km long covering approximately 250 ha (Table 1A; Figs 1.1, 1.2 & 1.3). The tide has been known to travel up to 20 km upstream. The river forms an 'S' bend in the final reaches, allowing for large areas of mudflats and saltmarsh that provide significant habitats for plants and animals that are of considerable conservation value.

The dune/sandspit area at the river's outlet is dynamic, and sand accretion pushes the river mouth south around 15 m a year. Periodic flood events cause breaches of the spit at the north end, allowing the process to begin again. There is evidence that the river outlet has been over 2 km north of its current position at times (Ravine 2007).

Table 1A. Manawatū River site information (see also Figs 1.1 & 1.2).

| SITE NAME | MANAWATŪ RIVER |
|-----------------------------------|--|
| Location | Foxton Beach |
| NZTM (coordinates) | 1788982 5517289 |
| NZ Topo50 | BM33 890 173 |
| Area | Approx. 250 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Private |
| | Foxton Beach Coastal Reserves (Horowhenua District Council) |
| | Waitārere Marginal Strip (DOC) |
| | Foxton Conservation Area (DOC) |
| | Foxton Harbour Improvements Reserve (DOC) |
| | Manawatū Estuary Marginal Strip (DOC) |
| | Harbour Recreation Reserve (DOC) |
| | Foxton Marginal Strip (DOC) |
| | Manawatū River Marginal Strip (DOC) Awahou Conservation Area (DOC) |
| | ` , |
| Existing rankings | Ramsar site (Manawatū Estuary) |
| | Ramsar candidate site (Manawatū River mouth and estuary) |
| | Ecol Sites 282 & 1205 |
| | RAP 22 (Ecol Site 282) SSWI: High |
| | Horizons Regional Council Priority A wetland |
| | DOC Ecosystem Management Unit rank 101 |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 15 |
| At Risk species (number) | 20 |
| Ecosystem value (score 1–5) | 5 |
| Social value (score 1-5) | 5 |
| Restoration potential (score 1–5) | 3 |
| Pressures (score 1–5) | 3 |
| NB: 1 = high pressures | |
| Dominant habitat | Kōwhangatara grassland |
| | Pīngao sedgeland |
| | Bachelor's button herbfield |
| | Remuremu herbfield |
| | Restiad rushland |
| | Raupō reedland |
| | Sandflats |
| | Mudflats |
| | Subtidal |



Figure 1.1. Manawatū River estuarine site showing the Ramsar site and candidate site boundaries.

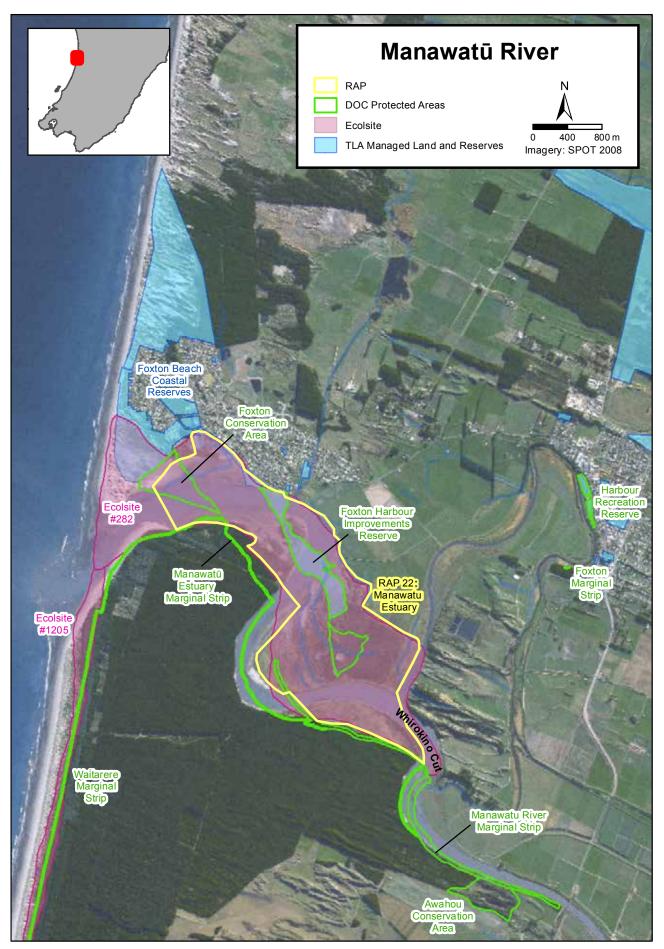


Figure 1.2. Manawatū River estuarine site showing areas and places mentioned in the text.



Figure 1.3. Aerial photograph of the Manawatū Estuary with extensive dunes at the river mouth (foreground), Foxton township and spit (left), S-bend and Fernbird flats (in the distance). *Photo: Don Ravine*.

The estuarine site has been modified by the creation of an artificial channel, known as the Whirokino Cut, effectively isolating a 7 km loop of the main channel. This, in conjunction with a network of flood barrages in the north and east, has impacted on the site by stabilising up to 200 ha of historic wetland.

The site is recognised as internationally important for its wetland habitat for plants and animals and in 2005 was designated a Ramsar site under the 1971 Ramsar Convention (Fig. 1.1).

1.2 Conservation values

1.2.1 Ecological

The broad serpentine sweep of the river has led to the formation of large, nutrient-rich mudflats on either side of the channel. It is these that form the basis of the extensive saltmarshes, and support the invertebrate population. A narrow sandspit at the northern end of the estuarine site (Figs 1.3 & 1.4) separates the western saltmarsh area from the main channel. This spit has played a significant part in reducing the impact of the river channel on the marsh (Woods & Kennedy 2008).

There are four distinct areas of vegetation in the estuarine site, as defined by Ravine (1992, 2007). The first is the great expanse of bachelor's button herbfield in the areas most affected by the tide, which at around 80 ha is one of the largest populations of this species in the lower North Island (Te Ika-a-Māui). Pūrua grass (Bolboschoenus caldwellii) is also common in these areas. In the lea of the river mouth sandspit, the herbfields are dominated by remuremu, shore primrose and glasswort. Further up the tidal zone, around the river channel, sea rush is found in bands up to 100 m wide. Sharp rush is an aggressive coloniser of the sea rush population. Finally, in the tidal flats, oioi and saltmarsh ribbonwood dominate the high tide area. Raupō dominates in three artificial ponds originally created in the saltmarsh for duck shooting. Other significant species include taupata, toetoe, flax, and horse's mane. Sea sedge and native musk are two uncommon species known to be found in the estuarine site; Selliera rotundifolia could still possibly be



Figure 1.4. The 'Fernbird Flat' saltmarsh area in the Manawatū Estuary is habitat for a population of fernbirds.

growing amidst the remuremu, and New Zealand iris and sebaea are known to have occurred historically in the sand dunes (Ravine 2007).

Buffering the site, sand coprosma occurs in bushy patches in stable sand dunes behind some tidal flats. On the sand dunes at the mouth of the river, kōwhangatara and pīngao dominate, with patches of sand pimelea present.

In total, 32 native plant species have been recorded from the mudflats and saltmarsh (Royal Forest and Bird Protection Society 2004).

The site is a nationally important site for migratory shorebirds and wading species, attracted by the large, invertebrate rich tidal flats. At least 95 bird species have been recorded in the site (OSNZ, cited in Royal Forest and Bird Protection Society 2004), seven of which were singled out as significant in the site's Ramsar application (Royal Forest and Bird Protection Society 2004; Leckie 2005). The most notable of these is the wrybill; a significant portion of the population over-winters here. The large eastern saltmarsh is known locally as 'Fernbird Flat' (Figs 1.4 and 1.5), as it provides habitat for a population of fernbirds (Ravine 2007). Other significant species include banded dotterel, Caspian tern, white-fronted tern, spotless crake, the black-fronted tern, and little black shag (Ravine 2007). Fernbirds, crakes and bitterns are particularly associated with the artificial ponds. The bar-tailed godwit arrives in the estuarine system (typically 200 to 300 birds) during spring, following its migration from the Northern Hemisphere. Some bartailed godwits (c. 50 birds) overwinter in the estuarine site each year. Smaller numbers of red knot are summer migrants and usually associate with the godwits. Numerous other common and uncommon shorebirds, waders and waterfowl feed and roost here, notably variable oystercatcher, South Island pied oystercatcher (summer), pacific golden plover (summer migrant), royal spoonbill, grey teal, paradise shelduck and black shag. Shore plover used to be found in small numbers, coming from Mana Island, but this population is now locally extinct.



Figure 1.5. Manawatū River northern intertidal flats. In the foreground is three-square sedgeland, with clumps of sea rush. In the middle of the photo is the narrow sandspit area with a variety of birds present. *Photo: Helen Kettles*.

Sixteen migratory native freshwater fish species have been recorded in the catchment, including eight species listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, torrentfish and lamprey; Allibone et al. 2010). Ravine also notes that the estuarine system is a vital breeding ground for inanga. In fact, a recent survey carried out by Horizons Regional Council, members of the local iwi and DOC have located extensive inanga spawning sites, noted as being potentially the largest known site in the country (Hans Rook, DOC, and Mike Hickford, University of Canterbury 2013, pers. comm.). Several coastal marine species are resident or frequent visitors to the estuarine site, including kahawai, black flounder, grey and yellow-eyed mullet (Royal Forest and Bird Protection Society 2004), and the estuarine stargazer (Hicks & Bell 2003).

Although the large numbers of birds in the estuarine system are attracted by the abundant marine invertebrate biomass in the tidal sediments, there is little information regarding the species composition of the invertebrate animals. Asher & Stark (1988) measured 'microfauna density' in core samples, and estimated 23 000 individuals per square metre, while Stringer et al. (1992) recorded the presence of a variety of invertebrate groups, including amphipods, insects, crabs, and molluscs. Polychaete worms were particularly significant. The dunes at the river mouth provide habitat for katipō spiders, although numbers have declined in recent years (Ward 1998; Griffiths 2006 (cited in Ravine 2007)).

There are old records of northern grass skink, brown skink and a green gecko species in the area and further survey is warranted, especially in the dunes and wetlands.

This chapter is not intended as a detailed summary of the site as much research, especially relating to birds and vegetation, is available elsewhere.

Table 1B lists native species present in, or utilising, the estuarine system.

Table 1B. Native species present in, or utilising, the Manawat $\bar{\textbf{u}}$ River estuarine system.

| GROUP | SPECIES | GROUP | SPECIES |
|---------------------------|---------------------------|---------------------------|------------------------------------|
| Threatened/At Risk plants | Native musk* | Birds continued | Reef heron+ |
| | Sea sedge* | | Royal spoonbill* |
| | Selliera rotundifolia* | | Scaup |
| Birds | Arctic tern | | Sharp-tailed sandpiper |
| | Australasian shoveler | | South Island pied oystercatcher* |
| | Australian coot | | Southern black-backed gull |
| | Banded dotterel+ | | Spotless crake* |
| | Bar-tailed godwit* | | Spotted shag |
| | Bittern+ | | Spur-winged plover |
| | Black-billed gull+ | | Swamp harrier |
| | Black-fronted dotterel | | Terek sandpiper |
| | Black-fronted tern+ | | Turnstone |
| | Black-tailed godwit | | Variable oystercatcher* |
| | Caspian tern+ | | Welcome swallow |
| | Cattle egret | | White heron+ |
| | Chestnut teal | | White-faced heron |
| | Common tern | | White-fronted tern* |
| | Crested tern | | White-winged black tern |
| | Curlew sandpiper | | Wrybill+ |
| | Dabchick+ | Fish | Banded kōkopu |
| | Fairy tern+ | | Black flounder |
| | Far eastern curlew | | Common bully |
| | Fernbird* | | Common smelt |
| | Gannet | | Estuarine stargazer |
| | Glossy ibis | | Giant bully |
| | Great knot | | Giant kōkopu* |
| | Greenshank | | Grey mullet |
| | Grey duck/mallard hybrid | | Inanga* |
| | Grey plover | | Kahawai |
| | Grey teal | | Kōaro* |
| | Gull-billed tern | | Lamprey+ |
| | Hudsonian godwit | | Longfin eel* |
| | Kingfisher | | Redfin bully* |
| | Little black shag* | | Rough skate |
| | Little egret | | Sand flounder |
| | Little shaq | | Shortfin eel |
| | Little tern | | Shortjaw kōkopu+ |
| | Marsh crake* | | Spotty |
| | New Zealand dotterel+ | | Sprat |
| | New Zealand pipit* | | Torrentfish* |
| | Pacific golden plover | | Yellowbelly flounder |
| | Paradise shelduck | | Yellow-eyed mullet |
| | Pectoral sandpiper | Aquatic macroinvertebrate | • |
| | Pied shag+ | ,, | Mudflat snail |
| | Pied stilt* | | Mud snail (<i>P. estuarinus</i>) |
| | Pied still Pūkeko | | Paddle crab |
| | | | Pipi |
| | Red-billed gull+ Red knot | | Tunnelling mud crab |
| | Red-necked stint | Threatened/At Risk | Katipō spider* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

1.2.2 Recreational

The town of Foxton Beach, on the north shore of the estuarine system, is a popular holiday destination. While many activities are centred on the beach rather than the estuarine site, the area is still popular for recreational walking, swimming, boating, fishing, duck shooting, whitebaiting, birdwatching and more recently kite surfing. The dunes at the mouth of the site are one of the few such habitats in the lower North Island (Te Ika-a-Māui) where recreational offroading is still legally permitted.

1.3 Catchment properties

The Manawatū River, the second largest in the North Island (Te Ika-a-Māui), rises on the east side of the Ruahine Ranges, draining the northwestern Wairarapa and southern Hawke's Bay, before passing across the divide via the Manawatū Gorge. The catchment covers an area of 586 840 ha and contains five major tributary rivers (the Upper Manawatū, Mangahao, Mangatainoka, Pōhāngina, and Ōroua). The Mangatainoka River has been identified as a key national site for shortjaw kōkopu (Allibone & Chadderton, cited in MacDonald & Joy 2009). There are also various townships near the river: Dannevirke, Pahīatua, Eketāhuna and Woodville east of the gorge and Palmerston North and Foxton to the west.

Eighty percent of the catchment area is farmed. In such a large catchment, with diverse land use, water quality is negatively influenced by a variety of sources, including diffuse agricultural runoff, seepage from landfills and septic tanks, industrial and town wastewater discharge, and urban runoff (MacDonald & Joy 2009). Gibbard et al. (2006) showed significant increases in nitrogen and dissolved phosphorus in the river over the period from 1989–2004. The water quality of the Manawatū River is currently ranked 'fair' for nitrogen concentration at Whirokino (meets the One Plan target 40-60% of the time) and the river is almost always too phosphorus rich (Horizons Regional Council 2013).

The river is prone to flooding, particularly on the Manawatū Plains. Stopbanks contain the estuarine system, and many kilometres of the river upstream. The Whirokino Cut (a channel constructed in 1942) and the Moutoa Floodway form part of these flood control works. Ravine (2007) maintains that these have minimal impact on the estuarine system itself, other than a higher than normal peak flow during flooding.

There are numerous areas along the Manawatū River that DOC has jurisdiction for, including the Awahou Conservation Area and the Manawatū River Marginal Strip, near the upper end of the estuarine system. The lower area of the Manawatū River, including the Whirokino Cut (Fig. 1.4), is also a Ramsar candidate site and has two additional DOC-managed areas: the Harbour Recreation Reserve and the Foxton Marginal Strip.

1.4 Threats

A range of mammals are likely to be present at the site. There is evidence that mammals can cause significant disturbance to flocks of wading birds in open habitats and may directly prey on some. Nesting birds within the estuarine environment are at increased risk from predators. Rabbits, hares and sambar deer are also present, and can do considerable damage to native vegetation. In the past, cattle have occasionally grazed on the fringes of the saltmarsh at Fernbird Flat and trampling has contributed to physical damage to the ecosystem and assisted the spread of pasture weeds.

There are unconfirmed reports of rainbow skinks at Foxton Beach settlement. Further confirmation of these records would be desirable, as this species has unknown impacts on native reptiles and terrestrial invertebrates but can reach extremely high densities.

Spartina has historically been a significant ecological weed in the estuarine system but has been controlled through a sustained programme of spraying over several years (Ravine 2007). Now only a few plants remain, mainly along the path of a single channel in the mudflats (McKinnon 2009). Tall fescue and sharp rush are invading the saltmarsh from the pasture to the east; these species can potentially compromise the habitat for fernbirds by forming impenetrable swards. Other common ecological weed species found at the site, such as reed sweetgrass, pampas, gorse, and tree lupin do not necessarily pose the threat that they do in smaller habitats, but still contribute to the degradation of the environment.

The water quality is poor and the improvement of water quality in streams in the Horizons Regional Council boundaries has been targeted in their proposed regional plan—the One Plan—with the aim of reducing agricultural and urban contamination within 20 years (Environment Court 2012).

The concentration of heavy metals in the sediments at the northern end of the site have been found to be below the ANZECC interim sediment quality guideline values (Woods & Kennedy 2008).

Changes in land use throughout the catchment during the 20th century have led to increases in sedimentation in the site. Analysis of historical data has shown that increased silt loads have significantly altered the course of the river and the extent of the mudflats since 1950 (Woods & Kennedy 2008).

1.5 Conservation management

1.5.1 Current

A number of different stakeholders have responsibilities for the estuarine site.

The Manawatū Estuary Trust is a key community organisation made up of local representatives from the Royal Forest and Bird Protection Society and OSNZ, and plays a strong role in conservation advocacy, public education, and coordination of community interest groups in the estuarine system. The Trust was instrumental in lobbying for Ramsar status for the site.

As mentioned, a number of iwi have strong cultural ties with the Manawatū River as a whole, including several groups from the headwaters in the Wairarapa and Hawke's Bay, and maintain strong interests in management of the Estuary.

A Management Plan for the Estuary, as part of the Ramsar requirements, has recently been revised, for a10 year period, by the Manawatū Estuary Management Team which includes central, regional and local government, tangata whenua and the Manawatū Estuary Trust (Manawatū Estuary Management Team 2015). The Plan includes annual action planning and will be reviewed biennially. They intend to develop activity plans for plant and animal pests, at risk plants, habitat and shellfish, undertake a knowledge gap analysis and enhance educational opportunities and awareness of the site, They will explore opportunities to expand the Ramsar site (e.g. into the Foxton Loop) and purchase the privately owned portion of Fernbird Flat. This Plan updates one produced by the Manawatū Estuary Trust (Ravine 2007).

In 2010 an Accord was signed by numerous organisations to take collaborative action to improve the state of the Manawatū River. An Action Plan was then developed (Manawatū River Leaders Forum 2011) which aims to improve catchment management including reducing sediment runoff, point discharges and non-point runoff and loss of habitat for native fish and birds. Through the Fresh Start for Freshwater Clean-up Fund the Ministry for the Environment has awarded \$5.2 million to restore the health of the Manawatū River by improving water quality, enhance habitats for native fish species and involve the community in restoration activities.

DOC has jurisdiction for around 100 ha of the site within different blocks: the Foxton Conservation Area, the Foxton Harbour Improvements Reserve, and the Manawatū Estuary and River Marginal Strips. These areas are mainly mud and sandflats. Horowhenua District Council administers the dunes and sand bar at the mouth and along the north side of the estuarine system as part of the Foxton Beach Coastal Reserves. This area comprises various reserves with

differing restrictions in place e.g. no motorbikes, horse riding or dogs. While the dunes at the mouth of the river are a designated 4WD area, access to the mudflats of the estuarine site by recreational vehicles is not permitted. This activity, and more recently kite surfing, can have impacts on wildlife and has required some education and management.

The southern margin, while technically Crown Land, is leased to a private forestry company as part of the Waitārere Forest. The leasee controls access on the south bank and is responsible for fire control. A significant portion of Fernbird Flat is privately owned and is lightly grazed. DOC and Horizons Regional Council are jointly responsible for administering any part of the estuarine site designated Crown Land, but not otherwise allocated. No monitoring is carried out in the estuarine system.

A network of boardwalks has been constructed in the saltmarsh to facilitate whitebaiting and duck shooting in the estuarine site. The Ministry of Primary Industries regulates all other recreational fishing and shellfish gathering.

Recently, a large portion of DOC management has focused on spartina control in the estuarine site (Ravine 1992, 2007) using ground-based spraying. Spartina is still present, but the area is greatly reduced (McKinnon 2009). A significant area of the mudflats has been recolonised by the native herb bachelor's button as a result. A large range of pest animal and plant species are controlled by Horizons Regional Council and Horowhenua District Council under the Manawatū-Wanganui Regional Pest Animal Pest Management Strategy (Horizons Regional Council 2009), the Regional Pest Plant Management Strategy (Horizons Regional Council 2007), and the Foxton Beach Coastal Reserves Management Plan (Horowhenua District Council 2009) respectively. Restoration efforts in the estuarine system and dunes have been largely driven by the Manawatū Estuary Trust. Recently, these have included planting of riparian vegetation, enhancement of whitebait spawning habitats (supported by the He Tini Awa Trust⁷), and the construction of a visitor viewing platform. These programmes have been supported and funded by all three governmental bodies and several private organisations.

Save Our River Trust (SORT) has been working to reintroduce more water from the main river channel into the Loop by establishing a new channel from the river (from just west of the power boat ramp and running north for about 400 m to the loop). Their activities have also included clearing and killing willows and ecological weeds, fencing off the cattle on Matakarapa Island from the Loop (with help from Horizons Regional Council) and planting giant flax on the banks of the Loop. The local Wildlife Foxton Trust is also undertaking a stewardship role for the area. With the region's wetlands restored the 'Foxton Everglades' could become a major tourist attraction.

The public technically have legal access to the Crown-owned areas of the estuarine site via Foxton Beach, but passage by foot into the saltmarsh is impractical. Access over private land via the boardwalks to Fernbird Flat is only by arrangement with the landowner.

Although the estuarine system is listed as a Ramsar site and a Recommended Area for Protection, there is currently little specific legal protection of the estuarine ecosystem and surrounding land. The subitidal and intertidal areas, and the dunes of the Foxton Beach Coastal Reserve, would be broadly protected under the Horizons Regional Council Proposed One Plan as coastal habitats (Horizons Regional Council 2008).

1.5.2 Potential

Given the large amount of restoration underway in relation to the Manawatū River catchment it would be useful to include monitoring of the estuarine system including measures water quality, sediment and biological communities in and on the sediment. This would provide important information about the state of the feeding ground for the wide variety of birdlife that utilise the area. Horizons Regional Council are currently investigating options for monitoring of the estuarine environment (A. Madden, Horizons Regional Council 2015, pers.comm.).

⁷ http://www.horizons.govt.nz/about-us/people-and-careers/grants-and-sponsorship/he-tini-awa-trust/

The area would benefit from the creation of a Wildlife Reserve in the estuarine area, contiguous with the existing Foxton Beach Coastal Reserves. This reserve should be managed primarily as a wildlife conservation area, while still catering for the administration of recreational pursuits. Management of such a reserve would be best served by a partnership between DOC, Horizons Regional Council, tangata whenua, and the Manawatū Estuary Trust, in consultation with other interest groups. It would be good to include recreational users of the site in the management process through their own administrations, following the model of the 4WD clubs. This would allow greater awareness of the significance of the estuarine system and its wildlife, and facilitate sustainable recreational use in the environment. Coordination of this aspect could be managed by the Trust.

The vegetated sandspit between the marsh area and the river channel has grown in extent over the years due to sand blowing inland from the mobile foredune (Woods & Kennedy 2008). This area is important as bird feeding habitat, and should be monitored to ensure that dune management strategies do not have inadvertent adverse impacts. The Foxton Beach Coastal Reserves Management Plan outlines plans to help stabilise foredunes by planting a buffer of native sand-binding plants and managing access to the area (Horowhenua District Council 2009).

The control of spartina has reached a point where techniques currently employed may no longer be effective (McKinnon 2009). McKinnon suggests aerial spraying may be necessary to ensure the elimination of the remaining plants, followed by ongoing monitoring to ensure that any regrowth is removed. It would be desirable to implement control strategies for other ecological weed species, particularly sharp rush and tall fescue.

Reports of rainbow skink are concerning. This species is listed as an Unwanted Organism, and it should be reported to Horizons Regional Council or DOC if sightings are confirmed. In the meantime, it may be prudent to monitor the dunes and estuarine margins for the presence of the species.

Further work to locate, document, and restore inanga spawning sites would also be valuable.

It appears that significant areas of the estuarine system are self-restoring following ecological weed control (Ravine 2007); it may only be necessary for ongoing habitat restoration efforts to focus on continued monitoring of the situation, continued ecological weed control if necessary, and targeting key sites for restoration planting.

1.6 References

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2. Wairarawa Stream

2.1 Site description

Wairarawa Stream passes through the coastal settlement and dunes of Waitārere before reaching the sea over the sandflats. The outlet is unconstrained, and changes its course across the beach frequently (Table 2A, Figs 2.1 & 2.2).

Table 2A. Wairarawa Stream site information (see also Fig. 2.1).

| SITE NAME | WAIRARAWA STREAM |
|--|---|
| Location | Waitārere |
| NZTM (coordinates) | 1786182 5509188 |
| NZ Topo50 | BN33 862 092 |
| Area | Approx. 1 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Waitārere Domain (Horowhenua District Council) Newman Esplanade Reserve (Horowhenua District Council) |
| Existing rankings | Ecol Sites 1204 & 1205 |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 6 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1–5) | 2 |
| Restoration potential (Score (1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 2 |
| Dominant habitat | Tall fescue grassland Reed sweetgrass grassland Sandflats |

2.2 Conservation values

2.2.1 Ecological

The lower reaches of the estuarine system is situated amongst rapidly accreting dunes (Wildland Consultants 2011) that have no developed indigenous vegetation to buffer the stream banks. Occasional specimens of taupata and flax are present along the banks. Three-square is present in small patches along the margins of the waterway.

Some threatened or at risk native species in the adjacent dunes include sand tussock, kōwhangatara, pīngao, sand pimelea and sand coprosma (Milne & Sawyer 2002), although none occur within the estuarine site itself.

A variety of shorebirds are present on the beach adjacent to the outlet, although not in abundance (M. Todd 2009, pers. obs.). Red-billed and southern black-backed gulls, variable oystercatchers, pied stilts, spur-winged plovers and a single black shag were all seen roosting.

Wildland Consultants (2007) list inanga, shortfin eel, and yellow-eyed mullet as present in the estuarine area, noting that the inanga appeared to be unable to migrate further upstream because of the dense growth of aquatic plants, particularly water celery. A perched culvert upstream will also be preventing migration (L. Brown, Horizons Regional Council 2013, pers. comm.).

Table 2B lists native species present in, or utilising, the Wairarawa Stream estuarine system.



Figure 2.1. Wairarawa Stream estuarine site showing areas and places mentioned in the text.

2.2.2 Recreational

The stream margin is used as access for recreational visitors to the beach and some whitebaiting does occur.



Figure 2.2. The mouth of the Wairarawa Stream flows across beach sandflats, with dunes on either side. Photo: Matt Todd.

Table 2B. Native species present in, or utilising, the Wairarawa Stream estuarine system.

| Oyotorn. | |
|----------|----------------------------|
| GROUP | SPECIES |
| Birds | Bar-tailed godwit* |
| | Black shag* |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | White-fronted tern* |
| Fish | Inanga* |
| | Shortfin eel |
| | Yellow-eyed mullet |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

2.3 Catchment properties

The stream drains the Wairarawa lagoons, a small dune lake system at the rear of the Waitārere settlement, approximately a kilometre from the beach. Several small waterways feed into the Wairarawa lagoons, draining an area of around 2000 ha, comprising farmland and small areas of dune wetland. Ōtūroa Lake No. 3, a Priority One Recommended Area for Protection (Ravine 1992) is part of this lagoon network.

2.4 Threats

The estuarine system has a severe ecological weed problem. Lining the banks for most of the length of the estuarine margin is a thick mosaic of exotic tall fescue, buffalo grass, and browntop (Fig. 2.3), with a number of other exotic grass species also present. Large mats of reed sweetgrass are beginning to clog the estuarine waters

in parts, and water celery is abundant. Watercress, monkey musk and parrot's feather (Fig. 2.3 foreground) are also present in patches. Coastal wattle and giant reed are both present adjacent to the upper tidal reaches; both have the potential to form dense colonies in the dunes and stream margins, to the exclusion of other species. A combination of control methods will be necessary if the stream is to be cleared of aquatic, emergent and terrestrial ecological weed species.

A range of mammals are likely to be present but their impacts have not been assessed at this site. Uncontrolled domestic pets, particularly dogs and cats, or people can cause significant disturbance effects on wildlife.

The abundance of filamentous brown algae (periphyton) and aquatic weeds indicate elevated nutrient levels, the result of contamination by nitrates and phosphates. The source of this is uncertain, but could be due to a combination of several factors, including diffuse agricultural runoff.



Figure 2.3. Ecological weeds (e.g. parrot's feather in the foreground) are abundant along the margins of Wairarawa Stream and in the waterway of the tidal area *Photo: Matt Todd.*

The stream is culverted as it passes underneath roads in the settlement. At least one of these culverts (Rua Road) has been scoured by erosion at the downstream end, leaving it exposed and hanging above the surface of the water. This is likely to be acting as a barrier to passage further upstream by inanga (M. Todd 2010, pers. obs.). Wildland Consultants (2007) suggested that the dense growths of water celery also form a significant barrier to inanga passage upstream.

2.5 Conservation management

2.5.1 Current

A restoration plan for Waitārere Beach, including the entire Wairarawa Stream, is being implemented by Horizons Regional Council and Horowhenua District Council (Wildland Consultants 2011). This work includes ecological weed control strategies with excellent reduction of coastal wattle from the toe of the foredune to the housing. Other ecological weeds treated include cape ivy, boxthorn, climbing dock, yucca, tree lupin and exotic conifers. Enhancement of the indigenous habitat has involved Horizons Regional Council assisting a community group to propagate spinifex seedings which they hope to extent to a wider range of ecosourced native species. A small section of walking track to the Wairarawa lagoons has been constructed by Horowhenua District Council. The waterway has no protection in the form of fencing.

The site is currently managed as part of the Waitārere Beach domain and Newman Esplanade Reserve, and the area is undergoing dune restoration by Horowhenua District Council. Information boards outline the restoration process at the road end by the surf club. Horizons Regional Council monitors water quality in the stream for swimming risk on a weekly basis during the summer. This focuses on *E. coli* levels as an indicator of faecal contamination. Generally, water quality in the stream mouth is rated as a 'Poor' in this regard (Horizons Regional Council 2012).

2.5.2 Potential

As the estuarine area runs through the domain and esplanade reserve, inclusion of the stream banks in the restoration programme would be appropriate. Rushes such as wīwī, oioi (both found elsewhere on the coast), and three-square (already present) could be planted along the margin, augmented by riparian planting of flax and toetoe. This would also assist in the enhancement of water quality by acting as a filter for nutrients.

The rough footpath that passes through this area is poorly formed, occasionally coming within centimetres of the stream bank. This could be better defined, keeping foot traffic clear of the margin to reduce erosion. In addition, a fence could be erected along this path in order to protect native plantings.

Improvement of water quality in streams in the Horowhenua and Manawatū has been targeted by Horizons Regional Council through the One Plan, with the aim of reducing agricultural contamination (Environment Court 2012).

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3. Hōkio Stream

3.1 Site description

The Hōkio Stream mouth is a small tidal river mouth type of estuarine system, spilling over the sandflats of the beach. (Table 3A, Figs 3.1, 3.2). The stream is tidal for perhaps a kilometre. The settlement of Hōkio Beach is immediately adjacent to the upper estuarine area, and the area has been modified and disturbed by housing and vehicles. A vehicle bridge crosses the upper tidal reaches and vehicle tracks run along both banks to the beach. The stream mouth is dynamic, and in storms can undercut the dunes to the south of the estuarine site. Due to its dynamic nature, and risk to flooding to the township, the stream mouth has been cut straight through to the sea a number of times in its history. The sandflats support herbfields, although tall fescue and other ecological weed species are abundant. The banks of the upper estuarine area are steep and dominated by grasses.

3.2 Conservation values

3.2.1 Ecological

The beach at the mouth is devoid of vegetation, but the flats at the rear of the beach, where the stream forms two loops, have historically had herbfield areas dominated by bachelor's button (Figure 3.3). Although common in the region batchelor's button does not generally dominate large patches, as it has done here. Other species found in these areas include remuremu, sharp spike sedge, and mudwort, while three-square fringes the low water mark. Patches of wīwī,

Table 3A. Hōkio Stream site information (see also Fig. 3.1).

| SITE NAME | HŌKIO STREAM |
|--|---|
| Location | Hōkio Beach |
| NZTM (coordinates) | 1784582 5503787 |
| NZ Topo50 | BN33 846 038 |
| Area | 10 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Private |
| Existing rankings | Ecol Site 26 WERI: 2, SSWI: Moderate Horizons Regional Council Priority D Wetland |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 5 |
| At Risk species (number) | 10 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1-5) | 4 |
| Restoration potential (score 1–5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Tall fescue grassland |
| | Reed sweetgrass grassland |
| | Willow treeland |
| | Bachelor's button herbfield |
| | Sandflats |
| | Subtidal |



Figure 3.1. Hōkio Stream estuarine site showing areas and places mentioned in the text.



Figure 3.2. View of the Hōkio Stream mouth and 'Cut' in 2015 just after realignment for flood management. Photo: Helen Kettles.



Figure 3.3. In 2009, prior to flood management operations, bachelor's button formed large swathes on the sandflats of the Hōkio Stream mouth. *Photo: Matt Todd.*

knobby clubrush and *Schoenus nitens* are scattered across the flats. Further up the tidal reaches, near the settlement, the banks are steeper, and larger shrubby species are found. Toetoe, giant umbrella sedge, taupata, and flax are all present in patches. Raupō is found at the saltwater limit.

Two notable plant species occur in the vicinity; sand coprosma and sand pimelea (de Lange 1993) have both been recorded in the dunes. *Selliera rotundifolia* (de Lange 1993⁸) was known to occur on the sandflats, and possibly also in the dunes. Sebaea was recorded here by Ogle (1989) but is no longer present.

The large sandflats are excellent roosting and feeding habitat for a wide range of shorebirds and waders, with southern black-backed gulls forming particularly large flocks that stretch along the beach. Red-billed gulls, variable oystercatchers, and pied stilts are also common. Waterfowl feed in the narrower, upper reaches of the tidal area. This estuarine site was included in the OSNZ (2007) river mouth bird survey.

⁸ BioWeb is a system which holds much of DOC's national data about New Zealand's natural heritage, including observations of plants and animals. Public access to BioWeb is currently restricted and must be obtained through DOC.

Table 3B. List of native species present in, or utilising, the Hokio Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------------|
| Threatened/At Risk plants | Selliera rotundifolia* |
| Birds | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black-billed gull+ |
| | Black-fronted dotterel |
| | Black-fronted tern+ |
| | Caspian tern+ |
| | Grey duck/mallard hybird |
| | Pied stilt* |
| | Red-billed gull+ |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | Spur-winged plover |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Common bully |
| | Common smelt |
| | Giant kōkopu* |
| | Inanga* |
| | Longfin eel* |
| | Shortfin eel |
| | Torrentfish* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

Eight migratory native freshwater fish have been found in the catchment, including four that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga and torrentfish; Allibone et al. 2010). The tall fescue in the upper estuarine area would provide good spawning habitat for inanga. A population of lacustrine common smelt (reproduce in the lake but non diadronmous due to a weir acting as a barrier to the sea) was located recently in Lake Horowhenua during an electric fishing survey (Tana 2013). A recent survey also determined that large numbers of eel (primarily shortfin eel) were living in the in the lake however these were almost entirely of a small size, consistent with heavy fishing pressure from commercial and/or recreation eel fisheries. Tempero (2013).

There are no records of lizards at this site, although the dunes and driftwood could provide suitable habitat for several species of lizard. Invertebrate records are also limited.

Table 3B lists native species present in, or utilising, the Hōkio Stream estuarine system.

3.2.2 Recreational

The estuarine system is bordered to the west by the coastal settlement of Hōkio Beach, and access tracks to the beach run along both sides of the stream. During the summer, the beach is a popular holiday spot for swimmers, sunbathers, and walkers. Recreational fishers visit year round, surf casting from the beach and, less frequently, fishing in the stream. Recreational boats are often launched from the stream mouth. The stream is also popular for whitebaiting.

3.3 Catchment properties

The stream is the sole outlet for Lake Horowhenua. The catchment covers around 7000 ha (MacDonald & Joy 2009), mainly drained by streams flowing into Lake Horowhenua from the surrounding coastal plain. Apart from the town of Levin, the area consists almost entirely of farmland (largely sheep and beef with some dairying), with some horticulture, and coastal dune wetlands. Water quality in the lake and stream is regarded as extremely poor (Manawatū-Wanganui Regional Council 1998; MacDonald & Joy 2009), there having been a history of discharge of sewage, from the Levin township, and ongoing diffuse land use and stormwater inputs. The site of the old Levin landfill is some 3 km upstream and potentially contributes to this.

The lake level (height required by legislation) is maintained by a weir across the stream, near its outlet from the lake.

There are a few Recommended Areas for Protection in the catchment, including those associated with Lake Horowhenua: Whitiki Bush and Swamp (51 ha) and Lake Horowhenua West Bush (6 ha) (Ravine 1992). DOC also manages the Hōkio Stream Public Reserve, approximately 500 m up from the bridge and alongside the Hōkio Stream Esplanade Reserve managed by Horowhenua District Council.

3.4 Threats

Water quality in the stream is acknowledged to be poor, mainly due to long-term issues with high nutrient levels and eutrophication in Lake Horowhenua (Manawatū-Wanganui Regional Council 1998; Gibbs 2011). Monitoring by Horizons Regional Council (2013) puts both the nitrogen and phosphorus concentrations at 'poor' (i.e. meets the One Plan target only 20–40% of the time). Gibbs (2011) has identified a range of probable causes of the poor water quality in the lake, including (but not restricted to) historic discharge of raw sewage from Levin into the lake (a practice discontinued in 1987), and diffuse runoff from intensified agriculture in the catchment.

Population numbers of native fish species in the stream are in advanced decline (Manawatū-Wanganui Regional Council 1998), and it is likely that pollution is a major part of the reason. Nutrient enrichment of the stream also promotes the build-up of algal growth, which in turn leads to anoxic sediments and eutrophication. Gibbs (2011, 2012) suggests that the problem is exacerbated by the presence of the weir preventing sediment flushing. Perch are also in the stream and in the tidal areas (MacDonald & Joy 2009). The weir on the Hōkio Stream outlet would prevent migration/movement of a range of fish species including shortfin and longfin eel, grey mullet, smelt, inanga and black flounder.

Adjacent to an urban area, feral pest incursions are recurring threats to birdlife. Human disturbance is significant, as the area is a popular site with recreationalists. Domestic dogs frequently accompany their owners on the beach and also cause a disturbance to wildlife.

The upper tidal reaches have a severe ecological weed problem. The margins are inundated with an assortment of mat-forming weed species, particularly reed sweetgrass (Fig. 3.4), which have almost totally displaced any native species. Other weeds of particular concern include oxygen



Figure 3.4. Reed sweetgrass and riparian ecological weeds are abundant in the waterway of the Hōkio Stream. Photo: Matt Todd.

weed and parrot's feather in the waterway and a stand of giant reed on the sandflats of the lower part of the site. Purple loosestrife, an unwanted organism, is known around Lake Horowhenua and the Hōkio Stream and estuarine system (Giddy 2001).

Common ecological weeds are also found throughout the ecosystem. Tall fescue can be seen everywhere and is the most common species in the ecosystem. Buffalo grass, Mercer grass, pampas grass, gorse and dock are present along the banks (Fig. 3.4), while watercress and monkey musk are in the waterway.

Vehicles are allowed on the beach, with few restrictions enforced. Not only does this adversely impact the vegetation and wildlife, but vehicles are frequently dispersal vectors for ecological weeds, and their passage creates a disturbance of the ecosystem that can facilitate the incursion of ecological weed species.

The river mouth has also traditionally been moved around to take it straight to the coast rather than forming south along the beach. This practice poses a threat to the functioning of the ecosystem. In 2015 this was undertaken ('Hōkio Cut') under emergency works provisions of the RMA to alleviate the risk of flooding to infrastructure and health and safety (septic tank seepage). This diversion of water flow resulted in blocking the flow to the main wetland area, a physical loss of 0.1 ha of wetland habitat (raupō) and 1 km of stream length which supported inanga spawning. This also greatly reduced regional rare large patches of bachelor's button An offset funding of \$20,000 over 2 years was paid into the Horizon Regional Council's Hei Tini Awa Trust for restoration initiatives.

Horowhenua District Council (2008) has targeted Hōkio Beach for future development. In particular, the area adjacent to the southern margins of the estuarine site has been highlighted as suitable for low-density housing which has potential to result in further disturbance to the habitat of the lower part of the ecosystem and the adjacent sand-dunes.

3.5 Conservation management

3.5.1 Current

Active management by Horowhenua District Council appears to be restricted to the esplanade reserve adjacent to the bridge and settlement along the Hōkio Stream. Despite bylaws regulating vehicle access to the beach (Horowhenua District Council 1999), there are no apparent restrictions in place to prevent inappropriate vehicle use.

The waterway is managed by Horizons Regional Council under the Lake Horowhenua and Hōkio Stream Catchment Management Strategy (Manawatū-Wanganui Regional Council 1998), in conjunction with Horowhenua District Council, DOC, and Horowhenua Lake Trustees (representing local landowners and Muaūpoko). The priority of the Strategy is to improve water quality and aquatic biodiversity in the catchment through identification, alleviation, and monitoring of contamination sources, and through restoration of riparian habitats. Ecological weed control, including purple loosestrife, is being undertaken by Horizons Regional Council. In conjunction with iwi they are also undertaking some restoration planting of species such as flax, toetoe, and taupata along the stream margins.

3.5.2 Potential

The priority for biodiversity restoration in the estuarine system is a long-term plan for management interventions currently needed to manage flooding risk to the approximately 25 Hōkio Beach residents. It has been estimated that the stream mouth will reorient to the south again in 9 years (Lambie 2015) therefore this is an ongoing management issue. An assessment of the options for management should take into account sealevel rise and the hydrological needs of the wetland area. In particular, exploring options in the shortterm to allow some water movement back into the wetlands should be undertaken.

In the long-term another priority issue is improvement in the water quality, an issue that is tightly bound to the management of Lake Horowhenua. Gibbs (2011) suggests several intensive management strategies to alleviate the nutrient enrichment problem in the lake, but warns that none could be successful without strict catchment-wide regulation of both agricultural and urban diffuse nutrient sources. He suggests longer-term strategies for ecosystem restoration in the Lake Horowhenua Restoration Plan (Gibbs 2012), including the permanent modification of the weir to allow increased sediment flushing and fish passage. Gibbs (2012) also notes that a vital element of this process would be clearing obstructions such as woody debris and aquatic weed mats from the waterway of Hōkio Stream.

Generally speaking, it could be assumed that improving the water quality of Lake Horowhenua would lead to a corresponding direct improvement in that of Hōkio Stream. However, it should be noted that Gibbs (2012) has made no analysis of potential changes in the stream resulting from controlled sediment flushing of the lake; including the effects of periodic sustained variations of flow rates, and the potential for elevated sediment deposition. It would be prudent for such an investigation to be conducted prior to any alterations to the current management of the lake outflow.

Apart from water quality, there are other issues that could also be addressed. The upper part of the site in particular has a chronic weed problem, although several of the aquatic species are associated with nutrient enrichment of the waterway, others are terrestrial colonisers, including tall fescue, pampas grass, buffalo grass, and gorse. The ecological weeds will require a range of ongoing control methods, as there are many different exotic species invading the area. Continued restoration planting of species such as flax, toetoe, and taupata could be made along the stream margins to supplement the existing populations and inhibit weed regrowth through overtopping. Lower in the tidal reaches, the existing weed population could be replaced with plantings of rushes such as wīwī, sea rush, and oioi. Saltmarsh ribbonwood is known in other estuarine systems along the coast, and would be an appropriate species to plant.

In the dunes, any restoration schedule would require control of marram, followed by plantings of native species: pīngao, kōwhangatara, sand coprosma, sand pimelea and tauhinu, in particular. An intact buffer of native dune vegetation along the estuarine margins would help reduce ecological weed incurrence in the ecosystem.

The herbfields on the lower flats are particularly significant. Not only do they contain rare species such as *Selliera rotundifolia*, but also mudwort, which is uncommon along this coast, and large areas dominated by bachelor's button, which in terms of estuarine systems in this report, are seen elsewhere only in the Manawatū Estuary. These areas require special attention to enable water flow, control encroaching weed species, and provide fencing to prevent inadvertent damage by walkers and vehicles. It may be appropriate to erect information panels to raise public awareness of the significance of these herbfields and the reasons for their protection. Similarly, panels highlighting sensitive roosting and nesting sites for birds could be erected elsewhere on the beach.

Any restoration sites in the area would require ongoing monitoring to ensure that further establishment by ecological weeds was prevented.

Vehicle use on the sandflats and beach is an issue. The access track and parking area, for vehicles, could be defined so as to minimise the impact of vehicles on the sensitive habitat, reduce disturbance to birdlife, and diminish the opportunity for weed dispersal.

In addition, it would be useful to assess the legal status of the site to see if there were options for increasing the long-term protection for the environment. Any future development in the vicinity should include strategies to minimise the environmental impact of any habitat or wildlife disturbance.

Locating, documenting, and restoring any potential inanga spawning sites would be valuable.

The Lake Horowhenua Accord, which has been signed by multiple partners including local iwi, Lake trustees and the district and regional councils, aims to target multiple issues relating to the quality of Lake Horowhenua.

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4. Waiwiri Stream

4.1 Site description

This braided stream mouth discharges across the beach between Ōhau and Hōkio. The tide penetrates about 300 m upstream, and the estuarine system is entirely within the coastal dune system (Table 4A, Figs 4.1 & 4.2). The area is isolated, with Hōkio Beach the nearest settlement, 4 km north along the beach. The stream is used as an access point for the beach; a vehicle track runs down the middle of the bed. Apart from small patches of saltmarsh vegetation, weeds dominate the environment (Fig. 4.2).

The stream is the sole outlet for Lake Papaitonga.

4.2 Conservation values

4.2.1 Ecological

Although weeds dominate the dry parts of the stream bed, there are several patches of saltmarsh, consisting of herbfields fringed with bands of sedge. Three-square and clubrush are mixed with areas of shore primrose, bachelor's button, and sharp spike sedge. Selliera rotundifolia and Schoenus nitens were recorded here by de Lange (1993). Knobby clubrush, toetoe, and flax may be found on the very edge of the stream bed. Pīngao and sand pimelea are found in small amounts in the dunes at the mouth of the stream (A. Madden, Horizons Regional Council 2016, pers. comm.).

During the 2009 survey, the only birds observed were roosting southern black-backed gulls. Red-billed gulls and variable oystercatchers have also been reported from this site.

Table 4A. Waiwiri Stream site information (see also Fig. 4.1).

| SITE NAME | WAIWIRI STREAM |
|-----------------------------------|--|
| | _ |
| Location | North of Ōhau |
| NZTM (coordinates) | 1783382 5500187 |
| NZ Topo50 | BN33 834 002 |
| Area | Approx. 1 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Private |
| Existing rankings | Ecol Sites 1201 & 1202 |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 5 |
| Ecosystem value (score 1–5) | 1 |
| Social value (score 1–5) | 4 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) | 3 |
| NB: 1 = high pressures | |
| Dominant habitat | Kōwhangatara grassland |
| | Water celery herbfield |
| | Three-square sedgeland |
| | Sandflats |



Figure 4.1. Waiwiri Stream estuarine site showing areas and places mentioned in the text.



Figure 4.2. Water celery is dominant throughout the bed of the Waiwiri Stream. Photo: Matt Todd.

Five migratory native freshwater fish species have been found in the catchment (MacDonald & Joy 2009; Petrove 2009), three of which are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga; Allibone et al. 2010).

There are no invertebrate and herpetofauna records from this stream area.

Table 4B shows the distribution of native species present in, or utilising, the Waiwiri Stream estuarine system.

4.2.2 Recreational

The stream mouth is used in current times by local recreational fishers and whitebaiters.

Table 4B. Native species present in, or utilising, the Wairiri Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Selliera rotundifolia* |
| Birds | Red-billed gull+ |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| Fish | Banded kōkopu |
| | Common bully |
| | Giant kōkopu* |
| | Inanga* |
| | Longfin eel* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

4.3 Catchment properties

The catchment is entirely within the ancient coastal dune system between the Ōhau River and Lake Horowhenua, covering approximately 1520 ha. Land use is predominantly sheep and beef plus some dairying. Its main feature is Lake Papaitonga (known to Muaūpoko as Waiwiri), protected as a scenic reserve by DOC.

Monitoring by Horizons Regional Council detected elevated nutrient levels in the waterway, with a water quality rating of 'very poor' in 2005 (Horizons Regional Council 2005). The causes of this are uncertain, but are likely to include diffuse agricultural runoff in the catchment. Leaching of waste from the 'The Pot' (an unlined artificial pond which receives secondary treated human effluent located about 300 m from the stream) has been shown unlikely to be a significant contributor (see Allen et al. 2012). The water quality at the site was not reported on in the latest state of the environment report (Horizons Regional Council 2013).

There is a high level of community interest in the ecological restoration of Lake Papaitonga. The lake has high conservation values as a wetland, along with cultural significance for Muaūpoko.

4.4 Threats

Nutrient enrichment is the largest threat to the values of this estuarine system. Weed infestation resulting from elevated nutrients has resulted in the excessive growths of water celery and monkey musk which have all but inundated any native vegetation in the stream bed and largely make the area unsuitable for many bird species.

Other than the water celery and monkey musk, a variety of ecological weeds infest the dry parts of the stream bed. Many of these are pasture species that have been introduced along the vehicle track, such as tall fescue, browntop, white clover, and dock. Others are associated with the water way; these include Mercer grass, reed sweetgrass and watercress.

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. For instance, hares and rabbits are likely in the adjoining dunes, and could do considerable damage to new growth of native grasses and sedges such as kōwhangatara and pīngao. In a rural area, wandering stock trampling the banks of the stream and damaging the habitat is a possibility, although no evidence of stock in the vicinity was noted at the time of visiting.

Vehicle use of the track in the dry parts of the stream bed areas disturbs and causes compaction of sediments, damages the native herbfields and facilitates ecological weed dispersal.

4.5 Conservation management

4.5.1 Current

A priority for biodiversity restoration in the estuarine system is in the long-term improvement in the water quality. Monitoring of the workings of the sewage treatment site is a requirement of the resource consent. Horizons Regional Council has listed the Waiwiri catchment as a priority for nutrient management (Horizons Regional Council 2008) and has rules in place around nutrient management and leaching rates for intensive land use (Environment Court 2012). Horizons Regional Council are also undertaking riparian habitat restoration which will connect with restoration being undertaken by DOC adjacent to the lake. Research and management supported by local kaitiaki supports this approach (Allen et al. 2013).

There is no evidence of ecological weed or pest control and no fencing to exclude any wandering stock.

4.5.2 Potential

The ecological weed situation at this site requires monitoring, if not a comprehensive control programme. Several of the species are particularly invasive and are capable of dispersing upstream into Lake Papaitonga.

Locating, documenting, and restoring any potential inanga spawning sites would be valuable.

The site would benefit from management by a local community group. Sites suffering from a similar degree of degradation elsewhere along the Horowhenua/Kāpiti coast have flourished under restoration management, and this would be a logical extension of work going on around Lake Papaitonga.

4.6 References

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5. Ōhau River

5.1 Site description

The Ōhau estuarine site (Table 5A and Fig. 5.1) is a Category B estuarine system, the form of which is dominated by a coastal sandbar. The river mouth is highly dynamic, and can move over 100 m each year; it has even historically flowed into the Waikawa Stream (Ravine 1992). There is currently a large saline tidal pool (known as Ōhau Lagoon) at the rear of the sandbar, which is separated from the river by around 100 m (Fig. 5.2). The course of the river is known to flow through this pool at times. Parts of the estuarine site have been significantly modified through drainage and cultivation.

The estuarine influence extends about 3 km upstream. There are around 10 ha of saltmarsh in patches throughout the area. The largest sites are associated with the main river channel, while others are on the pool margins. A large remnant oxbow wetland area, called the Ōhau Loop, was largely cut off from the main flow of the river for flood protection works in the 1970s.

Table 5A. Site information for the Ōhau esturine site (see also Fig. 5.1).

| SITE NAME | ŌHAU RIVER |
|--|---|
| Location | 2 km north of Waikawa |
| NZTM (coordinates) | 1782982 5497286 |
| NZ Topo50 | BN33 830 973 |
| Area | 250 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Private Te Hakari Wetland (Te Iwi o Ngāti Tukorehe Trust) Esplanade Reserve (Horowhenua District Council) Accretion Conservation Area (DOC) |
| Existing rankings | Ecol Sites 89 & 1201 RAP (2)5 (Ecol Site 89) WERI: 3, SSWI: Moderate-High Horizons Regional Council Priority A wetland |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 12 |
| At Risk species (number) | 16 |
| Ecosystem value (score 1–5) | 4 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1–5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Remuremu herbfield Glasswort herbfield Sandflats Mudflats Subtidal |

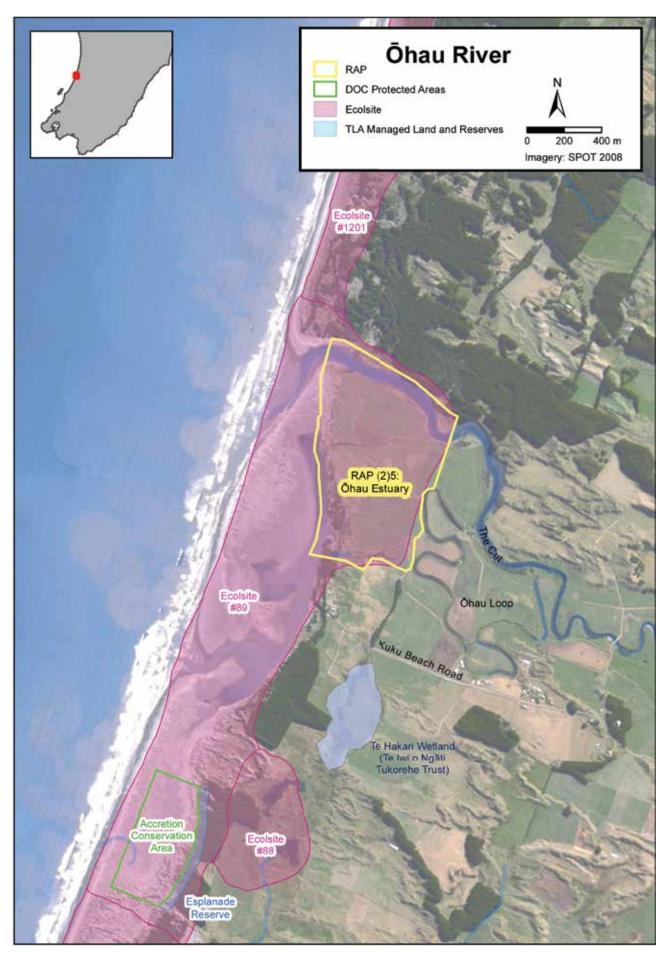


Figure 5.1. $\,\bar{\text{O}}\text{hau}$ River estuarine site showing areas and places mentioned in the text.



Figure 15.2. Glasswort and remuremu herbfields (centre) on the sandflats adjacent to Ōhau Lagoon. Photo: Matt Todd.

5.2 Conservation values

5.2.1 Ecological

Saltmarsh wetland flanks the tidal mouth of the river on both sides (Figs 5.3 & 5.4). Two-thirds of the riverbank saltmarsh is covered by sea rush over remuremu. Oioi is found on the southern bank, and a large band of saltmarsh ribbonwood occurs through the centre of the area. Other notable species found in the saltmarsh include native musk, shore primrose, three-square, glasswort, wīwī, bachelor's button, toetoe and flax. Many other wetland plants are also present.

Significant areas of glasswort and remuremu herbfield line the margins of the pool, particularly on the coastal side (Fig. 5.2).

Pīngao and kōwhangatara are present in the dunes abutting the river mouth and pool.

Spiranthes and swamp buttercup were both recorded as occurring at this site by Duguid (1952). Pygmy clubrush and sand tussock are known to have occurred in the vicinity (Druce 1972).

The saltmarsh and dunes support a wealth of birdlife. The area is visited by a range of migratory waders and shore birds, along with resident species, for feeding and roosting. Bar-tailed godwits and Caspian terms are commonly seen here during the summer months, and wrybills frequent the estuarine area during the winter. There is a breeding colony of variable oystercatcher in the dunes, and the estuarine ecosystem is an important non-breeding site for this species (Dowding & Moore 2006). This estuarine site was included in the OSNZ (2007) river mouth bird survey. Smith et al. 2011 have also recorded birds as part of cultural monitoring.

Thirteen migratory native freshwater fish species have been found in the catchment, including eight species that are listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, kōaro, inanga, redfin bully, bluegill bully, torrentfish and lamprey; Allibone et al. 2010). A variety of coastal marine fish use the river mouth and lowest reaches of the estuarine site.

There are no records of reptiles from the area.

Table 5B lists native species present in, or utilising, the Ōhau estuarine system.



Figure 5.3. Saltmarsh (sea rush and saltmarsh ribbonwood) on the northern bank of the \bar{O} hau River is visible at the rear of a vegetated bank. *Photo: Matt Todd.*



Figure 5.4. Saltmarsh ribbonwood and oioi in the saltmarsh on the southern bank of the Ōhau River. The farmed part of the Recommended Area for Protection is at the rear. *Photo: Matt Todd.*

Table 5B. Native species present in, or utilising, the Ōhau estuarine system.

| GROUP | SPECIES |
|---------------------------|------------------------|
| Threatened/At Risk plants | Native musk* |
| | Pygmy clubrush+ |
| | Sand tussock* |
| Birds | Australasian shoveler |
| | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Bittern+ |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Black-fronted dotterel |
| | Black-fronted tern+ |
| | Caspian tern+ |
| | Gannet |
| | Grey teal |
| | Gull-billed tern |
| | Kingfisher |
| | Little egret |
| | Little shag |
| | New Zealand dotterel+ |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Red knot |
| | Red-billed gull+ |

| GROUP | SPECIES |
|-----------------|----------------------------------|
| Birds continued | Royal spoonbill* |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Turnstone |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| | Wrybill+ |
| Fish | Banded kōkopu |
| | Black flounder |
| | Bluegill bully* |
| | Common bully |
| | Common smelt |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Lamprey+ |
| | Longfin eel* |
| | Redfin bully* |
| | Rough skate |
| | Shortfin eel |
| | Shortjaw kōkopu+ |
| | Torrentfish* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

5.2.2 Recreational

An unformed track around the pool gives trail bikes access to the dunes and beach. Surfcasters visit occasionally, and the estuarine site is used by whitebaiters and duck-shooters.

5.3 Catchment properties

The majority of the 18 800 ha catchment is open farmland with only the upper few kilometres of the catchment in the forested western foothills of the Tararua Range. The small settlement of Kūkū is situated immediately adjacent to the estuarine site and the township of Ōhau is near the river at SH1. Stock access and diffuse source contamination, along with gravel extraction sites, are listed as factors which could contribute to deteriorating water quality (MacDonald & Joy 2009), but they appear to be of low significance, as Horizons Regional Council (2013) rate the water quality in the river as 'fair" for nitrogen concentration (meets the One Plan target 40-60% of the time) and "good' for phosphorus (meets the target 60-80% of the time).

5.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. It is known that hares and rabbits are common in the area and can do considerable damage to native vegetation.

Spartina and sharp rush were observed in the pool and wetland respectively; both have the potential to form thick mats on the mudflats. Senegal tea is known to occur in the catchment (Proctor 2003; MacDonald & Joy 2009); this species can form thick floating rafts that clog waterways.

Ravine (1992) noted that a large area of the eastern part of the tidal flat was to be drained and developed, although it wasn't considered likely to be successful due to the frequent inundation by high tides. Nevertheless, it would appear that a large part of the original Ōhau Estuary Recommended Area for Protection is now farmed and is no longer wetland habitat (Fig. 5.4).

The recreational use of trail bikes on the beach and sandflats at the mouth of the river appears to be a regular occurrence. The unrestricted use of trail bikes in wetlands and soft substrate habitats has been shown to not only impact directly on vegetation (Fig. 5.5) and wildlife, but also to exacerbate erosion by removing groundcover and degrading the structure of the substrate (Pymble-Ward 2009).

5.5 Conservation management

5.5.1 Current

Much of the surrounding land is owned by Ngāti Raukawa, and the nearby Te Hākari wetlands are administered by Te Iwi o Ngāti Tukorehe Trust, with support from Horizons Regional Council, Horowhenua District Council and DOC (Ngā Whenua Rāhui). Horizons Regional Council rates the site as a Priority A wetland (Lambie 2008). The local hapū/iwi Ngāti Tukorehe has invested much energy into managing the conservation in this area.

The Ōhau Loop still receives tidal flow, via culverts from the main river but it is insufficient to maintain healthy ecosystems. The hapū/iwi have installed a fish friendly floodgate and have plans to restore the natural meander and flow of water to this area which was once abundant with flounder, mullet and whitebait (Allen et al. 2011).



Figure 5.5. Vehicle damage in glasswort herbfields at Ōhau Estuary. Photo: Matt Todd.

Stock from the surrounding pasture are excluded by fencing on the south bank, and a buffer zone maintained, occupied by a plantation of macrocarpa and radiata pine. The north bank is not fenced, although a much larger plantation occupies the land on that side of the river.

Te Hākari wetlands are the site of a vegetation restoration initiative by the Trust, although there is currently no restoration planting in the main estuarine area. The Trust restricts access to the variable oystercatcher breeding site during the nesting season, although there is no physical barrier to the area (i.e. they erect signs). Fish populations are monitored as part of customary fishing rights by Te Iwi o Ngāti Tukorehe Trust (H. Smith, Manaaki Taha Moana 2015, pers. comm.).

The hapū/iwi undertake mustelid control to assist bird populations. Otherwise, there appears to be only a low level of pest animal control in the area, as hares and rabbits are conspicuous.

5.5.2 Potential

It would be worthwhile investigating options to formally protect remaining habitat areas in the Recommended Area for Protection. This site has a high conservation value, but is currently legally unprotected. This could be explored in consultation with Te Iwi o Ngāti Tukorehe Trust, Horizons Regional Council, Horowhenua District Council, and other neighbouring landowners.

The value of the Recommended Area for Protection could be further enhanced with a programme of ecological weed and pest control. Marram and tall fescue are particularly abundant in the saltmarsh; these can be controlled but are difficult to eradicate entirely. In a wetland, gorse can be controlled before it overgrows wetland plants. Spartina requires active management in order to eradicate it from the estuarine habitat, and vigilance would be required to ensure that it no longer persists, even after it is thought to be eradicated. The pine plantation on the adjacent dunes will also act as a source of ecological weeds, so it is likely that regular monitoring and occasional control will be required here also.

The dunes are dominated by marram. Dune restoration requires physical fencing of the chosen site, followed by control. Pīngao, kōwhangatara, and sand tussock are all local. These species could easily be planted and used for cultural gathering, also the native shrubs sand coprosma, sand pimelea and tauhinu. An intact buffer of native dune vegetation along the estuarine margins would help reduce weed incurrence in the estuarine ecosystem.

4WD vehicle and quad bike access to the beach is controlled by Te Iwi o Ngāti Tukorehe Trust. It would be desirable to work in partnership with the Trust and local trail bike enthusiasts in order to reduce the impact of trail bikes on the coastal habitat.

Locating, documenting, and restoring any inanga spawning sites would be valuable.

As much of the wetland is within the area owned and managed by Te Iwi o Ngāti Tukorehe Trust, recommendations in this report would need to be agreed by hapū/iwi. Implementation support could be sought from local authorities and DOC. Given the ecosystem values of this estuarine site it may be also worth investigating the option of creating a Wildlife Reserve.

5.6 Other comments

This is the only relatively undeveloped river estuarine system on the western side of the conservancy and therefore is unique. Special attention should be paid to future development proposals to ensure that they don't degrade the estuarine values, particularly in terms of the wildlife.

5.7 References

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6. Waikawa Stream

6.1 Site description

The Waikawa Stream and Ōhau River shared a single outlet until 1870 (Ravine 1992), and the Waikawa estuarine system (Table 6A and Fig. 6.1) still meanders through the alluvial plain that remains from this merging. The estuarine system is a Category B type which is constrained by a dynamic sand bar at the outlet (Fig. 6.2). The settlement of Waikawa Beach, immediately adjacent on the inland side of the stream has stabilised the banks in the lower and middle tidal reaches of the estuarine system (Figs 6.3, 6.4), but the upper tidal reaches spreads out to fill a shallow basin behind the dunes with mudflats and an extensive saltmarsh (Fig. 6.5). The tide travels nearly 3 km upstream. The intertidal area makes up 54% of the total estuarine area.

A footbridge crosses the estuarine site near the settlement to provide access to the beach.

Table 6A. Waikawa Stream site information (see also Fig. 6.1).

| | T |
|--|--|
| SITE NAME | WAIKAWA STREAM |
| Location | Waikawa Beach |
| NZTM (coordinates) | 1781582 5494086 |
| NZ Topo50 | BN33 816 941 |
| Area | 30 ha |
| DOC Office | Te Papaioea / Palmerston North Office |
| Councils | Horowhenua District Council, Horizons Regional Council |
| Land status (tenure) | Private Esplanade Reserve (Horowhenua District Council) Riverbank Reserve (Horowhenua District Council) Waikawa Conservation Area (DOC) |
| Existing rankings | Ecol Sites 153 & 1200 RAP 13 (Ecol Site 153) WERI: 2, SSWI: Moderate Horizons Regional Council Priority C wetland |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 7 |
| At Risk species (number) | 12 |
| Ecosystem value (score 1–5) | 4 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1–5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Pūrua grass reedland Tall fescue grassland Harakeke flaxland Glasswort herbfield Sandflats Mudflats Subtidal |

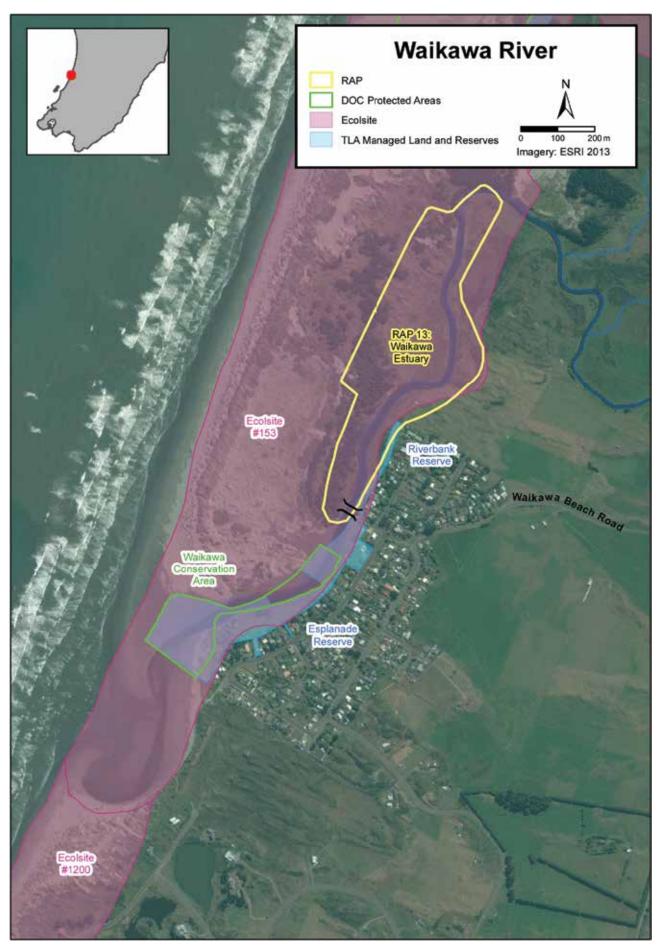


Figure 6.1. Waikawa Steeam estuarine site showing areas and places mentioned in the text.



Figure 6.2. Intertidal sandflats at the Waikawa River mouth provide a rich food source for a variety of shorebirds. *Photo: Helen Kettles*.



Figure 6.3. Saltmarsh (rushland and emergent sedgeland) adjacent to the pine plantation on the western bank of the Waikawa Stream. *Photo: Matt Todd*.



Figure 6.4. Saltmarsh (herbfield and emergent sedgeland) adjacent to the settlement on the eastern bank of the Waikawa Stream. *Photo: Matt Todd*.



Figure 6.5. Saltmarsh fills a dune basin in the upper tidal reaches of the Waikawa Stream (centre). Pampas is dominant in the foreground. *Photo: Matt Todd*.



Figure 6.6. Intertidal sandflats at the Waikawa Stream mouth provide a rich food source for a variety of shorebirds. *Photo: Helen Kettles*.

6.2 Conservation values

6.2.1 Ecological

The large area of saltmarsh in the upper estuarine area is on both sides of the stream, and a similar pattern may be seen on either side (Ravine 1992) (Fig. 6.5). At the low tide mark, pūrua grass and three-square dominate, with patches of bachelor's button. This gives way to rushland, mainly oioi and sea rush, growing over herbfields of remuremu, glasswort, and shore primrose. Saltmarsh ribbonwood overtops the rushes in a transition zone before a band of toetoe and flax at the high tide mark. This continues downstream along the banks adjacent to the settlement. Kōwhangatara is present in the dunes adjacent to the stream mouth. There are no threatened plants recorded at this site.

The coastal flats (Fig. 6.6) attract a large variety of shorebirds, including bar-tailed godwits (during summer), wrybills (during winter), and royal spoonbills after they have finished breeding on Kāpiti Island. Banded dotterels and variable oystercatchers breed here. The saltmarsh attracts waders such as white-faced herons and pied stilts and some waterfowl. Ravine (1992) suggested that the vegetation would provide excellent habitat for fernbirds. This estuarine site was included in the OSNZ (2007) river mouth bird survey.

Eight migratory native freshwater fish species have been found in the catchment, including six species that are listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, kōaro, inanga, redfin bully and torrentfish; Allibone et al. 2010). The estuarine system provides excellent spawning habitat for inanga (Ravine 1992). A variety of coastal marine fish may be found in the stream mouth and lowest reaches of the estuarine system.

A specimen of Wellington green gecko was identified here (Meads 1972).

Table 6B lists native species present in, or utilising, the Waikawa estuarine system.

Table 6B. Native species present in, or utilising, the Waikawa estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Kingfisher |
| | Little shag |
| | Pied shag+ |
| | Pied stilt* |
| | Red-billed gull+ |
| | Royal spoonbill* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | White-faced heron |
| | White-fronted tern* |
| | White heron+ |
| | Wrybill+ |
| Fish | Common bully |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Rough skate |
| | Shortfin eel |
| | Shortjaw kōkopu+ |
| | Torrentfish* |
| Herpetofauna | Wellington green gecko* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

6.2.1 Recreational

The estuarine site is adjacent to the settlement of Waikawa Beach, and a footbridge allows pedestrian access to the beach. During the summer there is a moderate level of recreational use from swimmers, surfers, and holiday-makers. The area is also popular for seasonal duck shooting and whitebaiting.

6.3 Catchment properties

The catchment drains the western foothills of the Tararua Range near the settlement of Manakau and the intervening coastal plain. In total, some 7626 ha fall within its boundaries (MacDonald & Joy 2009). Around 35% is in native cover, 26% sheep and beef, 24% dairy and there are some exotic plantations. The stream drains a series of wetlands in the swales behind the ancient dune system for several kilometres before its waters reaches the coast.

Horizons Regional Council (2013) rate the water quality in the lower stream as 'very poor' (meets the One Plan targets < 20% of the time) for both nitrogen and phosphorus concentrations (water is almost always unsafe for swimming), due to a high degree of diffuse agricultural runoff and organic contamination.

6.4 Threats

As the estuarine area is adjacent to an urban holiday settlement and a rural farming community, it is likely to be part of the territory of local cats and visited by wandering dogs. A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Garden weeds are of concern around the settlement. Development has stabilised the banks, creating an opportunity for ecological weed species to establish in the wetland. This has been hastened by the cutting of tracks, allowing greater access for invasion into the habitat by ecological weeds and predators. Tall fescue, buck's horn plantain and tree lupin are common amongst the rushes, but cacti and chrysanthemums may also be found. American spartina

is present as a small patch at the low tide mark, just downstream of the footbridge. The rear dunes on the coastal side of the estuarine area are planted in radiata pine, with an understory containing tree lupin, gorse, brush wattle and pampas grass. This may act as a seed source for ecological weeds growing in the wetland (Fig. 6.3).

It is noticeable that tall fescue may be found throughout the wetlands in the lower part of the estuarine system, while in the less disturbed areas upstream it penetrates only to the high tide mark (although this may also be due to the much greater extent of the upstream wetlands). Mature specimens of karo, planted in adjacent gardens, are acting as seed sources for wilding seedlings in the saltmarsh. American spartina was noted in the estuarine site at the time of visiting. This is of concern, as this had not been previously recorded here.

Bacterial contamination poses a threat to human health. Horizons Regional Council (2005) reports frequent high levels of faecal contamination in the Waikawa Stream.

6.5 Conservation management

6.5.1 Current

The lower reach of the estuarine system (downstream of the footbridge) are part of the Waikawa Conservation Area, managed by DOC. Horowhenua District Council administers the esplanades reserves adjacent to the settlement and conservation area, as well as streambank reserves on either side of the foot bridge. These access areas are regularly mown, and the paths maintained, but there appear to be no intensive ecological weed or pest control programmes in the site and these paths typically have exotic and garden weeds from the adjacent settlement. Horizons Regional Council rates the site as a Priority C wetland (Lambie 2008). Horizons Regional Council monitors water quality and suspended sediment levels on a monthly basis and *E. coli* levels for contact recreation purposes during the swimming season (1 November to 30 April). There is some good interpretation material for people as they enter the area.

The saltmarsh in the upper estuarine area is listed as a Recommended Area for Protection (No. 13) and is privately owned. The wetland is partially fenced to exclude stock on the inland bank.

There is no known community group active at the site. Ngāti Raukawa and Muaūpoko both maintain an interest in the management of the area.

6.5.2 Potential

A priority for biodiversity protection in the estuarine system is in the long-term improvement in the water quality. Horizons Regional Council has listed the Waikawa catchment as a priority for nutrient management (Horizons Regional Council 2008) and has rules in place around nutrient management and leaching rates for intensive land use (Environment Court 2012).

Locating, documenting, and restoring any inanga spawning sites would be valuable.

Options for protecting the high conservation values of the Waikawa Estuary could be explored with consultation with the landowner, Horizons Regional Council, Horowhenua District Council, neighbouring landowners, and local hapū. The value of the Recommended Area for Protection wetland could be further enhanced with a programme of ecological weed and pest control. Tall fescue is particularly abundant in the saltmarsh; this can be controlled but is difficult to eradicate entirely. The pine plantation on the adjacent dunes will also act as source of weeds, so it is likely that regular monitoring and occasional ongoing control will be required. It is unlikely that further planting will be needed.

An intact buffer of native dune vegetation along the estuarine margins would help reduce weed incurrence in the ecosystem.

Fencing the entire coastal bank of the wetland would help to physically define the boundaries and reduce disturbance. Information panels and viewing points, including information about keeping dogs on leads, would increase public awareness of the site's conservation value and sensitivity to disturbance. In the lower estuarine area, a campaign to heighten local residents' awareness of ecological weed control and the threat people pose through disturbance to wildlife would be prudent, particularly along the esplanade area managed by the district council. The ecological weeds would require a range of control methods, as there are many different exotic species invading the area. Once cleared, a programme of publicity regarding disposal of green waste and the use of appropriate species in gardens could be promoted in an effort to reduce reinvasion by ecological weeds. The small patch of American spartina requires prompt action to eradicate it before it spreads, and ongoing monitoring to ensure that it doesn't return.

6.6 References

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7. Waitohu Stream

7.1 Site description

The Waitohu Stream estuarine system (Table 7A, Figs 7.1 & 7.2), although relatively small, has several distinctive estuarine vegetation communities. A small area of oioi saltmarsh sits directly behind the dunes with a large area of sea rush and saltmarsh ribbonwood upstream of this. The stream is tidal for nearly a kilometre upstream.

The urban area of Ōtaki Beach is adjacent to the upper estuarine area on the southern bank. Most of the wetland area has been fenced and is actively managed by the local community group (Fig. 7.1).

7.2 Conservation values

7.2.1 Ecological

The estuarine site has three distinct areas of saltmarsh, and each has their own character. The first of these is nearest the mouth: a small tidal estuarine area, an old stream course in the lee of the dunes on the northern bank (Fig. 7.3). Three-square is the dominant species in this area, and it fills a significant part of the arm's bed. Oioi forms a band along the high tide mark, with flax and toetoe also present. Bachelor's button and native musk form a herbfield around the three-square.

Table 7A. Waitohu Stream estuarine system site information (see also Fig. 7.1).

| SITE NAME | WAITOHU STREAM |
|-----------------------------------|---|
| Location | Ōtaki Beach |
| NZTM (coordinates) | 1779282 5489185 |
| NZ Topo50 | BN32 793 892 |
| Area | 5 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Private |
| | Ōtaki Beach Reserve (Kāpiti Coast District Council) |
| | Esplanade Reserve (Kāpiti Coast District Council) |
| Existing rankings | Ecol Site 162 |
| | WERI: 2, SSWI: Moderate |
| | Ecosite (K014)(Kāpiti Coast District Council) |
| | Key Native Ecosystem (GWRC) |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 10 |
| At Risk species (number) | 15 |
| Ecosystem value (score 1–5) | 4 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) | 3 |
| NB: 1 = high pressures | |
| Dominant habitat | Sand sedge sedgeland |
| | Restiad rushland |
| | Saltmarsh ribbonwood shrubland |
| | Three-square sedgeland |
| | Bachelor's button herbfield |
| | Sandflats |
| | Subtidal |

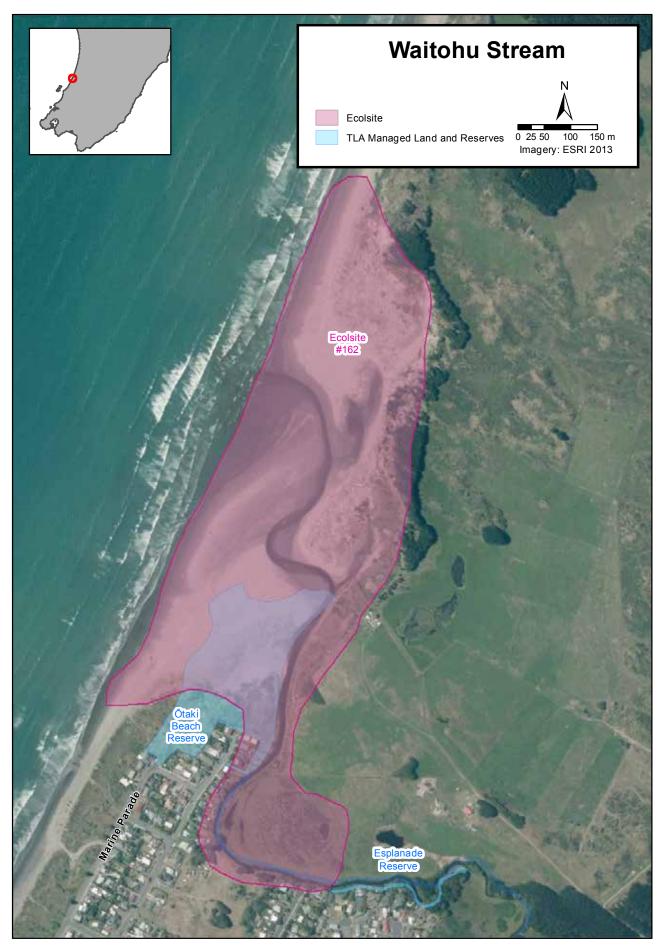


Figure 7.1. Waitohu Stream estuarine site showing areas and places mentioned in the text.



Figure 7.2. Restored wetland at the Waitohu Stream. Photo: Matt Todd.



Figure 7.3. Emergent three-square sedgeland in a lateral arm of the Waitohu Stream, adjacent to the stream mouth. Pine forest dominates at rear. *Photo: Matt Todd.*

Wetland continues along the bank from this area, following a historic path of the stream. Sea rush and oioi dominate here, along with patches of flax. Three-square is present on the water's edge. On the southern bank, near the Moana Street entrance, is the restored area of saltmarsh and riparian planting (Fig. 7.2). Sea rush is again the dominant species here, with patches of oioi and clubrush on the water's edge. Native shrubs here include flax, toetoe, taupata, tauhinu, small-

leaved pōhuehue, and cabbage tree. Finally, near the upper tidal limit, a 2 ha area of saltmarsh is present on the inside bend of the stream. Sea rush is again the main species here, but saltmarsh ribbonwood is present through most of the area, with sea rush near the dunes rear of the wetland. There is also a patch of flax and a patch of raupō in this area. A very small amount of seagrass is present (Robertson & Stevens 2007).

Along the majority of the stream margin, however, tall fescue grows thickly right up to the water's edge (Fig. 7.4), and is also abundant within the rushes. Tree lupin has been controlled in the wetland areas.

In the dunes, there is a significant amount of kōwhangatara and pīngao in the area fenced off for restoration. Speckled sedge, sand coprosma and sand pimelea can also be found in the restoration area. There is an area of sand sedge sedgeland on sandflats within the northern dune system.

Shorebirds congregate on the sandflats to roost, while waders and waterfowl feed in the shallow wetlands. Southern black-backed and red-billed gulls are the most numerous species here, although variable oystercatchers, spur-winged plovers, banded dotterels, and pied stilts are common on the beach. White-faced herons, black and little shags, bitterns, and kingfishers are resident in the wetland areas, and black swans are frequently seen on the water. The local care group has also seen New Zealand dotterel on one occasion. Caspian terns and Australasian shovelers are occasional visitors. This estuarine site was included in the OSNZ (2007) river mouth bird survey.

Thirteen migratory native freshwater fish have been found in the catchment, including ten species that are listed as 'At Risk: Declining' (shortfin eel, brown mudfish, longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, torrrentfish and lamprey; Allibone et al. 2010). Black flounder have been found in the estuarine system. Smaller marine fish include triplefins and yellow-eyed mullet which enter the estuarine waters to feed in the sediments. Kahawai have been known to follow these species into the shallow water.



Figure 7.4. Tall fescue along the Waitohu Stream margins. Photo: Matt Todd.

There are no records of lizards in the area, although the dunes and driftwood could provide suitable habitat for lizards. Similarly, there are no comprehensive records of marine invertebrates, although pipi and mud snails are present and toheroa beds occur further along the beach.

Table 7B lists native species present in, or utilising, the Waitohu Stream estuarine system.

7.2.2 Recreational

The stream mouth is currently popular with swimmers, walkers, and recreational fishers, as part of Ōtaki Beach.

7.3 Catchment properties

The stream has a catchment of around 4570 ha (MacDonald & Joy 2009), roughly half of which is dairy pasture. The remainder is native scrub and forest in the foothills of the Tararua Range. The stream, and its major tributary, the Mangapōuri Stream, has a history of pollution, and was listed as one of the 'six most polluted waterways in Greater Wellington' (Clarke 2003, cited in MacDonald & Joy 2009). This was largely due to the number of discharges of untreated dairy effluent in the catchment. In current times, all dairy effluent shed discharges now occur to land although water quality in the stream is still very low, indicating that significant runoff is occurring. There is also a quarry in the upper catchment which occasionally discharges sediment into the stream. Water quality is monitored in the stream at Norfolk Crescent (GWRC site RS04) and consistently scores 'poor' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010; Perrie et al. 2012; Morar & Perrie 2013, Keenan & Morar 2015).

Table 7B. Native species present in, or utilising, the Waitohu Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------------|
| Threatened/At Risk plants | Native musk* |
| | Seagrass* |
| Birds | Australasian bittern |
| | Australasian shoveler |
| | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Bittern+ |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Black-fronted dotterel |
| | Black-fronted tern+ |
| | Caspian tern+ |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | New Zealand dotterel+ |
| | Paradise shelduck |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Royal spoonbill* |
| | South Island pied oystercatcher+ |
| | Southern black-backed gull |

| GROUP | SPECIES |
|----------------------------|-------------------------|
| Birds continued | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Black flounder |
| | Common bully |
| | Common smelt |
| | Giant kōkopu* |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Lamprey+ |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Shortjaw kōkopu+ |
| | Torrentfish* |
| Aquatic macroinvertebrates | Mudflat snail |
| | Pipi |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

7.4 Threats

GWRC has identified flood risk management issues, including flooding, erosion, and gravel aggredation within this catchment (Wallace 2006). The Mangapōuri Stream historically drained into the Ōtaki Estuary and has been diverted into the Waitohu Stream; since the 1940s there has been altering of catchment size and stream dynamics.

Adjacent to an urban area, predator pest incursions are likely to be a recurring threat to birdlife. Human disturbance is significant, as the area is a popular site with recreational walkers, picnickers, motorbikers, 4WD, quad bikers, and recreational fishers. Domestic dogs frequently accompany their owners on the beach. The rabbit population in the area is significant, and they can do considerable damage to the habitat restoration efforts by destroying newly planted seedlings.

Weeds are abundant along the river margins, particularly tall fescue (Fig. 7.4); there is also an association of tree lupin, blackberry and pampas adjacent to the pine plantation. The main ecological weed species are gorse and lupin on the sand flats and estuarine edges, sharp rush in the damp sand flats and marram and tall fescue grasses on the wetland edges. Nutrient enrichment and elevated algal levels are common, particularly during summer when water levels are low and the mouth is blocked.

7.5 Conservation management

7.5.1 Current

Most of the estuarine margins are privately owned, except for the Ōtaki Beach Reserve and a small esplanade reserve, both managed by Kāpiti Coast District Council. Much of the estuarine area, however, is actively managed by the Waitohu Stream Care Group and is one of the most successful restoration sites in the Wellington region. The group was established in 1999 in response to the water pollution issue in the catchment (Graeme 2004). Their focus is on propagation and restoration of estuarine and dune vegetation, physical protection through fencing of sensitive habitats, monitoring of water quality, bird surveys and public education. It is through this group's effort that the wetland, riparian area, and dunes on the southern side of the estuarine area have been restored. This enhances natural coastal habitat sequences (Fig 7.5). They have also been instrumental in working with landowners further upstream to exclude stock from wetlands, allowing saltmarsh to regenerate. Carefully formed tracks allow the public to engage with the restoration project, with information panels strategically placed (Fig. 7.6), while ensuring that sensitive habitats (particularly the kōwhangatara plantings in the dunes) remain undisturbed. The group is supported by GWRC, Kāpiti Coast District Council, and DOC.

The Waitohu Stream mouth has also been listed as Ecosite by the Kāpiti Coast District Council.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. The KNE Plan for Waitohu Coast and Wetlands 2014-2017 (GWRC 2015) provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site. The stream was previously part of the GWRC 'Streams Alive' initiative (Forsyth & Sevicke-Jones 2005), whereby if landowners on properties adjacent to the stream prevented stock access to the stream by fencing, GWRC provided resources over a 2-year period to plant and maintain riparian areas, in order to assist in restoring the value of the stream as a whole.

In conjunction with this, staff from Te Wānanga-o-Raukawa has initiated a riparian planting and water quality monitoring project, with respect to Māori values, in the Mangapōuri Stream.

GWRC has undertaken habitat mapping of the Waitohu Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).



Figure 7.5. Wetland, riparian and dune areas at the Waitohu Stream mouth. Photo: Helen Kettles.



Figure 7.6. Waitohu Stream Care Group panel with information on ecological values and restoration initiatives. *Photo: Helen Kettles*.

The Waitohu Stream mouth is managed by GWRC for flood and erosion risk management purposes, within the rules of the Regional Coastal Plan and guidelines in Dawe (2010).

7.5.2 Potential

The Waitohu Stream Care Group has a long-term management goal of restoring the estuarine system to as close to a natural state as feasible, under the terms of the Waitohu Reserve Management Plan (Graeme 2004). This is a project that deserves continued support.

Due in no small part to the success of the restoration of the wetland and dunes on the southern bank, the landowner of the wetland on the northern margin has set aside land for restoration. The landowner obtained funding from GWRC to set up a dune care group to revegetate the dune area, but the programme is currently on hold. GWRC has been assisting with some pest animal control and fencing on these properties.

The Manaaki Taha Moana Research Team have expressed interest in undertaking a case study of the Waitohu Stream to identify sources of poor water quality and develop recommendations for stream restoration (Smith et al. 2011).

Locating, documenting, and restoring any inanga spawning sites would be valuable.

There is currently no legal protection of the restored areas, but the dunes and wetlands on the southern margin could be designated as a conservation reserve, administered by local government, or included as part of the DOC-managed Ōtaki Conservation Area (c. 1.8 km to the south) or protected by other methods.

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8. Ōtaki River

8.1 Site description

The Ōtaki River is a Category B estuarine system (one of only two in this report) with a sandspit restricting its mouth (Table 8A, Fig. 8.1). In reality, the river is braided, fast-flowing and dynamic, and there is little scope for the formation of saltmarsh. However, adjacent to the river mouth is the confluence of the Rangiuru stream, and an estuarine lagoon has formed at this location (Fig. 8.2). A large area of saltmarsh (4 ha) within this northern lagoon is the site of a restoration project by a local community group. Small fragments of saltmarsh persist in the changing landscape south of the river and on the river side of the stopbank. A second lagoon, on the south side of the river, is bisected by a stopbank.

8.2 Conservation values

8.2.1 Ecological

The main river bed is a gravel braided system fed from material from the Tararua mountain range via the fast-flowing Ōtaki River. This is unusual in the Kāpiti and Horowhenua Districts, where single channel systems with a heterogeneous range of habitats are the norm (Fig. 8.3). The lagoon on the northern side of the river mouth is subject to a large-scale restoration planting

Table 8A. Ōtaki River site information (see also Fig. 8.1).

| SITE NAME | ŌTAKI RIVER |
|--|--|
| Location | Ōtaki Beach |
| NZTM (coordinates) | 1777782 5486085 |
| , | |
| NZ Topo50 | BN32 778 861 |
| Area | 20 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Private Soil Conservation and River Control Reserve (GWRC) |
| Existing rankings | Ecol Site 98 WERI: 2, SSWI: Moderate Ecosite (K027) (Kāpiti Coast District Council) Key Native Ecosystem (GWRC) |
| Ecological district | Foxton |
| Estuarine classification | Category C |
| Threatened species (number) | 9 |
| At Risk species (number) | 13 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 4 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Clubrush rushland Harakeke flaxland Bachelors' button herbfield Raupō reedland Tall fescue grassland Gravelfield Mudflats Subtidal |



Figure 8.1. Ōtaki River estuarine site showing areas and places mentioned in the text.



Figure 8.2. The outlet of Ōtaki Lagoon. The restoration area is visible in the distance, at the far end of the lagoon. *Photo: Matt Todd.*



Figure 8.3. The main channel of the Ōtaki River mouth. Kāpiti Island is visible at rear. *Photo: Matt Todd*.

project, led by the Friends of the Ōtaki River and supported by GWRC. Many of the ecological weeds have been removed in recent years and restoration planting has commenced using a nodal approach, based on a restoration vision developed by the late Geoff Park and GWRC.

Around the northern lagoon is an open environment dominated by flax, toetoe, and patches of regenerating coastal forest dominated by taupata (Fig. 8.4) and karamū. Significant areas of



Figure 8.4. Outlet of the Rangiuru Stream towards Ōtaki Lagoon, in the restoration area. Photo: Helen Kettles.

herbfield are found in the intertidal zone; the dominant native species here are bachelor's button and slender clubrush. Shore primrose, remuremu and mudwort are also present in the intertidal zone. There are small patches of rushes, particularly wīwī and a large raupō swamp adjacent to the small tributary stream, Rangiuru (Fig. 8.4).

The southern lagoon contains a sizable area of harakeke flaxland along with areas of three-square and other estuarine species on the river side of the stopbank. Cabbage trees are common in the area, particularly to the south of the stopbank.

A very small amount of seagrass is present (Robertson & Stevens 2007).

Pīngao is present on the gravel beaches on either side of the river mouth. New Zealand spinach was recorded here by Druce (1989) and sand pimelea by Allen (1940) but neither has been recorded since.

The northern lagoon is an excellent feeding and roosting habitat for a range of waterfowl and waders. Black swans are frequently seen on the open water, and are known to nest here. Kingfishers, white-faced herons, and black shags all frequently stalk prey or roost in the wetland. Royal spoonbills and bitterns are seen less often. Many shore-birds may be found around the river mouth and on the adjacent Ōtaki Beach, including large numbers of black shags, white-fronted terns and southern black-backed gulls. Some bird species in and near the estuarine area are also likely to utilise the nearby Ōtaki wastewater treatment plant. This estuarine site was included in the OSNZ (2007) river mouth bird survey.

Ten migratory native freshwater fish species have been found in the catchment, including seven species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully and torrentfish; Allibone et al. 2010). Taylor & Kelly (2001) recorded inanga in the northern lagoon, and suggested that it would make excellent spawning habitat. Later surveys by Taylor & Marshall (2016) again recorded numerous sites containing suitable inanga spawning habitat, although no spawning sites were confirmed. Many coastal marine species are likely to travel into this lagoon to feed.

Northern grass skinks have been recorded at the river mouth by Jewell (1973).

Historically, the beach adjacent to the river mouth has supported toheroa beds but this population has declined and gathering is banned.

Table 8B lists native species present in, or utilising, the Ōtaki estuarine system.

Table 8B. Native species present in, or utilising, the Ōtaki estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Sea sedge |
| | Seagrass* |
| Birds | Australasian shoveler |
| | Banded dotterel+ |
| | Bittern+ |
| | Black shag* |
| | Black swan |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Gannet |
| | Grey teal |
| | Kingfisher |
| | Little shag |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Reef heron+ |
| | Royal spoonbill* |
| | Scaup |
| | Southern black-backed gull |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | Spur-winged plover |
| | Swamp harrier |
| | Turnstone |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White heron+ |
| | White-faced heron |
| | White-fronted tern* |
| | Wrybill+ |
| Fish | Banded kōkopu |
| | Common bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Sandflounder |
| | Shortjaw kōkopu+ |
| | Shortfin eel |
| | Torrentfish* |
| Herpetofauna | Northern grass skink |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

8.2.2 Recreational

The river mouth is a popular year-round beach site for fishing, surfing, swimming and picnicking. The town of Ōtaki Beach is only a short distance north. The river is a seasonally popular spot for whitebaiting.

8.3 Catchment properties

The Ōtaki River is unusual on this stretch of coast as it is a large, fast, braided river system that has been extensively constrained by flood protection works. GWRC has responsibility for flood risk management for those parts of the Ōtaki River and its tributaries which are covered by the Ōtaki River Floodplain Management Plan (Wellington Regional Council 1998). The catchment drains around 34550 ha of the western Tararua Range (MacDonald & Joy 2009) and approximately 80% of the catchment is in native forest. The coastal plains are mainly in dairy farms, and the towns of Ōtaki and Ōtaki Beach are located adjacent to the river near the coast. Generally, water quality is high in the Ōtaki, rated as 'good'—'excellent' according to the monitoring site at the river mouth (GWRC site RSO6; Perrie 2007, 2008, 2009; Perrie & Cockera 2010; Perrie et al. 2012; Morar & Perrie 2013; Keenan & Morar 2015), although there is no monitoring of the Rangiuru Stream which drains into the northern lagoon saltmarsh.

8.4 Threats

A range of mammalian predators are likely to be present, including domestic predators from the nearby urban area. Human disturbance to wildlife is probably significant, as the area is a popular site with groups such as recreational walkers, picnickers, and recreational fishers. This use may limit some disturbance-sensitive species. Despite local bylaws restricting access, vehicles are common on the beach, particularly around the river mouth (Kāpiti Coast District Council 2006). These cause damage to regenerating native vegetation, and possibly to shellfish beds on the spit. Shore bird populations are disturbed by vehicles, and nests may be destroyed.

The banks of the main river are dominated by exotic species, including silver poplar, alder, blackberry, Japanese honeysuckle, brush wattle and pampas. In the northern lagoon, tall fescue and montbretia are distributed throughout the wetland, and are severely encroaching on the herbfields and rushlands. Sharp rush is also abundant but localised. Many of these species are aggressive competitors in disturbed sites, particularly along waterways. The gravel beaches on the coastal side of the lagoon are dominated by ice plant, gorse and marram grass.

Parrot's feather and *Egeria densa* are present about 7 km upstream at Chrystall's Bend. These species spread vegetatively along waterways, forming large mats in calmer water if not controlled, and are capable of inundating less-competitive species.

Historic river management works in the Ōtaki River and Rangiuru Stream have constrained the waterways and significantly altered the form of the estuarine system. Ongoing disturbance and dredging of sediments could lead to the total loss of shellfish beds and wetland birds.

Water quality measurements indicate issues are present. Recreational water quality grades produced from two monitoring sites in the river ranged from 'fair' to 'very good' during 2014–15, while the monitoring site at the surf club registered enterococci levels which exceeded guidelines during a monitoring event in November 2014 (Keenan et al. 2015). Unnaceptable levels of faecal coliforms were also recorded at this site during the 2014/2015 season (Keenan et al. 2015).

8.5 Conservation management

8.5.1 Current

The entire bed of the river, including the two lagoons and the sandspit, is managed by GWRC under the Ōtaki Flood Plain Management Plan (Wellington Regional Council 1998). It has been the subject of historical river and flood risk management works.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for the Ōtaki Coast is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site. The Ōtaki estuarine system and gravel beaches 500 m north of the Ōtaki river to 3 km south, are included in the GWRC Ōtaki Coast KNE.

The northern lagoon has been spared significant modification. The habitat is being restored by the Friends of the Ōtaki River (FOTOR), a community group supported by GWRC and Kāpiti Coast District Council, and DOC. The group focuses on the planting of wetland, river, lagoon edges and gravel beaches. Species planted include flax/toetoe wetland, pūkio on riparian edges, karamū, ngāio and taupata further back and pīngao, sand coprosma and knobby clubrush on gravel beaches.

FOTOR represents the community in the management and development of the Ōtaki River and its environment. The group monitors the management of the Ōtaki River for flood protection and liaises regularly with GWRC's Flood Protection Department. They have also developed a viewing platform and an interpretation panel is on display at the estuarine site.

The wetland is undergoing large-scale ecological weed control by GWRC. Approximately 5 ha of pampas, silver poplars, brush wattles, blackberry, Japanese honeysuckle and gorse have been cleared and and regrowth sprayed each year. All drains and waterways are regularly cleared of weeds but these tend to regrow from fragments.

The restoration site is surrounded by low barriers to encourage people to stay to formal tracks, such as those through the wetland. Visitor information signs are adjacent to the beach and at the parking area beside the floodgates on the Rangiuru Stream mouth. Every year a large number of people visit the site as part of the Annual Public Walkover Day of the Ōtaki River.

Both Ngāti Raukawa and Muaūpoko maintain a keen interest in the management of the river.

GWRC has undertaken habitat mapping of the Ōtaki Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to coastal and estuarine habitats (Robertson & Stevens 2007).

8.5.2 Potential

FOTOR have plans to expand their restoration planting to take in the entirety of the northern lagoon. Ecological weeds will be progressively controlled in the estuarine environment as part of the GWRC KNE programme, including on the southern side of the river. A fish friendly floodgate will also be installed across the Katihiku floodgate to increase the passage of whitebait.

Barriers would be needed to further restrict vehicle access, allowing foot access only. It would be advisable to go through a process of local pubic consultation prior to implementing this measure.

Further work to locate, document, and restore inanga spawning sites would be valuable.

Given the ecosystem values of this estuarine site it would be worth investigating the option of creating a Wildlife Reserve.

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9. Mangaone Stream

9.1 Site description

This small tidal stream mouth estuarine system discharges across a narrow stony beach at the northern end of the Kāpiti Coast, adjacent to the small settlement of Te Horo Beach (Table 9A; Fig. 9.1). The narrow stream mouth, which is frequently blocked, is managed by GWRC under the rules of the Regional Coastal Plan for flood risk management purposes (Fig. 9.2). This includes artificial opening of the mouth. The upper estuarine area, and much of the lower reaches of the stream itself, have been straightened and constrained by the construction of the adjacent access road. A bridge crosses the estuarine site at its upper limit.

Saline influence in the estuarine system is likely to be intermittent (Robertson & Stevens 2007).

The stream mouth was diverted during the 1950s (B. Taylor, Kāpiti Coast District Council 2009, pers. comm.), and the causeway built for vehicle access to the beach. The old stream bed remains as an ephemeral wetland depression at the rear of the beach, prone to flooding, but blocked off from the estuarine area.

9.2 Conservation values

9.2.1 Ecological

The unstable pebble banks on the beach have little vegetation and banks of driftwood flank the stream mouth (these may have been the result of machine work in the mouth). A small area of raupō swamp is evident on the true right of the stream. Native pondweed is found in the stream itself.

Table 9A. Mangaone Stream site information (see also Fig. 9.1).

| MANGAONE STREAM |
|--|
| Te Horo |
| 1775782 5482585 |
| BN32 758 826 |
| Approx. 5 ha |
| Kāpiti Wellington Office |
| Kāpiti Coast District Council, GWRC |
| Private Local Purpose Esplanade Reserve (Kāpiti Coast District Council) |
| Key Native Ecosystem (GWRC) |
| Foxton |
| Category B |
| 2 |
| 4 |
| 2 |
| 3 |
| 3 |
| 3 |
| Reed sweetgrass grassland Riparian shrubland Raupō reedland Restiad rushland Gravel fields Sandflats |
| |



Figure 9.1. Mangaone Stream estuarine site showing areas and places mentioned in the text.

The upper reach of the estuarine system flows through highly modified esplanade reserves, where an effort has been made to restore a riparian strip consisting of native shrubs, sedges flax, karo, cabbage tree, and giant umbrella sedge. The planting does not extend all the way across stream banks, for flood control purposes.

The wetland depression cut off from the stream retains the most natural area of vegetation at the site. Oioi and sea rush form a dense mosaic amongst flax, giant umbrella sedge, taupata, and toetoe. There are no records of threatened species at this site.

The beach is a popular roosting spot for southern black-backed gulls. Spur-winged plovers were the only other birds observed at the time of visiting.



Figure 9.2. The mouth of Mangaone Stream is frequently blocked by gravel and debris. The outlet is maintained by mechanical means in such situations. *Photo: Matt Todd.*



Figure 9.3. Reed sweetgrass lines both margins of the stream adjacent to the settlement of Te Horo Beach. *Photo: Matt Todd.*

Eight migratory native freshwater fish species have been found in the catchment, including five species that are listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, kōaro, inanga and redfin bully; Allibone et al. 2010). Taylor & Kelly (2001) commented that the grasses and rushes in the upper tidal reaches, particularly creeping bent and raupō, provided excellent spawning

habitat for inanga, and noted observing a shoal despite the presence of reed sweetgrass. However, it appears that since then, the sweetgrass invasion has inundated such habitat (Fig. 9.3).

While there are limited herpetological records from the area, the pebbles and driftwood environment could be habitat for several species of gecko.

Table 9B lists native species present in, or utilising, the estuarine system.

Table 9B. lists native species present in, or utilising, the Mangaone Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Paradise shelduck |
| | Pūkeko |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Welcome swallow |
| Fish | Banded kōkopu |

| GROUP | SPECIES |
|----------------|------------------|
| Fish continued | Common bully |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Shortjaw kōkopu+ |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

9.2.2 Recreational

The stream mouth is adjacent to the small holiday settlement of Te Horo Beach and receives a moderate amount of recreational beach use. Some whitebaiting occurs during the season (Robertson & Stevens 2007).

9.3 Catchment properties

The Mangaone Stream catchment extends across the coastal plain as far as the foothills of the Tararua Range, an area of around 4950 ha (MacDonald & Joy 2009). Most of this area is historically part of a large area of coastal swamp (Ravine 1992), now drained and given over to dairy farming (MacDonald & Joy 2009). The upper catchment contains a significant area of forestry. The stream, particularly in the mid and lower reaches, has been heavily modified during the process of reclamation. From the settlement of Te Horo, the stream bed has been straightened alongside the access road to Te Horo Beach (Fig. 9.1).

The stream has a history of agricultural use, having water removed for irrigation and receiving untreated discharge from as many as six dairy sheds (Milne & Perrie 2005), as well as fertiliser and effluent runoff from adjacent fields. Water quality is monitored in the stream at Sim's Road (GWRC site RS07) and is consistently reported as 'poor' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010; Perrie et al. 2012; Morar & Perrie 2013; Keenan & Morar 2015).

9.4 Threats

Catchment land use is a significant threat to this estuarine system with farm runoff and silt from forestry logging operations negatively affecting water quality in the stream.

Reed sweetgrass grows thickly on both banks for a stretch of 200 m, backed by tall fescue, browntop and a variety of exotic herbs. There is also an infestation of oxygen weed and cape pondweed in the stream. The extensive presence of reed sweetgrass is an immediate threat in the estuarine ecosystem. It is an aggressive, mat-forming species that can take over small waterways, and can spread vegetatively via flowing water. This plant is thick along both banks of the stream from the Sims Road Bridge nearly to the top of the beach. The upstream extent of the infestation

extends 1 km along the Paruaha Drain. In the face of inundation, larger native species, such as raupō and flax, are maintaining a foothold, but smaller wetland species have disappeared. Seasonal smothering by bindweed is an additional threat (Taylor & Kelly 2001). The presence of oxygen weed and cape pondweed in the stream is also of concern; while it has not reached the epidemic proportions of the reed sweetgrass, it too has the potential to choke stream beds, and is difficult to control. Sharp rush is abundant in and around this wetland.

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Due to the extensive stream modification, there is now little absorption of stormwater in the system, and the lower reaches are prone to flooding (Purves 2001). Although water quality has improved since the termination of direct discharges from milking sheds (Milne & Perrie 2005), the water is still of poor quality. Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Te Horo Beach at Mangaone Stream) during the 2010/11 summer bathing season (Morar & Warr 2011) as well as the 2014/15 summer season (Keenan et al. 2015).

9.5 Conservation management

9.5.1 Current

The area locally known as the Mangaone Reserve along the lower tidal reaches is managed by Kāpiti Coast District Council as an esplanade reserve. This area has been the subject of restoration planting by the Mangaone Restoration Group. However, the estuarine system is subject to GWRC flood control strategies (Wellington Regional Council, 1998), requiring a clear strip of approximately 5 m on the south bank for heavy machinery access. A hydraulic excavator is also used to mechanically clear the stream mouth when the triggers under the Regional Coastal Plan are met.

GWRC has identified this area as a site with high biodiversity values as part of the draft GWRC Key Native Ecosystem (KNE) Plan for the Ōtaki Coast (GWRC in press). Under the KNE programme, GWRC staff actively manage the site to protect and restore these values. The draft KNE plan provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

The associated wetland area receives little attention beyond rubbish clean-ups, although iron beams have been used as bollards at the mouth of an unformed track to prevent vehicle entry. Smaller tracks dissect the area, providing access between private residences and the beach.

GWRC has undertaken habitat mapping of the Mangaone Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

9.5.2 Potential

The Mangaone Restoration Group would primarily like to see the control of the particularly invasive weed species (reed sweetgrass and oxygen weed) in the estuarine system and margins, followed by a restoration of water quality. Reed sweetgrass will be controlled in the estuarine site as part of the draft GWRC Ōtaki Coast KNE Plan.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

The historic stream bed could easily be restored to a wetland by reconnecting it to the stream via a culvert, allowing overflow to flood the depression. It would be prudent to control ecological weeds. The wetland elements of the existing native vegetation would then thrive, and minimal restoration planting would be required. Access to the beach for residents could be maintained through the use of boardwalks. This area could serve the double purpose of a habitat for wildlife and a flax resource for traditional weaving, as suggested by the Restoration Group.

Currently, the Mangaone Reserve is simply a part of the esplanade reserve, while the old stream bed is regarded as part of the foreshore. Both areas may benefit from more formal protection; for example, as a Kāpiti Coast District Council recreation reserve, an expansion of the current esplanade reserve, or, in the case of a newly re-established wetland, as a Wildlife Reserve/Pā Harakeke. The residents of Te Horo Beach could be encouraged to participate in the restoration process, through community working bees and education, possibly the use of information boards at strategic points.

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10. Kukutauaki Stream

10.1 Site description

The estuarine system of this small stream is almost entirely within the dune complex at the rear of Peka Peka Beach (Table 10A; Figs 10.1 & 10.2). The margins are thickly vegetated with a variety of native and exotic species until the stream exits the dunes. The outlet is unconstrained and changes its course across the beach frequently. Blockage probably occurs from time to time.

This stream is also known locally as Hadfields Stream (after Octavius Hadfield, a missionary based at Ōtaki during the mid-19th century, Lethbridge, 1993) and by others as Te Kowhai Stream.

The area immediately inland is currently undergoing development as a subdivision. The pasture at the rear of the dune complex is fenced, and stock have been excluded from the site.

Table 10A. Kukutauaki Stream site information (see also Fig. 10.1).

| KUKUTAUAKI STREAM |
|-------------------------------------|
| 1 km north of Peka Peka |
| 1773682 5478685 |
| BN32 737 787 |
| Approx. 2 ha |
| Kāpiti Wellington Office |
| Kāpiti Coast District Council, GWRC |
| Private |
| Key Native Ecosystem (GWRC) |
| Foxton |
| Category B |
| 4 |
| 8 |
| 1 |
| 2 |
| 3 |
| 4 |
| |
| Marram grassland |
| Restiad rushland |
| Mercer grass grassland |
| Tall fescue grassland |
| Sandflats |
| |

10.2 Conservation values

10.2.1 Ecological

Vegetation in the wetland margins of the upper estuarine area is a mosaic of rushes, reeds, sedges, grasses and scrub. Flax, toetoe, raupō, clubrush, wīwī and cutty grass are all present in patches.

Kōwhangatara is abundant in the adjacent dunes. There are no threatened plant species recorded at this site.

The sandflats attract a range of shore birds, with variable oystercatchers, pied stilts, spur-winged plovers, southern black-backed gulls and red-billed gulls all observed in moderate numbers foraging on the beach. White-faced herons were seen in the upper tidal reaches.

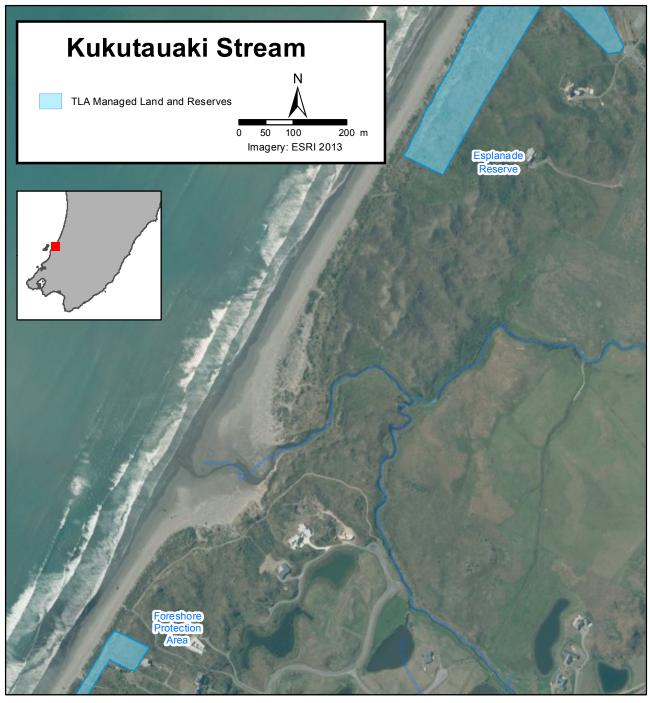


Figure 10.1. Kukutauaki Stream estuarine site showing areas and places mentioned in the text.

Longfin eel, shortfin eel, banded kokopu and inanga are found in Kukutauaki Stream. The Kukutauaki Stream has not been surveyed for evidence of inanga spawning, but there is some suitable habitat. There are no records of lizards.

Table 19B lists native species present in, or utilising, the estuarine system.

10.2.2 Recreational

Due to its relative isolation, recreational use of this estuarine site is low. A poorly formed track runs alongside the coastal bank, and there is evidence of vehicle and trail bike use. During the holiday season, this part of the beach attracts a moderate number of swimmers and picnickers, but little at other times. Some seasonal whitebaiting occurs.

Table 10B. lists native species present in, or utilising, the Mangaone Stream estuarine system.

| GROUP | SPECIES |
|--------|------------------------|
| Plants | Coastal kānuka* |
| Birds | Banded dotterel+ |
| | Black-billed gull+ |
| | Black-fronted dotterel |
| | Capsian tern+ |
| | Gannet |
| | Grey teal |
| | Paradise shelduck |
| | Pied stilt* |
| | Red-billed gull+ |
| | Royal spoonbill* |

| GROUP | SPECIES |
|-----------------|----------------------------------|
| Birds continued | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Inanga* |
| | Long fin eel* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.



Figure 10.2. The mouth of the Kukutauaki Stream flows across beach sandflats, with dunes closely buffering the margins. Photo: Matt Todd.

10.3 Catchment properties

The catchment is small, extending only to the limits of the coastal plain, and drains mainly pastureland and a small area of exotic forest. The stream runs through the large Te Hāpua Wetland Complex.

10.4 Threats

There is a wide variety of invasive weed species including reed sweetgrass and Mercer grass, which form mats along the estuarine margin (Fig. 10.3); blackberry, great bindweed, monkey musk, tree lupin, gorse and tall fescue all have significant presences. Oxygen weed in the stream is particularly problematic as it is an aggressive coloniser and difficult to control.



Figure 10.3. The tidal reach of the Kukutauaki Stream. Aquatic ecological weeds (reed sweetgrass and Mercer grass) are abundant in the margins. *Photo: Matt Todd*

Stock are allowed periodic access to the upper part of the estuarine site (north bank) from the adjoining farm. This is causing bank collapse, pugging and nutrient influx from cow effluent.

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of both enterococci and faecal coliforms at their nearby recreational water quality monitoring site (Peka Peka Beach at road end) during the 2010/11 summer bathing season (Morar & Warr 2011) as well as during the 2014/15 summer season (Keenan et al. 2015).

Vehicles, particularly SUVs and quad motorbikes, can cause significant damage to shellfish beds and vegetation in the beach and dune environment, and disturb and/or cause injury to resident wildlife (particularly birds and lizards).

10.5 Conservation management

10.5.1 Current

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. The KNE Plan for Peka Peka Coast 2015–18 (GWRC 2015) provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

Kāpiti Coast District Council maintains a foreshore protection area from the high tide line (Kāpiti Coast District Council 2006) along the beach area to the south of the site, although the estuarine area is not currently included. A stock fence crosses the stream on the inland side of the dunes, and it appears to continue along the rear of the dunes in either direction. There was no evidence of wandering stock.

Active management of the stream appears to be minimal. GWRC has undertaken habitat mapping of the Kukutauaki Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

10.5.2 Potential

The weed problem in the estuarine system is severe. A combination of control methods will be necessary if the stream is to be cleared of aquatic, emergent and wetland/terrestrial pest species. Once the ecological weed problem has been controlled, the estuarine margins could be restored with native species already present, such as wīwī, clubrush, flax and toetoe.

Access to the dunes on the north side of the stream could be restricted to foot traffic only, as these dunes are have been damaged by vehicle and horse traffic. If fenced, the dunes could be restored in conjunction with the estuarine system, presenting an integrated native coastal ecosystem. An intact buffer of native dune vegetation along the estuarine margins would help reduce weed invasion in the ecosystem. Pīngao and sand tussock are present elsewhere on the coast; these species, and the kōwhangatara already present, could be planted in place of the invasive marram. Extending the boundaries of the reserve from the south could also offer protection.

As the area adjacent to the estuarine site is currently targeted for redevelopment as a rural subdivision, there is potential for habitat restoration options for environmental enhancement to be explored with the developers and/or eventual residents. It would also be appropriate to consult and include recreational users in any restoration planning stages, in order to raise awareness of the habitat, and implement mitigating strategies to reduce the impact of traffic and horses.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

10.6 References

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11. Waimeha Stream

11.1 Site description

The estuarine system of this small stream has its upper reaches in urban Waikanae Beach, passes through the dune barrier, and empties into the sea across the sandflats of the beach (Table 11A; Figs 11.1 & 11.2). Upstream of the dunes, the stream has been channelised for urban development. The Ngārara Stream flows into the Waimeha Stream just before the Field Way Bridge (Fig. 11.3), which crosses the stream as it enters the dunes (Fig. 11.4). Patches of saltmarsh vegetation, particularly rushes, are evident. The outlet is unconstrained, and changes its course across the beach frequently.

The stream is clearly shown on early maps as diverging from the Waikanae River in the vicinity of what is now the site of the railway bridge (Maclean & Maclean 1988), and flowing back into the estuarine site at the Waimanu Lagoon. It had disappeared underground, to reappear at its current source, by 1896. This is an artificial estuarine system; historically the stream ran parallel with the coast through what is now the string of small lakes in Waikanae Beach, and discharged into Waikanae Estuary. The current course was cut during the early 1920s, 'so giving the west coast another whitebaiting stream' (Maclean & Maclean 1988, p. 91) and also allowing an area to be developed for housing.

| Table 11A. | Waimeha | Stream site | information | (see | also Fig. | 11.1). |
|------------|---------|-------------|-------------|------|-----------|--------|
|------------|---------|-------------|-------------|------|-----------|--------|

| SITE NAME | WAIMEHA STREAM |
|-----------------------------------|--|
| Location | Waikanae |
| NZTM (coordinates) | 1770981 5474985 |
| NZ Topo50 | BP32 710 750 |
| Area | Approx. 2 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Esplanade Reserves (Kāpiti Coast District Council) |
| | Waimeha Domain (Kāpiti Coast District Council) |
| | Waimeha Conservation Area (DOC) |
| Existing rankings | None |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 3 |
| At Risk species (number) | 8 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 2 |
| Pressures (score 1–5) | 2 |
| NB: 1 = high pressures | |
| Dominant habitat | Exotic grass land |
| | Raupō reedland |
| | Lupin shrubland |
| | Sandflats |
| | |

11.2 Conservation values

11.2.1 Ecological

Patches of restored saltmarsh are present along the tidal stream margins, consisting of raupō, wīwī, oioi, and clubrush (Fig. 11.3). Bachelor's button is present, usually associated with clubrush. There are no threatened plant species known from this ecosystem.



Figure 11.1. Waimeha Stream estuarine site showing areas and places mentioned in the text.



Figure 11.2. Whitebaiting in the mouth of the Waimeha Stream. Photo: Helen Kettles.



Figure 11.3. The junction of the Ngārara and Waimeha Streams, with a mix of tall fescue, taupata, harakeke and raupō lining the banks. *Photo: Helen Kettles*.

On the sandflats there was a small flock of pied stilts, Caspian terns, several variable oystercatchers, and a mixed group of red-billed and southern black-backed gulls. A solitary white-faced heron was also seen working the estuarine margins amongst the dunes.

Nine migratory native freshwater fish species have been found in the catchment, including four species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga and redfin bully;



Figure 11.4. The lower tidal reaches of the Waimeha Stream. Note the discolouration of the water. Photo: Helen Kettles.

Allibone et al. 2010). Inanga spawning has been reliably reported here in recent history (Taylor & Kelly 2001, and references therein), and a shoal of inanga were observed.

There are no records of lizards in the area.

Table 11B lists native species present in, or utilising, the Waimeha Stream estuarine system.

Table 11B. Native species present in, or utilising, the Waimeha Stream estuarine system.

| GROUP | SPECIES | |
|-------|----------------------------------|--|
| Birds | Black-fronted tern+ | |
| | Caspian tern+ | |
| | Pied stilt* | |
| | Red-billed gull+ | |
| | South Island pied oystercatcher* | |
| | Southern black-backed gull | |
| | Spur-winged plover | |
| | Variable oystercatcher* | |
| | Welcome swallow | |
| | White-faced heron | |
| | White-fronted tern* | |
| Fish | Banded kōkopu | |

| GROUP | SPECIES |
|--------------------|--------------------|
| Fish continued | Giant kōkopu* |
| | Common bully |
| | Common smelt |
| | Giant bully |
| | Inanga* |
| | Longfin eel* |
| | Shortfin eel |
| | Redfin bully* |
| | Yellow-eyed mullet |
| Aquatic | Cockle |
| macroinvertebrates | pipi |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

11.2.2 Recreational

The stream margin is used as foot access between the beach and residential area. Some whitebaiting occurs during the season (Fig. 11.2).

11.3 Catchment properties

Both the Waimeha Stream and its tributary, the Ngārara Stream, are spring fed. The source of the Waimeha is on the outskirts of Waikanae township, while the source of the Ngārara is near Peka Peka. In total, the catchment covers 1780 ha of mainly pastureland (MacDonald & Joy 2009). The site of the decommissioned Waikanae wastewater treatment plant is adjacent to the Ngārara Stream. Discharge into the stream from the oxidation ponds over many years has led to elevated nutrient and *E. coli* levels in the system, although this has improved since the plant was closed in 2002 (Milne & Perrie 2005).

An esplanade reserve along the Ngārara Stream is managed by Kāpiti Coast District Council, and along Waimeha Stream, the Waimeha Conservation Area and Waimeha Stream Reserve are managed by DOC.

The Ngārara Stream flows through Te Harakeke wetlands (Kawakahia), a Recommended Area for Protection, which is currently protected as a QEII Covenant (5/07/240 A & B).

11.4 Threats

Ecological weed species around the estuarine area include blackberry, ice plant, gorse, pampas and lupin. Any of these species have the potential to compete with and exclude native wetland species. Blackberry is of particular concern along the margins of the stream, as it can form dense swards that will inundate other vegetation, and is quite tolerant of saline conditions. In the upper reach of the tidal area, buffalo grass is present along the edge of the channel, often extending all the way down the bank into the water.

Human disturbance to wildlife could be significant, as the area is a popular site with groups such as recreational walkers, picnickers, and recreational fishers. Feral mammalian predators are likely to be present, along with domestic predators from the adjacent urban area.

Water quality in the Waimeha/Ngārara system is generally poor. A combination of fertiliser runoff from farmland, stormwater contamination from residential areas, and residual sewage contamination means that recovery since the closure of the sewage treatment plant has not progressed as quickly as anticipated (Milne & Perrie 2005).

There are heightened nutrient levels in the Ngārara Stream. Parrot's feather has become established in the system, and is beginning to encroach into the Waimeha Stream. Buffalo grass is already present on the margins of the upper tidal reaches. Left uncontrolled, both of these species form dense mats that smother other vegetation, and further lower the water quality. It is still unknown whether this growth is affecting fish migrations (Taylor & Kelly 2001; MacDonald & Joy 2009). Manchurian rice grass is also in the system (Ravine 1992). This species is currently managed for the Ministry for Primary Industries by GWRC Biosecurity.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Waikanae Beach at William Street) during the 2010/11 summer bathing season (Morar & Warr 2011), but not during the 2014/15 summer season (Keenan et al. 2015).

Kāpiti Coast District Council has approved a private plan change to the District Plan that would allow the development of a new subdivision near the Ngārara Stream (Kāpiti Coast District Council 2008). This will likely include a change to area of the QEII Convenant. Such developments should be planned to ensure current water quality is at least maintained or enhanced, and other estuarine and river values are not threatened.

11.5 Conservation management

11.5.1 Current

GWRC has responsibility for maintaining the capacity of the Waimeha Stream for flood risk management purposes. This maintenance currently comprises aquatic weed clearance and mouth cutting under the Permitted Activity rules of the Regional Coastal Plan.

The Waimeha/Ngārara system was recognised by the Wellington Regional Freshwater Plan (Wellington Regional Council 1999) as 'needing enhancement for aquatic ecosystem purposes'. It would appear that this has occurred in the site through the restoration of saltmarsh vegetation along the banks of the stream in the Waikanae urban area (Fig. 11.3).

A local community group, the Waimeha Restoration Group, focus their activities on the Waimeha Lagoon, which was part of the Waikanae estuarine system and is south of the Waimeha estuarine site.

A well-defined new pedestrian track between the road and beach in the stream vicinity has enabled protection of native plantings.

GWRC has undertaken habitat mapping of the Waimeha Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

11.5.2 Potential

Control and monitoring of ecological weeds at the confluence of the Ngārara Stream is urgently required to improve water quality. Once ecological weeds are controlled, water quality could be further enhanced by riparian planting in the upper tidal reaches. Overhanging species such as toetoe, flax, or koromiko would be appropriate as they would create an environment unsuitable for the proliferation of kikuyu. Flax is particularly appropriate, as the area is historically a centre of the flax industry.

Development of a plan for restoration would help prioritise weed and pest control and also restoration planting. Currently, the vegetation is well along the progression towards exotic woodland, with tree lupin and blackberry binding the sand enough to allow the appearance of wilding banksia. The estuarine margins could be replanted with rushes and sedges, as a continuation of the plantings upstream, and the dune vegetation restored to native kōwhangatara, pīngao, sand tussock and sand pimelea. Sand coprosma is known to occur in the vicinity; it too would thrive here. During the transition, care should be taken that the dune integrity is not compromised, as nearby housing is reliant on the stabilisation of the dune environment. An intact buffer of native dune vegetation along the estuarine margins would help reduce ecological weed incurrence in the ecosystem. As there is active dune restoration in the vicinity there is the potential to restore dune-estuarine habitat sequences.

Some recontouring of stream sides, to create a diversity of habitats, would also be advantageous to wildlife. Further work to locate, document, and restore potential inanga spawning sites would be valuable

11.6 References

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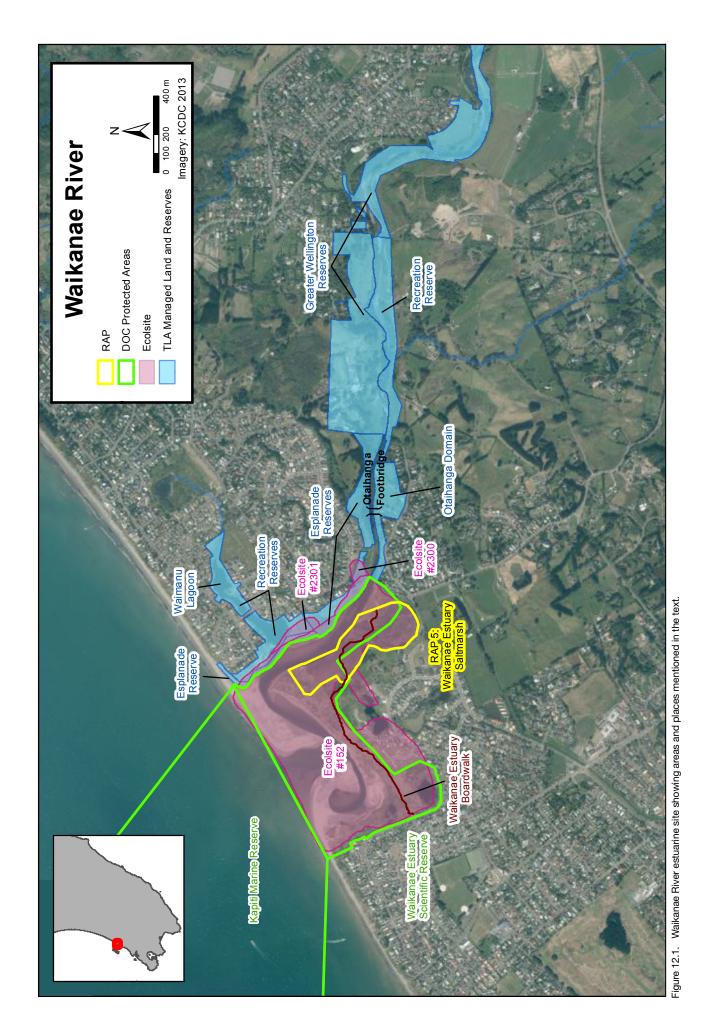
12. Waikanae River

12.1 Site description

The Waikanae estuarine site is a large (approx. 80 ha) Category B system on the edge of Waikanae Beach residential area, with a high conservation value (Table 12A; Fig. 12.1). The estuarine system contains a wide array of vegetation types and habitats, ranging from sand bars to a large area of saltmarsh (Fig. 12.2) and a large tidal pool. Historically, the environment underwent frequent, dynamic change, as the river mouth changed course (Park 2006; Gabites 2010). During this process part of the river was separated and formed the Ōtaihanga Oxbow (Fig. 12.3). While the wetlands are still relatively intact, stabilisation of the outlet and urban development on the margins of the estuarine system have significantly modified the terrestrial ecosystem (Fig. 12.4), allowing the proliferation of a range of ecological weed species. Human interventions, such as the opening of the river mouth to the north and the construction of floodgates, have blocked off tidal action in the large historically estuarine arm, allowing the creation of Waimanu Lagoon as an artificial lake.

Table 12A. Waikanae River site information (see also Fig. 12.1).

| SITE NAME | WAIKANAE STREAM |
|--|--|
| Location | Waikanae |
| NZTM (coordinates) | 1768981 5473285 |
| NZ Topo50 | BP32 690 733 |
| Area | 80 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Recreation Reserves (Kāpiti Coast District Council) Esplanade Reserves (Kāpiti Coast District Council) Waikanae Estuary Scientific Reserve (DOC) Kāpiti Marine Reserve (DOC) |
| Existing rankings | Ecol Sites 152, 2300 & 2301 RAP 5 (Ecol Site152) WERI: 4, SSWI: Moderate-High Area of Significant Conservation Value (GWRC) Ecosite (K081) (Kāpiti Coast District Council) DOC Ecosystem Management Unit (proposed) rank 966 |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 13 |
| At Risk species (number) | 21 |
| Ecosystem value (score 1-5) | 5 |
| Social value (score 1–5) | 4 |
| Restoration potential (score 1–5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 2 |
| Dominant habitat | Marram grassland Lupin shrubland Gorse shrubland Restiad rushland Remuremu herbfield Saltmarsh ribbonwood shrubland Raupō reedland Harekeke flaxland Mudflats Sandflats Subtidal |



102



Figure 12.2. Intact saltmarsh along the margins of the Waikanae River, consisting of oioi/sea rush rushland. Photo: Helen Kettles.



Figure 12.3. Aerial photograph of Waikanae Estuary, 1952, highlighting the changes in residential development during the subsequent years. The u-shaped Ōtaihanga Oxbow can be seen at the centre right.

12.2 Conservation values

12.2.1 Ecological

Saltmarsh vegetation was more extensive on the northern side of the river mouth before development occurred at Waikanae (Wodzicki 1946). While stabilisation of the river mouth and estuarine margins have allowed for the establishment of ecological weed species, the wetlands and saltmarsh still remain a haven for a wide variety of native plants. The saltmarsh of the Ōtaihanga Oxbow in the upper reaches of the estuarine ecosystem, listed as a Priority One Recommended Area for Protection (No. 5) by Ravine (1992), consists of rushland dominated by oioi and sea rush, overtopped by saltmarsh ribbonwood. In open areas of the saltmarsh there are dense swards of remuremu, and bachelor's button. Elsewhere in the estuarine system, small pools form the nucleus of raupō swamp, while patches of kōwhangatara may be found on the foredunes.



Figure 12.4. Part of the Waikanae Estuary Scientific Reserve. Restoration planting is underway on the dune terrace (centre), along with control of woody ecological weeds. The fence marks the boundary of the reserve. The course of the tidal waterway may be seen at rear (obscured). *Photo: Matt Todd.*

Two threatened species are known in the ecosystem: sea sedge (Silbery & Enright 1997) and swamp buttercup (Mason 1950). Maniototo button daisy was recorded historically (in 1967 by Tony Druce), but is now locally extinct. Wassilieff et al. (1986) recorded 43 indigenous species in total. A very small amount of seagrass was present in 2007 (Robertson & Stevens 2007) but not seen in a 2015 survey (Stevens & Robertson 2015a).

The estuarine system has extensive intertidal sandflats (Fig. 12.5) covering 50% of the total area (Stevens & Robertson 2006), and is an important habitat for a large variety of birds and native fish.

Falconer et al. (1973) stated that the estuarine site attracts a greater number of birds than any other place in the Wellington region. This is arguably still the case over 35 years later. The variety of micro-habitats provides resources that attract shorebirds, both local and migratory, each year to feed, breed, and/or roost. The estuarine site is an important nesting site for banded dotterel, dabchick, pūkeko, and variable oystercatchers. The estuarine site is also an important non-breeding site for the latter species (Dowding & Moore 2006). It attracts internal migrants such as wrybills and South Island pied oystercatchers, and international migrants such as bar-tailed godwits. Other species regularly visit from roosting sites elsewhere in order to feed in the mudflats and pools, such as the royal spoonbills from Kāpiti Island. A small number of brown teal, dabchick and scaup have been noted here regularly. Fernbirds have recently become established in the wetland of the Ōtaihanga Oxbow (L. Clapcott, DOC 2013, pers. comm.). Finally, several species, including the black shag and pied shag, have permanent roosts in the scientific reserve that they use as a base for feeding visits to the sea. Shore plover used to be found in small numbers, coming from Mana Island, but this population is now locally extinct. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Bird surveys have been frequently carried out at the Waikanae Estuary. Wodzicki (1946) and Wodzicki et al. (1978) documented changes in species population numbers during the 20th century. Wodzicki et al. (1978) showed that population numbers of different bird species differed in their reactions to the increasing urbanisation and modification of the habitat, with some declining while others increased or stayed the same. They noted a general decline in breeding populations.



Figure 12.5. View upstream of the tidal reach and mudflats, from the northern margin. Dense swards of three-square sedgeland dominate at left. *Photo: Matt Todd.*

With the rich fish habitat of the Kāpiti Marine Reserve adjacent, a variety of coastal marine fish may be found in the river mouth and lowest reaches of the estuarine system. Sprats, smelt, and yellow-eyed mullet are prey species for larger fish such as kahawai. Black flounder have been found in the estuarine waters, and other species of flounder may also be found occasionally. Rough skates and stingrays are infrequent visitors.

Fourteen migratory native freshwater fish species have been found in the catchment, nine of which are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, bluegill bully, torrentfish and lamprey; Allibone et al. 2010). Inanga are historically known to have spawned in the upper tidal reaches, with the last record in 1964. At this time, a weir was built downstream of the SH1 road bridge, greatly reducing the inanga range upstream (McDowell 1968, cited in Taylor & Kelly 2001). An inanga spawning site was identified in the lower reaches of the river during surveying in 2016 (Taylor & Marshall 2016).

Specimens of northern grass skink have been recorded in the past (Jewell 1965) and are possibly still present in low numbers.

One of the major food sources for wading birds in the estuarine system is the abundant marine invertebrate animals found in the sediments of the mudflats. Surveys of marine invertebrates (both those in and on the sediment) in this estuarine system were carried out over a number of years by Robertson & Stevens (2010, 2011, 2012) and Stevens & Robertson (2013, 2015b). Gastropod snails, paddle crabs, polychaete worms and amphipods may all be found throughout the waters and sediments of the estuarine ecosystem, while pipi are found in the sandflats of the beach near the mouth.

Table 12B lists native species present in, or utilising, the Waikanae River estuarine system.

12.2.2 Recreational

Since the European settlement of Waikanae, the estuarine area has gradually been hemmed in by residential areas. The stabilisation of the margins for development allowed ecological weeds to colonise, making foot access for recreation difficult. Until the creation of the scientific reserve, the estuarine system was neglected and little used other than for birdwatching and whitebaiting.

Table 12B. Native species present in, or utilising, the Waikanae River estuarine system.

| ODOLID. | 0050150 |
|---------------------------|----------------------------------|
| GROUP | SPECIES |
| Threatened/At Risk plants | Seagrass* |
| | Sea sedge* |
| | Swamp buttercup* |
| Birds | Australian coot |
| | Australasian shoveler |
| | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Black-fronted tern+ |
| | Brown teal* |
| | Caspian tern+ |
| | Dabchick+ |
| | Fernbird* |
| | Gannet |
| | Grey duck/mallard hybrid |
| | Grey teal |
| | Kingfisher |
| | Little black shag* |
| | Little egret |
| | Little shag |
| | Little tern |
| | New Zealand dotterel+ |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Reef heron+ |
| | Royal spoonbill* |
| | Scaup |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spotted shag |
| | Spur-winged plover |
| | Swamp harrier |
| | Terek sandpiper |
| | Turnstone |
| | Variable oystercatcher* |
| | Welcome swallow |
| | Welcome swallow |

| GROUP SPECIE | S |
|-----------------------------------|--|
| Birds continued White he | eron+ |
| White-fa | ced heron |
| White-fro | onted tern* |
| Wrybill+ | |
| Fish Banded | kōkopu |
| Barracou | uta |
| Black flo | under |
| Bluegill b | oully* |
| Common | n bully |
| Common | n smelt |
| Giant kō | kopu* |
| Hoki | |
| Inanga* | |
| Kahawai | i |
| Kōaro* | |
| Lamprey | / + |
| Longfin e | eel* |
| Redfin b | ully* |
| Rough s | kate |
| Sand flo | under |
| Shortfin | eel |
| Shortjaw | / kōkopu+ |
| Red cod | |
| Spotty | |
| Sprat | |
| Torrentfis | sh* |
| Yellowbe | elly flounder |
| Yellow-e | yed mullet |
| Aquatic macroinvertebrates Cockle | |
| Green lip | pped mussel |
| Mudflat | snail |
| | ils (P. antipodium, estuarinus upoides) |
| Oval trou | ugh shell |
| Paddle o | erab |
| Pillbox c | rab (H. varius and H. whitei) |
| Pipi | |
| Stalk-ey | ed mud crab |
| Trough s | hell species |
| Tunnellin | g mud crab |
| Herpetofauna Copper | skink |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

The estuarine site is divided between the DOC-administered scientific reserve, which focuses on conservation and habitat restoration to the south, and Kāpiti Coast District Council esplanade and recreation reserves to the north. Tracks allow foot access to both areas. The Waimanu

Lagoon was artificially created by blocking the north arm of the estuarine area; it is now a parkland facility used for boating, and is also a popular route for joggers and cyclists.

Due to the presence of the adjoining Kāpiti Marine Reserve, fishing (including whitebaiting) is not permitted either side of the seaward edge of the river mouth to the boundary markers. A bylaw was introduced in 1994 by DOC authorising the taking of whitebait and fish for non-commercial purposes from the Waikanae River within the boundaries of the Waikanae Estuary Scientific Reserve (DOC 1994). Whitebaiting is conditional; there are no motorised bikes, other vehicles, or dogs entering the reserve. A second bylaw was introduced in 1999 authorising the taking and killing of fish for non-commercial purposes by any means, including gill-netting, permitted by Amatuer Fishing Regulations 1986, within the Waikanae Estuary Scientific Reserve.

A track through the Waikanae Scientific Reserve, linking Ōtaihanga and Paraparaumu Beach, was opened in June 2012. The track, with sections of boardwalk and bridging are maintained by the Department of Conservation.

12.3 Catchment properties

The Waikanae River drains the western foothills of the Tararua Range, with a catchment of approximately 14900 ha (Robertson & Stevens 2007). The upper reaches are predominantly native bush covered hills; the middle reaches lie in the mainly pastoral Reikorangi Basin, where the main stream is joined by a number of tributaries; and towards the mouth, the river skirts the urban areas of Waikanae and Ōtaihanga. Most of the river margins below SH1 are managed by either Kāpiti Coast District Council or GWRC as the Ōtaihanga Domain and various esplanade and recreation reserves.

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the catchment. Currently, there are no control measures that can be applied to any but the smallest infestations.

Water quality in the river is measured at Greenaway Road (GWRC site RS10) and is consistently rated as 'excellent' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010; Perrie et al. 2012; Morar & Perrie 2013; Keenan & Morar 2015). Recreational water quality grades produced from two monitoring sites in the river ranged from 'fair' to 'good' during 2014–15, while the monitoring site at Ngāpotiki Street registered *E. coli* levels which exceeded guidelines in both January and February 2015 (Keenan et al. 2015). The estuarine system, however, receives treated wastewater from Paraparaumu via the Mazengarb drain (Robertson & Stephens 2007). Toxic algal blooms are a seasonal problem in this drain which leads to the estuarine area. Flooding can occur rapidly, although the relatively small catchment means that floodwaters quickly abate. Because of the flood risks the coastal plain portion of the river is constrained by stopbanks for flood protection.

GWRC has responsibility for flood risk management within the Waikanae River catchment for those parts of the Waikanae River covered by the Waikanae River Floodplain Management Plan (Wellington Regional Council 1997).

12.4 Threats

Subdivision has had a big impact on the estuarine system and with dense residential areas on both sides, disturbance is an ongoing problem (Figs 12.3 & 12.6). A range of mammalian predators and browsers will be present but mostly their impacts have not been assessed at this site. The rabbit population in the area is significant, particularly in the Ōtaihanga oxbow, as they can do considerable damage to the habitat restoration efforts by destroying newly planted seedlings and attracting predators.



Figure 12.6. Urban development on the wetland margins of Waikanae Estuary. Restoration plantings are visible amidst the grass in the foreground. *Photo: Matt Todd.*

Despite the restoration programme, ecological weeds and other exotic species still dominate the vegetation (see above). Wassilieff et al. (1986) recorded the presence of 58 ecological weed species and more have been seen since, although some are no longer apparent (e.g. spartina). Pampas grass has become firmly established; this South American relative of toetoe produces prodigious amounts of seed, can tolerate a wide range of conditions, and is an aggressive competitor that will crowd out other species if not controlled.

Due to the popularity of the Waimanu Lagoon Recreation Reserve and Waikanae Beach, the northern part of the estuarine area receives a high level of human disturbance impact, particularly during summer. This is heightened by the use of vehicles on the beach, ostensibly only permitted to launch boats, although this is difficult to enforce and frequently ignored. Even though vehicles are not permitted in the Waikanae Scientific Reserve they still regularly enter the site, particularly 4WD vehicles.

As the populations of Waikanae and Paraparaumu grow, development pressure on the margins of the estuarine ecosystem will increase. More housing on the Ōtaihanga fringe, for example, will lead to further structural stabilisation of estuarine edges, and possibly habitat loss. The fine-scale sediment monitoring in the estuarine site (Stevens & Robertson 2015b) indicate the need for management of nutrient and fine sediment sources entering the ecosystem.

The estuarine system is moderately enriched (mud and nutrients), but macroalgal growth is very low with no localised nuisance conditions (Stevens & Robertson 2013a, Stevens & Robertson 2015b).

12.5 Conservation management

12.5.1 Current

The majority of the estuarine site is managed by DOC as the Waikanae Estuary Scientific Reserve (65 ha), with the north bank run by Kāpiti Coast District Council as the Waikanae Estuary Recreation Reserve (5.2 ha) and associated esplanade reserves. Within the boundaries of these reserves, these two bodies, in conjunction with a local community group, the Waikanae Estuary Care Group, are actively working to restore the ecosystem to a state that would align satisfactorily with that of an original habitat, under the schedules laid out by Park (2006) and Gabites (2010). An intensive pest control programme has been initiated, particularly with regard to rabbits; ecological weeds have been targeted for a prioritised control and elimination scheme. On the northern side of the estuarine system a suite of 15 of the worst ecological weeds are controlled in a 7 ha area via a GWRC and Kāpiti Coast District Council partnership. Blackberry and tree lupin are currently controlled only adjacent to new planting sites.

The Waikanae Estuary Care Group is responsible for new planting. The original restoration schedule calls for the establishment of vegetation nodes in strategic areas. These will act as the nuclei of restored habitat once natural recruitment is established. Park (2006) lists 28 species of woody plants, 19 grasses, and 1 herb in the schedule, to be positioned in relevant habitats. Some of these are already present, others are known to have been present historically, and a few are known from similar habitats elsewhere in the area. Significant species include pīngao, sand tussock, and sand pimelea in the dunes, and sea sedge in the marsh; all are threatened species.

New tracks have been cut to improve public access, with board walks in place where necessary to protect fragile habitats. A new fence has been built along the Kotuku Drive boundary to the south-east. Large, comprehensible information boards have been placed at entrances and other strategic points to educate and raise public awareness. Developers in adjacent subdivisions have been included in strategic planning so that the impact of new housing might be mitigated by the inclusion of larger buffer zones and low impact landscaping e.g. low sedimentation impacts. Work in the Ōtaihanga Oxbow has focused on ecological weed control and planting of native vegetation. Kāpiti Coast District Council has also supplied culvert pipes to install to restore tidal and river flows through the area. GWRC has installed rock work around the pipes to prevent erosion.

The original Restoration Plan (Park 2006) has been reviewed and updated by Gabites (2010). In the updated Plan, the emphasis has shifted from restoration of the ecosystem to the original state, as envisioned by Park, to restoration of the natural processes of succession. This is in order to facilitate the establishment of an optimal state of equilibrium of the estuarine ecosystem with its environs. In addition to this, Gabites (2010) lays out objectives and detailed strategies for every facet of the restoration process, making it clear how the objective may be achieved. In 2014, native freshwater fish passage was reinstated into the Waimanu Lagoon at 'the pipe' located at the true righthand side of the river.

GWRC has undertaken habitat mapping of the Waikanae River estuarine site and margins (Stevens & Robertson 2006, 2015), fine-scale intertidal sediment and sediment biota monitoring, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). The site is part of GWRC's long-term estuarine state of the environment monitoring programme, with the first round of intertidal ecological monitoring (sediment quality and benthic plants and animals) conducted over 6 years (Robertson & Stevens 2010, 2011, 2012; Stevens & Robertson 2013b, 2014b, 2015b). Macroalgal mapping has been conducted four times (Stevens & Robertson 2010, 2012, 2013a, 2014a). Sedimentation plates have also been deployed in the site. Prior to this monitoring some survey work was carried out by Kāpiti Coast District Council (Kingett Mitchell & Associates 1994).

The area has also been identified as an Ecosite in the Kāpiti Coast District Plan due to its linkages to Kāpiti Island via the marine reserve and the habitat it provides for many species.

12.5.2 Potential

The area of saltmarsh in the upper tidal reaches, listed as a Priority One Recommended Area for Protection, is only partially within the boundaries of the Waikanae Estuary Scientific Reserve. The remainder, including the Ōtaihanga Oxbow, is on private property and is not legally protected. Although the entire area is currently included in the Restoration Plan (Gabites 2010), it would be good for the long-term to negotiate a covenant with the landowner.

While vehicle access is technically restricted on the beach and foreshore, as noted above, this bylaw is difficult to enforce, and off-road vehicles are often used irresponsibly in the area around the river mouth. Options to manage vehicle damage in the estuarine and coastal ecosystem would be worth exploring.

Ideally, in discussion with iwi and local communities, it would be preferable to restrict gill nets in the scientific reserve due to impacts on native bird species such as shags.

Robertson & Stevens (2011) recommend that any 'hotspot' sources of nutrients and fine sediment be identified and management undertaken to minimise their adverse effects on the estuarine uses and values. They also recommended investigating options for minimising the effects of the floodgates and the artificial opening of the river mouth on the historically higher quality estuarine areas to the north of the river mouth.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

Te Ātiawa ki Whakorongotai are keen to establish a series of cultural indicators to monitor the health and wellbeing of the river and estuarine ecosystem.

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13. Wharemauku Stream

13.1 Site description

The Wharemauku Stream flows through the suburban centre of Raumati Beach, discharging across the beach adjacent to a carpark Table 13A; Fig. 13.1). The estuarine system is entirely constrained by retaining walls and culverts, and the final 100 m before the beach have been artificially straightened (Fig. 13.2). The Raumati seawall reaches the stream mouth on the southern bank. A footbridge crosses the stream near the mouth, linking the two parts of the beach.

| WHAREMAUKU STREAM |
|---|
| Raumati Beach |
| 1766481 5468585 |
| BP32 665 686 |
| Approx. 1 ha |
| Kāpiti Wellington Office |
| Kāpiti Coast District Council, GWRC |
| Recreation Reserve (Kāpiti Coast District Council) Raumati Marine Gardens (Kāpiti Coast District Council) |
| None |
| Foxton |
| Category B |
| 5 |
| 13 |
| 1 |
| 2 |
| 1 |
| 2 |
| Pōhutukawa treeland |
| Sandflats |
| |

13.2 Conservation values

13.2.1 Ecological

In this modified environment, little indigenous vegetation remains, with no areas of saltmarsh left. Mature specimens of pōhutukawa line the banks, overhanging the water. These were planted by Kāpiti Coast District Council for amenity purposes. There are occasional, sparse patches of knobby clubrush present along the top of the retaining wall. Kōwhangatara is known to occur on nearby dunes (Partridge 1992). There are no other threatened or significant species recorded in the vicinity.

The stream discharges across the sandflats of Raumati Beach. Kāpiti Coast District Council lists shellfish as once being an abundant resource along the beach (Kāpiti Coast District Council 2006), and highlights the requirement for careful management of the remaining beds. Pipi are present in the lower parts of the intertidal zone.

The beach is often visited by shore birds, as well as resident species in the area. During the survey, a large group of southern black-backed and red-billed gulls were the only bird species evident but a range of birds are known from the site.

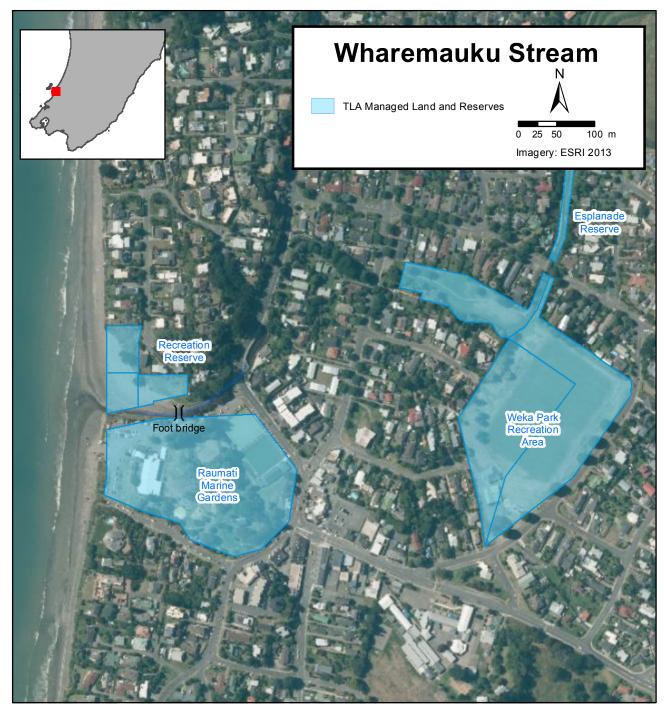


Figure 13.1. Wharemauku Stream estuarine site showing areas and places mentioned in the text.

Twelve migratory native freshwater fish have been found in the catchment, including seven that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully and torentfish; Allibone et al. 2010).

Copper skinks (Cyclodina aenea) have been recorded in the vicinity (McFarlane 1996).

Table 13B lists native species present in, or utilising, the Wharemauku Stream estuarine system.

13.2.2 Recreational

Raumati Beach is a popular holiday spot, and the beach adjacent to the stream mouth is well used for swimming, sun-bathing and fishing, particularly during the summer months. The beach is a perennial location for artist's depictions of Kāpiti Island. There is a boat-ramp at the nearby Marine Gardens, but vehicle use on this part of the beach is low.



Figure 13.2. The tidal area of the Wharemauku Stream is entirely constrained by retaining walls on the margins. Photo: Matt Todd.

Table 13B. Native species present in, or utilising, the Wharemauku Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Caspian tern+ |
| | Kingfisher |
| | Pied stilt* |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Red-billed gull+ |
| | Royal spoonbill* |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |

| GROUP | SPECIES |
|----------------------------|---------------------|
| Birds continued | White-fronted tern* |
| Fish | Banded kōkopu |
| | Common bully |
| | Common smelt |
| | Giant bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Sand flounder |
| | Shortfin eel |
| | Shortjaw kōkopu+ |
| Aquatic macroinvertebrates | Pipi |
| Herpetofauna | Copper skink |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

13.3 Catchment properties

The 1337 ha catchment drains the area of low hills immediately behind Raumati and Paraparaumu. Sixty percent of the catchment is pasture, 30% is urban, and the remainder is scrub and forest (MacDonald & Joy 2009). Gravel has been regularly extracted from the upper catchment in the past, although it is uncertain if this will continue. The stream flows through Kaitawa Recreation

Reserve (managed by Kāpiti Coast District Council), the site of a successful terrestrial ecosystem restoration project on the outskirts of Paraparaumu. Towards the mouth, the stream also flows through a Kāpiti Coast District Council managed esplanade reserve and Weka Park.

A local community group, the Friends of Wharemauku Stream, are carrying out a wetland restoration project along the urban margins of the stream, supported by both Kāpiti Coast District Council and DOC.

Streambed sediment sampling in the Wharemauku Stream was undertaken by GWRC in 2005 and sediments were found to exceed the ANZECC low trigger value for DDT (Milne & Watts 2008). Although the stream is not monitored by GWRC, some investigations and monitoring have been done by GWRC and Kāpiti Coast District Council to date, and it is likely that water quality is seldom deserving of a better rating than 'moderate', due to the high degree of agricultural and urban land use in the catchment, as well as the lingering effects of gravel extraction.

13.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Given the proximity to urban areas this could include domestic predators.

The wooden retaining walls stand at least a metre high well above the mean high water mark and therefore provide no habitat for inanga spawning. Vegetation along the tops of the retaining walls on either side of the stream mouth is dominated by exotic grasses, particularly kikuyu and browntop. Patches of brush wattle and pampas grass are also present. The dunes on the north side of the stream mouth are dominated by marram. Kikuyu is an exotic grass that forms thick mats, capable of invading many ecosystems (including both saltmarsh and sand dunes) and smothering other species. It appears to be kept under control along the tops of the retaining walls, but it would be useful to periodically check its growth. Pampas grass and brush wattle, while in low numbers along the bank, are also undesirable ecological species that ideally would be controlled prior to spread.

Põhutukawa, commonly regarded as an iconic native species, is an invasive threat to the regenerating forest of the Wellington Region, particularly where hybridisation with the local rata population occurs.

MacDonald & Joy (2009) suggest that, under increasing urban development pressure, further modification of the stream bed is planned, in the form of culverts and piping. The Raumati seawall, which has its northern end at the stream mouth, is scheduled for renewal under the Kāpiti Coast Coastal Strategy (2006). Construction work for this process is likely to further modify the estuarine system.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Paraparaumu Beach at Wharemauku Road) during the 2010/2011 summer bathing season (Morar & Warr 2011). The Marine Gardens monitoring site registered unacceptable levels of enterococci and of faecal coliforms at the Raumati Beach (Tainui St) site during the 2014/15 summer season (Keenan et al. 2015).

13.5 Conservation management

13.5.1 Current

Kāpiti Coast District Council is responsible for maintenance retaining walls and the various recreation and esplanade reserves along the stream. The Council also manages Raumati Beach under the Coastal Strategy (Kāpiti Coast District Council 2006), including the Wharemauku stream mouth. The Strategy recommends restoration of the native dune vegetation as far as is feasible and erosion control that is designed to have the least possible impact upon the character of the environment.

GWRC has undertaken habitat mapping of the Wharemauku Stream estuarine site and margins, fine-scale intertidal sediment and sediment biota monitoring (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

13.5.2 Potential

The environment has undergone major modification, including land stabilisation, and it is not considered feasible to return the estuarine system to its natural state. However, the walkways on either side of the stream could be planted with ecologically appropriate species to enhance the visual values of the estuarine area. Ecological weeds such as pampas grass and brush wattle would ideally be removed and replaced with shrubby species such as taupata, flax, toetoe, and koromiko. All of these species occur locally, and are tough, low-maintenance species that could overshade the kikuyu. Further, the top of the retaining wall could be replanted with native groundcover. These would form an attractive border for the wall, and would form a link with the dune restoration work being carried out on the beach.

It may be feasible to plant tidal species, such as oioi, wīwī, and clubrush along the base of the wall, in an effort to re-establish a saltmarsh ecosystem in the estuarine ecosystem. Any restoration plans would need to be drawn up in conjunction with the design considerations for the waterway structural works.

Friends of Wharemauku Stream are supporting the establishment of at least 20 m wide riparian margins on the stream between Rimu Road and Raumati Beach when the remaining bare land there comes up for development; this would improve water quality and restoration potential for the site.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

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14. Whareroa Stream

14.1 Site description

The estuarine system of the Whareroa Stream is a modified ecosystem that empties into the sea across Whareroa Beach. The outlet is occasionally blocked following rough weather. There is a degraded area of saltmarsh wetland lying in the upper part of the estuarine system, with relatively unmodified dunes adjacent to the north (Table 14A; Figs 14.1 & 14.2). The south bank has been stabilised by a wooden retaining wall (Fig. 14.3) to allow the development of a carpark and recreational picnic area. A footbridge connects this with the tracks on the north side of the stream. The entire site is within Queen Elizabeth Park.

Table 14A. Whareroa Stream site information (see also Fig. 14.1).

| SITE NAME | WHAREROA STREAM |
|--|--|
| Location | Queen Elizabeth Park |
| NZTM (coordinates) | 1765681 5464185 |
| NZ Topo50 | BP32 657 642 |
| Area | 5 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Queen Elizabeth Park (owned by DOC; managed by Greater Wellington) |
| Existing rankings | Ecol Site 329 RAP 2 (Ecol Site 329) Key Native Ecosystem (GWRC) |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 5 |
| At Risk species (number) | 10 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 4 |
| Dominant habitat | Kikuyu grassland Tall fescue Taupata shrubland Clubrush rushland Sandflats |

14.2 Conservation values

14.2.1 Ecological

Flax is the dominant species on either side of the stream (Fig. 14.4), interspersed with taupata and toetoe. Knobby clubrush, clubrush, giant umbrella sedge, wīwī, pūrua grass, three-square, kuāwa and bachelor's button are all found along the margins of the tidal area.

No threatened plants are recorded as occurring in the estuarine system, although sand coprosma is known to grow in the dunes nearby (Mercer & Dean 1995, cited in Milne & Sawyer 2002), and water brome has historically occurred in dune wetlands in the park (Ogle 1991, cited in Ravine 1992).

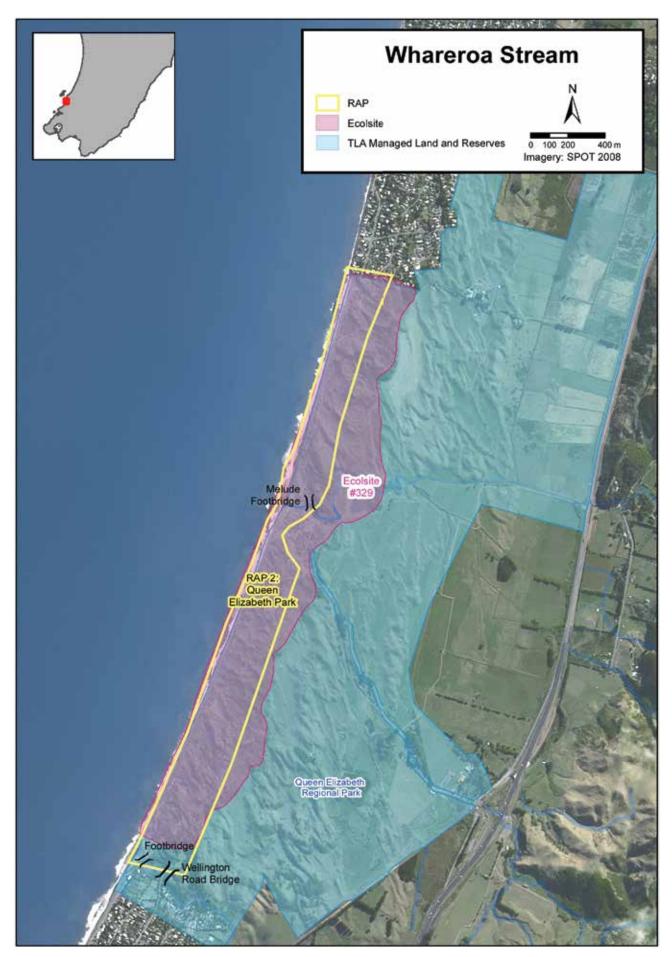


Figure 14.1. Whareroa Stream estuarine site showing areas and places mentioned in the text.



Figure 14.2. Saltmarsh in the upper tidal reach of the Whareroa Stream. Ecological weeds are abundant, and the margins of the waterway are lined with reed sweetgrass. *Photo: Matt Todd.*



Figure 14.3. The mouth of the Whareroa Stream has been modified and constrained by a wall on the south bank. *Photo: Matt Todd.*

At the time of visiting, the only birds present were southern black-backed, red-billed gulls, and a solitary kingfisher. Other species will visit frequently. Dabchicks and Australasian shovelers have recently been recorded in the park (GWRC 2008).

Nine migratory native freshwater fish species have been found in the catchment, including six species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, inanga, redfin bully and lamprey; Allibone et al. 2010). Taylor & Kelly (2001) suggested there was 'above average'



Figure 14.4. Harakeke flaxland is dominant on the northern margin of the stream mouth. Kāpiti Island is visible at rear. *Photo: Matt Todd*.

spawning habitat for inanga amongst the tall fescue, and report seeing two shoals in the upper tidal reaches. While the stream mouth is relatively small and shallow, some coastal marine fish species are still likely to enter occasionally, including yellow-eyed mullet and smelt.

There are no records of lizards around the estuarine site.

Table 14B lists native species present in, or utilising, the Whareroa Stream estuarine system.

Table 14B. ative species present in, or utilising, the Whareroa Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Water brome+ |
| Birds | Banded dotterel+ |
| | Black shag* |
| | Caspian tern+ |
| | Kingfisher |
| | Little shag |
| | New Zealand pipit* |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |

| SPECIES |
|---------------------|
| Welcome swallow |
| White-faced heron |
| White-fronted tern* |
| Banded kōkopu |
| Common bully |
| Giant kōkopu* |
| Inanga* |
| Kōaro* |
| Lamprey+ |
| Longfin eel* |
| Redfin bully* |
| Shortfin eel |
| |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

14.2.2 Recreational

The estuarine area is adjacent to the Whareroa Beach picnic area (GWRC); as such, it is the starting point for several walks in the park and gives access to the beach for swimming and fishing. The picnic area is often the centre for organised activities, and the Kāpiti Aero Modellers Club have their clubrooms near the upper limit of the tidal zone. Duck shooting is not permitted in the park (GWRC 2009).

14.3 Catchment properties

The area that the stream drains is modest, only 1590 ha, and consists mainly of coastal farmland, converted from the original swamp (Ravine 1992). A branch of the stream rises in the hill country behind Mckays Crossing, in DOC-administered Whareroa Farm Recreation Reserve, a retired pasture left to regenerate into native forest. Most of the catchment has been farmed for a long period of time, and over 80% is pasture and nearly all of the rest is scrub (MacDonald & Joy 2009). On the coastal flats, the stream is highly modified and channelised, only returning to its natural form as it passes through the dunes. GWRC monitors water quality at Queen Elizabeth Park (GWRC site RS12). Water quality is affected by agricultural and road runoff, and is consistently reported as 'poor' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015).

14.4 Threats

Animal pests in the park are well documented (GWRC 2008) with cats, rats, mice, possums, mustelids and hedgehogs likely to pose a threat to the wildlife of the estuarine ecosystem. Rabbits and hares are also present and can do considerable damage to regenerating vegetation. Dogs are permitted in the area if kept on a lead (GWRC 2011), but dogs frequently roam loose on the beach around the mouth where they can disturb shorebirds.

The estuarine system has an ecological weed problem, particularly in the wetland above the footbridge (Fig. 14.2). Of particular concern are blackberry, brush wattle, and gorse. These species are difficult to control and will not decline by overtopping in the open saltmarsh. Tall fescue and kikuyu are prevalent grasses in the estuarine ecosystem; kikuyu in particular requires monitoring, as it forms dense mats that can crowd out native species in the estuarine margins. In the open water, water celery is starting to form thick patches and this species can clog a waterway if not managed properly.

Sedimentation from soil erosion in the catchment, along with the effects of major roadworks at Mckays Crossing, is accelerating the process of aggradation in the river bed. This contributes to the effects of flooding and inhibits the growth of vegetation. Eventually, it can significantly alter the character of a small estuarine system.

14.5 Conservation management

14.5.1 Current

The site is entirely managed by GWRC as part of Queen Elizabeth Park, under the statutes of the Parks Network Plan (GWRC 2011). GWRC has also identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. GWRC is also responsible for overseeing ecological weed and pest control, visitor management, farm management, environmental monitoring, and ecosystem restoration projects in the park.

The site is covered by the GWRC Queen Elizabeth Park KNE Plan 2014–17. The KNE Plan identifies priorities for ecological weed and pest animal control work to 2017 (GWRC 2014). A large number of ecological weeds have been removed from the dunes, and the KNE Plan prioritises continued management of the most weedy plant species in the dunes and wetlands.

In 2010, a plan was completed to prioritise restoration work on the dunes and stream mouth area (Spence & Bergin 2010). Currently, parts of the stream are undergoing restoration by the Friends of Queen Elizabeth Park, a local community group. They are focusing on restoring the native vegetation of the riparian areas further upstream, in the parts of the stream modified by farming, and are supported by GWRC with financial resources. The restored areas and most grazed areas are fenced to exclude stock. It is hoped that these efforts will improve water quality and enhance instream values for native fish and birds. GWRC provides excellent signage on the restoration process in the area. The Whareroa Guardians are working in the upper catchment areas on the protection of the stream through stock exclusion, riparian planting and pest control.

The dunes on either side of the estuarine area are listed as a Priority One Recommended Area for Protection, as they contain pockets of vegetation that are representative of the original dune environment prevalent along the entire coast (Ravine 1992).

GWRC has undertaken habitat mapping of the Whareroa Stream estuarine site and margins (Stevens & Robertson 2006), fine-scale intertidal sediment and sediment biota monitoring, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

14.5.2 Potential

The value of the estuarine ecosystem could be greatly improved by a sustained programme of ecological weed control, particularly in the saltmarsh upstream of the bridge, where exotic scrub and tall fescue are abundant. There are enough native wetland species already present in this area to minimise the need for replanting. It is likely to become a flax dominated system. The process could be augmented if necessary with plantings of saltmarsh ribbonwood, flax, and wīwī. Restoration of this area would provide extra habitat for wetland birds.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

In the lower tidal reaches, the removal of the retaining wall on the south bank, which is in a state of disrepair, would release the stream constraints and allow the restoration of a wetland margin. This would require consideration in light of the effect on recreational values; the access path along the bank to the beach would be lost, but there are two others in close proximity, both leading from the picnic area. After removal of the wall, the margin could be replanted with flax, toetoe, wīwī, and pūrua grass. Fencing to minimise trampling by people would be advantageous while the new plantings get established. This would enhance and connect with the dune restoration project as discussed above.

14.6 References

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15. Wainui Stream

15.1 Site description

The mouth of the Wainui Stream forms a small tidal stream mouth estuarine system at the southern entrance to Queen Elizabeth Park (Table 15A; Fig. 15.1). The outlet drains across Paekākāriki Beach adjacent to the local surf-club, and it is likely that it is occasionally blocked (Fig. 15.2). A small tidal pool has formed behind the beach and passes through the coastal dunes, flanked on the south side by a steep bank (Fig. 15.3). On the true left bank, approximately 100 m upstream from the mouth, there is an area of saltmarsh wetland. A footbridge crosses the mouth at the rear of the beach, and connects the surf club to the walking tracks of the park, while a road bridge crosses the stream at the tidal limit. At times there can be large amounts of storm-tossed driftwood piled up in the lower tidal reaches.

Table 15A. Wainui Stream site information (see also Fig. 15.1).

| SITE NAME | WAINUI STREAM |
|--|--|
| Location | Paekākāriki |
| NZTM (coordinates) | 1765881 5462385 |
| NZ Topo50 | BP32 659 624 |
| Area | Approx. 1 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Kāpiti Coast District Council, GWRC |
| Land status (tenure) | Queen Elizabeth Park (owned by DOC; managed by Greater Wellington) |
| Existing rankings | RAP 2 (Ecol Site 329) Key Native Ecosystem (GWRC) |
| Ecological district | Foxton |
| Estuarine classification | Category B |
| Threatened species (number) | 3 |
| At Risk species (number) | 10 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Taupata shrubland |
| | Kōwhangatara grassland |
| | Tall fescue grassland |
| | Harekeke flaxland |
| | Sandflats |
| | Subtidal |
| | |

15.2 Conservation values

15.2.1 Ecological

Flax is the dominant species on either side of the stream, interspersed with taupata and toetoe. In the upper part of the estuarine area, the margins are overhung by pōhutukawa.

Flax is also the dominant species in the wetland, but pūrua grass, three-square, kuāwa, clubrush and wīwī are all present along the margins (Fig. 15.4). Clumps of knobby clubrush and giant umbrella sedge are scattered through the flax. This area is greatly stabilised by the presence of a large Norfolk Island pine at the rear of the wetland.

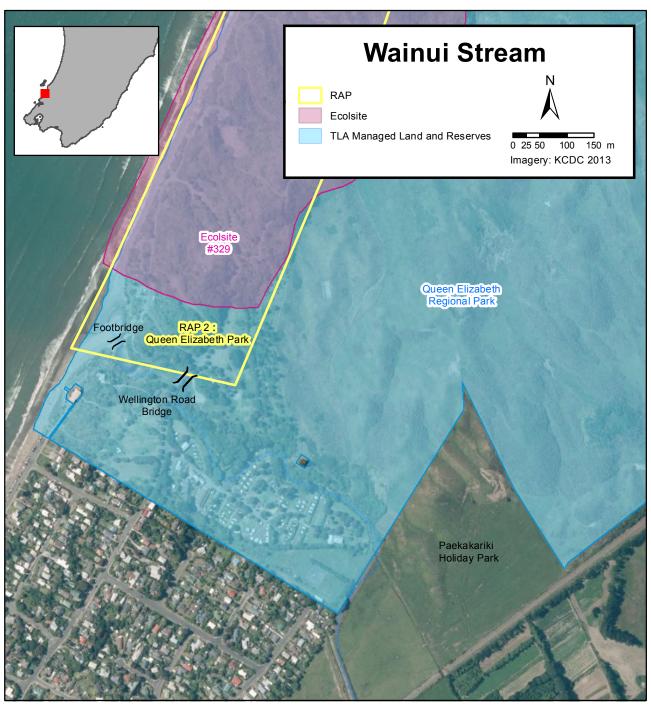


Figure 15.1. Wainui Stream estuarine site showing areas and places mentioned in the text.

There are no threatened plants recorded in the Wainui Stream estuarine ecosystem.

During our visit, the only native birds seen were southern black-backed gulls and variable oystercatchers. A range of shore birds are known to visit regularly (GWRC 2008), including pied stilts, banded dotterels, spur-winged plovers, and other common species. The estuarine ecosystem is likely to be frequented by white-faced herons, black shags, pūkeko and New Zealand pipits. Dabchicks and Australasian shovelers are also known in the restored wetlands (GWRC 2008).

Eight migratory native freshwater fish species have been found in the catchment, including five species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, redfin bully and torrentfish; Allibone et al. 2010). Despite the presence of suitable vegetation for inanga spawning, Taylor & Kelly (2001) did not survey the stream, and there is no other record of inanga. Small coastal marine species may occasionally enter the estuarine area.



Figure 15.2. The outlet for the Wainui Stream mouth is dynamic, and changes its course and position frequently. *Photo: Matt Todd*



Figure 15.3. The partially blocked Wainui Stream mouth. The Norfolk Island pine in the saltmarsh wetland (centre rear) is stabilising the environment. *Photo: Matt Todd.*

There are no records of lizards around the stream.

Table 15B lists native species present in, or utilising, the Wainui Stream estuarine system.



Figure 15.4. The upper tidal reach of the Wainui Stream is lined with three-square and tall fescue along the margins of the waterway. Harakeke flaxland occupies the wetland at rear. Photo: Matt Todd.

Table 15B. Native species present in, or utilising, the Wainui Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Black-billed gull+ |
| | New Zealand pipit* |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oyster catcher* |

| GROUP | SPECIES |
|-----------------|-------------------|
| Birds continued | White-faced heron |
| Fish | Banded kōkopu |
| | Common bully |
| | Giant kōkopu* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Torrentfish* |
| | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

15.2.2 Recreational

The stream forms the southern boundary of Queen Elizabeth Park and receives a moderate amount of foot traffic accessing the tracks through the dunes. Paekākāriki Holiday Park, adjacent to Queen Elizabeth Park, occupies the land at the upper limit of the tidal zone. The Paekākāriki Surf Club (within Queen Elizabeth Park) is immediately adjacent on the beach and is the nucleus of a high level of recreational use (surfing, swimming, fishing and picnicking), particularly during the summer months.

The Norfolk Island pines around the estuarine area and holiday park were planted by Ngāti Haumia during the early 20th century (D. Scott, GWRC 2009, pers. comm.).

15.3 Catchment properties

The catchment of the Wainui Stream is small, steep, and narrow, consisting of a single valley in the coastal hills. It covers no more than 810 ha and is an even mixture of pasture, scrub, and exotic forest (MacDonald & Joy 2009). The stream also passes along the northern end of Paekākāriki. The water quality is generally good, but there could be a small amount of organic contamination from agricultural runoff. There is a history of leakage from the motor camp septic tanks into the stream (D. Scott, GWRC 2009, pers. comm.), and it is possible that there is some urban contamination.

15.4 Threats

Feral pests, particularly cats, rodents, possums, mustelids and hedgehogs have been recorded at the site (GWRC 2008). Uncontrolled dogs on the beach are also a common problem and could cause disturbance to wildlife. Possums, rabbits and hares are all known in the vicinity and are capable of doing considerable damage to regenerating vegetation.

There are a number of ecological weeds in the estuarine ecosystem. Kikuyu can form dense mats along the margin of the stream, severely inhibiting the growth of native grasses. Gorse, tree lupin, boneseed and brush wattle are shrubby species that can be difficult to control in an open environment; boneseed is of particular concern. In the water, water celery is present and is of concern as it can quickly inundate a stream if not controlled. There are many other ecological weed species also present.

The single mature Norfolk Island pine in the wetland is stabilising the environment to the extent that it is facilitating the growth of other exotic species. The Norfolk Island pine presents an issue that would need some consultation before a resolution could be reached. Ngāti Haumia, in particular, has an interest in the pines in the area, as do the residents of Paekākāriki, and the tree would be costly and difficult to remove. However, the removal of trees would further promote the restoration of the wetland by reducing the opportunity for ecological weed shrubs to colonise.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Paekākāriki Beach at surf club) during the 2010/2011 summer bathing season (Morar & Warr 2011), but not during the 2014/15 summer season (Keenan et al. 2015).

15.5 Conservation management

15.5.1 Current

The site is managed by GWRC as part of Queen Elizabeth Park, under the statutes of the Parks Network Plan (GWRC 2011). GWRC has identified this area as a site with high biodiversity values under the Key Native Ecosystem (KNE) programme. The site is also managed under the Queen Elizabeth Park KNE Plan (GWRC 2014). The KNE Plan identifies priorities for ecological weed and pest animal control work through to 2017. A large number of ecological weeds have been removed from the dunes, and the KNE Plan prioritises continued management of the most weedy plant species in the dunes and wetlands, GWRC staff actively manage the site to protect and restore these values. They are responsible for overseeing ecological weed and pest control, visitor management, farm management, environmental monitoring, and ecosystem restoration projects in the park. In 2010, GWRC contracted the writing of a Plan to prioritise restoration work on the neighbouring dunes (Spence & Bergin 2010). The southern approaches to the stream through Paekākāriki are the responsibility of Kāpiti Coast District Council and are managed according to the contents of the Coastal Strategy (Kāpiti Coast District Council 2006). There are no restoration initiatives in the estuarine area at present.

15.5.2 Potential

Control of the grass and ecological weed species in the estuarine ecosystem would allow the native wetland species to reassert themselves in the environment. Ongoing monitoring of ecological weed species would be required to ensure that regrowth is kept under control. Flax and toetoe would be most likely to re-establish in the new space made available, while the sedge and rush species already present would thrive along the margins. The area near the footbridge, currently dominated by marram and kikuyu, could be planted with pīngao and kōwhangatara and be made contiguous with dune restoration efforts.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

Little extra public information would be required, as GWRC already maintains excellent signage regarding the restoration process.

Water quality monitoring is required in order to identify sources of contamination in the stream. If leakage from the motor camp septic tanks is still occurring, or road runoff emptying directly into the waterway, then this is an issue for the estuarine system.

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16. Taupō Stream

16.1 Site description

This is a small incised stream with a regionally significant flax swamp in it's middle reaches. The tide reaches no more than a few hundred metres up the narrow waterway. The mouth is greatly constrained by concrete bridge abutments underneath the road/rail corridor (Table 16A; Figs 16.1 & 16.2).

16.2 Conservation values

16.2.1 Ecological

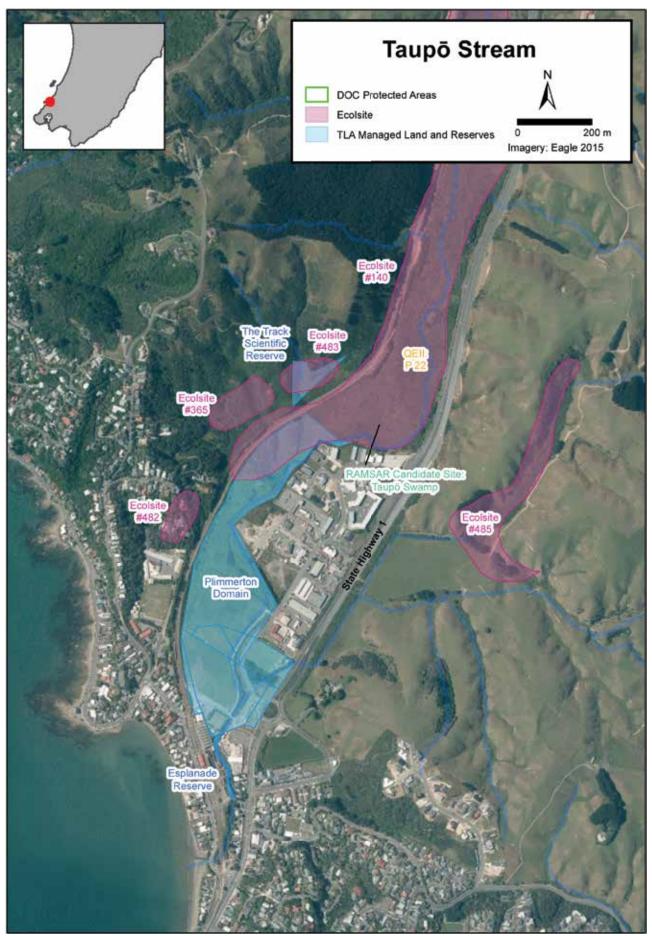
Due to the highly modified nature of the surrounding environment, the lower tidal reaches have very little indigenous vegetation save green algae (*Enteromorpha* sp.) on the margins and sea lettuce in the stream. The banks are steep and high (Fig. 16.3), and there is no space for saltmarsh vegetation. Mitcalfe & Horne (1999) recorded 18 indigenous plant species. Several shrub species overhang the waterway, including flax, taupata, toetoe and karo.

There are no threatened species at this estuarine site, although swamp nettle and swamp buttercup both occur in the Taupō Swamp upstream (Clelland 1984).

Below the railway culverts, the estuarine system offers little habitat for birdlife or for fish. Red-billed gulls were the only birds seen on the beach, although other shorebirds may visit occasionally. However, trees and shrubs lining the upper tidal reaches provide suitable habitat for foraging kingfishers and black shags. Two bird species, bittern and marshcrake, are known to be resident in Taupō Swamp although their present status is uncertain (I. Armitage, OSNZ 2011, pers. comm.).

Table 16A. Taupo Stream site information (see also Fig. 16.1).

| SITE NAME | TAUPO STREAM |
|--|---|
| Location | Plimmerton |
| NZTM (coordinates) | 1757590 5452070 |
| NZ Topo50 | BP32 576 521 |
| Area | 1 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Porirua City Council, GWRC |
| Land status (tenure) | Private Plimmerton Domain (Porirua City Council) Esplanade Reserve (Porirua City Council) |
| Existing rankings | Key Native Ecosystem (GWRC) |
| Ecological district | Wellington |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 6 |
| Ecosystem value (score 1–5) | 1 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1–5) | 1 |
| Pressures (score 1–5) NB: 1 = high pressures | 1 |
| Dominant habitat | Taupata shrubland Sandflats |



 $\label{eq:Figure 16.1.} \ \ \text{Taup\"o Stream estuarine site showing areas and places mentioned in the text.}$



Figure 16.2. The mouth of the Taupō Stream passes underneath road and rail bridges. Photo: Matt Todd.



Figure 16.3. The tidal reach of the Taupō Stream passes through a highly modified environment, dominated by woody ecological weeds and vines. *Photo: Matt Todd.*

Six migratory native freshwater fish species have been found in the catchment, including four species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga and redfin bully; Allibone et al. 2010). Taylor & Kelly (2001) rated the spawning habitat for inanga in the stream as 'good'. Further surveys in 2016 (Taylor & Marshall 2016) recorded some suitable habitat, although spawning was not confirmed.

There are no records of lizards from Taupō Stream.

Table 16B lists native species present in, or utilising, the Taupo Stream estuarine system.

Table 16B. Native species present in, or utilising, the Taupo Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Black shag* |
| | Kingfisher |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| Fish | Banded kōkopu |
| | Giant kōkopu* |
| | Inanga* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

16.2.2 Recreational

Plimmerton is a seaside suburb of Porirua City, and the beach and stream mouth is used year round by residents for exercise, swimming, and relaxing. The estuarine area, however, is unattractive and seldom accessed.

16.3 Catchment properties

The stream drains the valley that extends north from Plimmerton to Pukerua Bay township, approximately 900 ha. Around 70% of the catchment is pasture; the remainder is scrub and forestry, with a small area occupied by commercial properties on the ponding area near Plimmerton. The valley currently forms part of the main transport corridor, with both SH1 and the main trunk railway line following the hillside contour either side of the valley bottom. Water quality in the stream was historically considered poor with elevated levels of enterococci (MacDonald & Joy 2009) but there has been no recent reporting.

A major feature of the catchment is the regionally significant Taupō Swamp which is an excellent example of topogenous lowland freshwater mire despite being modified by the construction of the transport corridor (Cromarty & Scott 1995). The area is a QEII property (5/07/449; P22) and has been put forward as a candidate for Ramsar qualification. A weir built at the lower extremity of the swamp includes a fish pass, constructed to maintain the connection for fish between the swamp and the sea (GWRC 2005).

16.4 Threats

The stream may be influenced by road and agricultural runoff, sedimentation and industrial waste (MacDonald & Joy 2009).

A range of mammalian predators and browsers will likely be present but their impacts have not been assessed at this site. Due to the proximity to urban areas domestic cats are also likely to be present.

Ecological weed species are dominant in the highly modified tidal area. Although some native trees overhang the stream, the banks are dominated by species that have thrived in the modified habitat: tall fescue, gorse, blackberry, Cape ivy, and briar (Fig. 16.3).

The Taupō Stream catchment is identified as a proposed residential growth area by PCC in it's Northern Growth Area Structure Plan (Boffa Miskell Limited 2014). While any development is unlikely to occur in the near future (i.e. before 2020), the medium to long-term will see the potential development of over 3000 homes. While the significance of Taupō Swamp is recognised and a number of key gully/stream are identified for protection, sediment could be an issue during earthworks, and then likely impacts from stormwater runoff.

GWRC's recreational water quality monitoring at the Bath Street site registered enterococci levels which exceeded guidelines during monitoring events in both December 2014 and January 2015 (Keenan et al. 2015)..

16.5 Conservation management

16.5.1 Current

Porirua City Council is responsible for various areas, including the Plimmerton Domain along the stream, and GWRC for keeping the lower 1.2 km of the stream clear for flood flows. According to Perrie (2008) there is no regular monitoring of water quality in the stream.

GWRC has undertaken habitat mapping of the Taupō Stream estuarine site and margins (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for the Taupō Valley Wetlands is in development (GWRC in press). and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

A recent discovery and repair of a broken sewer line in the lower catchment will have improved water quality (K. Calder, PCC 2015, pers. comm.).

16.5.2 Potential

Restoration potential, for the estuarine area, is currently limited due to the nature of the modifications for transport infrastructure. In this greatly modified and severely degraded environment with infrastructural priorities, the greatest value is the connection the area provdes between and sea and the Taupō Swamp. As such, pollution is the factor which should continue to be a priority.

Other than sewage contamination which has been addressed, other sources of pollution in the catchment are not currently known. Identifying any other sources would enable planning to further improve water quality.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

Many of the ecological weed species could be controlled by restoration planting which will overgrow and shade weeds, while others, such as blackberry, will need to be actively managed.

16.6 References

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17. Te Awarua-o-Porirua Harbour

17.1 Overall site description

Te Awarua-o-Porirua Harbour is the largest estuarine ecosystem in the lower North Island. The large (807 ha), shallow harbour consists of two inlets (Onepoto (283 ha) and Pāuatahanui (524ha)) and is connected to the sea by a single narrow channel, opening into the wide mouth of the outer harbour at Plimmerton (Fig. 17.1). Pāuatahanui Inlet, a nationally significant estuarine area, is fed by a number of streams, while the Onepoto Arm is mostly fed by the Porirua Stream. The harbour has the largest proportionate subtidal area of any estuarine ecosystem in New Zealand (60%; in Stevens & Roberston 2008), but still characterised by extensive mudflats supporting significant (but depleted) areas of seagrass. Pāuatahanui Inlet is fringed by saltmarsh at it's northern and eastern extremities, and has saline to freshwater wetland sequences at its stream mouths. Little of the once extensive saltmarsh remains on the heaviliy modified edges of the Onepoto Arm. Almost the sole remnant occurs in the mouth of Te Onepoto Stream, which is part of the Whitireia Park. Te Awarua-o-Porirua Harbour is the only estuarine system in this report where any large beds of seagrass are found, and it is present in both inlets. It is also the only Category E estuarine system in the report.

Urban development and related reclamation, particularly the construction of transport infrastructure, has significantly modified and constrained large areas of the tidal margins in the harbour. However, there is still a high degree of hydrologic and ecosystem connectivity between the two inlets, meaning that factors impacting on the environment in one part of the harbour may also have an effect in the other.

To simplify the text we have arranged much of the information under separate headings for the two inlets, but with one overarching Conservation Management section.

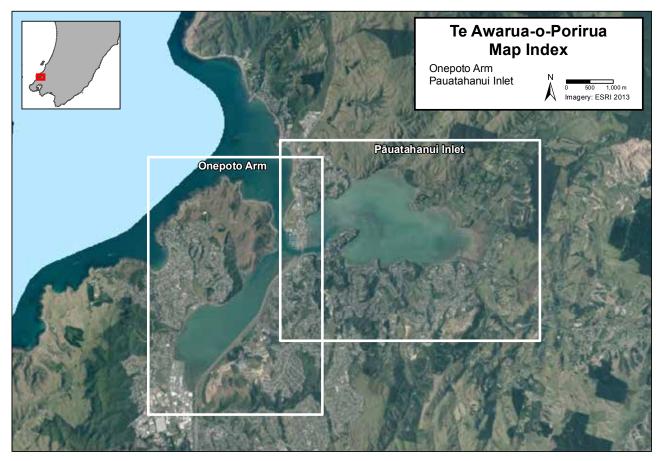


Figure 17.1. Location of Te Awarua-o-Porirua Harbour maps.

ONEPOTO ARM

17.2 Onepoto Arm site description

The southern inlet of Te Awarua-o-Porirua Harbour, the Onepoto Arm, has a deep central channel and several smaller feeder channels (Table 17A.1, Figs 17.1 & 17.2). It has extensive shallow areas in its southern and northern edges which are important bird roosting and feeding areas, but most of the fringing saltmarsh has been lost. SH1 and the main trunk railway line run across its eastern shore, and a large part of the estuarine area's southwestern side has been reclaimed and developed into the Porirua City commercial district. Urban development surrounds it almost entirely. Only the northwestern harbour margins remain largely unmodified.

Table 17A.1. Te Awarua-o-Porirua Harbour Onepoto Arm site information (see also Figs 17.1, 17.2 & 17.6).

| SITE NAME | TE AWARUA-O-PORIRUA HARBOUR – ONEPOTO ARM |
|--|---|
| Location | Porirua |
| NZTM (coordinates) | 1754979 5446286 |
| NZ Topo50 | BP31 550 463 |
| Area | 283 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Porirua City Council, GWRC |
| Land status (tenure) | Crown Land Private Ngāti Toa Domain (Porirua City Council) Papakōwhai Recreation Reserve (Porirua City Council) Bowler's Wharf Historic Reserve (Porirua City Council) Aotea Lagoon Recreation Reserve (Porirua City Council) Gear Homestead Recreation Reserve (Porirua City Council) Ökowai Lagoon (Porirua City Council) Porirua Stream North Recreation and Esplanade Reserves (Porirua City Council) Wi Neera Drive Foreshore Esplanade Reserve (Porirua City Council) Takapuwāhia Recreation Reserve (Porirua City Council) Onepoto Foreshore Esplanade Reserve (Porirua City Council) Onepoto Park Recreation Reserve (Porirua City Council) Gloaming Hill Recreation Reserve (Porirua City Council) Porirua Harbour Conservation Area (DOC) Aotea Conservation Area (DOC) Ökowai Lagoon Marginal Strip (DOC) Takapuwāhia Marginal Strip (DOC) Whitireia Park (GWRC) |
| Existing rankings | Ecol Sites 112, 369, 464, 465 WERI: 2, SSWI: Moderate |
| Ecological district | Wellington |
| Estuarine classification | Category E |
| Threatened species (number) | 9 (whole harbour) |
| At Risk species (number) | 20 (whole harbour) |
| Ecosystem value (score 1–5) | 4 (whole harbour) |
| Social value (score 1–5) | 4 (whole harbour) |
| Restoration potential (score 1–5) | 3 (whole harbour) |
| Pressures (score 1–5) NB: 1 = high pressures | 2 (whole harbour) |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Raupō reedland Browntop grassland Seagrass Mudflats Sandflats Subtidal |

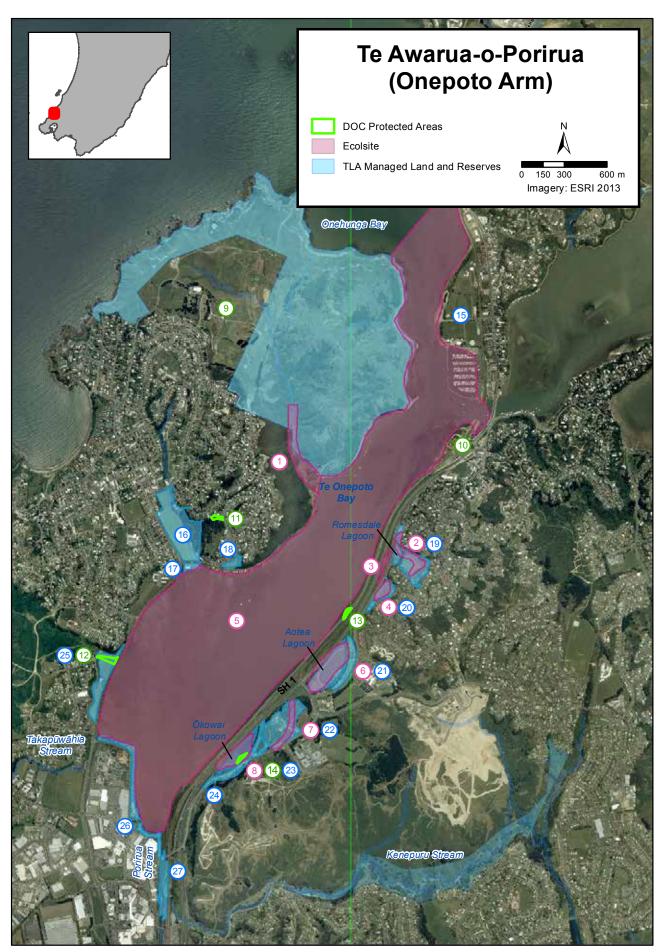


Figure 17.2. Te Awarua-o-Porirua Harbour Onepoto Arm estuarine site showing areas and places mentioned in the text. See key (following page) for location names.

Key to site numbers on Fig. 17.2.

| SITE No. | NAME | CATEGORY |
|----------|--|-----------|
| 1 | Ecolsite # 369 | Ecolsite |
| 2 | Ecolsite # 411 | Ecolsite |
| 3 | Ecolsite # 462 | Ecolsite |
| 4 | Ecolsite # 463 | Ecolsite |
| 5 | Ecolsite # 112 | Ecolsite |
| 6 | Ecolsite # 464 | Ecolsite |
| 7 | Ecolsite # 412 | Ecolsite |
| 8 | Ecolsite # 465 | Ecolsite |
| 9 | Whitireia Park Recreation Reserve | PCL (DOC) |
| 10 | Porirua Harbour Conservation Area | PCL (DOC) |
| 11 | Gloaming Hill Recreation Reserve | PCL (DOC) |
| 12 | Takapuwahia Marginal Strip | PCL (DOC) |
| 13 | Aotea Conservation Area | PCL (DOC) |
| 14 | Okowai Lagoon Marginal Strip | PCL (DOC) |
| 15 | Ngatitoa Domain | TLA |
| 16 | Onepoto Park Recreation Reserve | TLA |
| 17 | Onepoto Foreshore Esplanade Reserve | TLA |
| 18 | Gloaming Hill Recreation Reserve | TLA |
| 19 | Papakowhai Recreaion Reserve | TLA |
| 20 | Bowler's Wharf Historical Reserve | TLA |
| 21 | Aotea Lagoon Recreation Reserve | TLA |
| 22 | Gear Homestead Recreation Reserve | TLA |
| 23 | Okowai Lagoon | TLA |
| 24 | Okowai Lagoon Marginal Strip | TLA |
| 25 | Takapuwahia Recreation Reserve | TLA |
| 26 | Wineera Drive Foreshore Esplanade Reserve | TLA |
| 27 | Porirua Stream North Recreation and Esplanade Reserves | TLA |

The development of the causeway carrying the transport corridor has significantly altered the eastern tidal margin, leading to the creation of four small lagoons, three of which are connected to the main estuarine system by culverts. The largest of these, Aotea Lagoon, has been converted to a recreational facility and is completely enclosed in concrete; 'tidal' flushing is controlled artificially. Ōkowai Lagoon has been cut in two by a causeway; half of the lagoon is now completely isolated from the harbour and no longer has a saline influence. Romesdale Lagoon and an unnamed lagoon are the smallest in size.

Te Onepoto Bay, on the north-western shore, is the least modified enclosed bay in the entirety of Te Awarua-o-Porirua Harbour, and still retains an area of relatively unmodified saltmarsh vegetation around its margins. The bay is partially isolated from the harbour by a causeway across the mouth; saltwater only enters this area at high tide. A walking track circles the bay.

Porirua Stream, the largest waterway feeding into the Onepoto Arm, runs through the Porirua CBD, and is highly modified with a large part of the tidal reach bordered with concrete walls. Keneperu Stream, which enters Porirua Stream from the east adjacent to the Parumoana Street motorway ramp, is bridged in the tidal reach by the transport corridor, and has also been significantly constrained.

17.3 Onepoto Arm conservation values

17.3.1 Ecological

The intertidal areas of the Onepoto Arm make up 21.7% of the total area and provide important habitat for invertebrates and birds (Stevens & Robertson 2008). The intertidal area largely consists of firm sandflats (Milne & Watts 2008; Stevens & Robertson 2008, 2013a).

A significant area of the estuarine margin has been 'stabilised' with a rock rip-rap, or reclaimed, to allow CBD development and roading. These areas are invariably fringed with a variety of

exotic turf grasses well above the high tide mark. There are two main beds of seagrass in the Onepoto Arm, one in the south-west corner, the other near the mouth, adjacent to the Paremata railway station. Together they total 17.3 ha and are in good health (Stevens & Robertson 2013a. Historical information on the extent of seagrass beds is available from Richardson et al. (1979) and Healy (1980).

There is a small area of saltmarsh in Te Onepoto Bay (Fig. 17.3) which is at the mouth of a small stream. The shore is lined with a band of herbfields, dominated by remuremu, glasswort, saltgrass and shore primrose. This quickly grades into rushland, mainly oioi and sea rush, with a small amount of wīwī and giant umbrella sedge present. The rear of the saltmarsh (Fig. 17.4) is dominated by saltmarsh ribbonwood and small-leaved pōhuehue. Other significant species around the bay include flax, toetoe, taupata, tauhinu and cabbage tree. A small but dense patch of raupō occupies a niche in the shoreline. There is a belt of kuāwa where the stream enters the bay, backed by ruatahi and giant umbrella sedge. Clubrush grows in the stream at the head of Te Onepoto Bay.

Mahinoa Stream, which flows to the harbour through Takapuwāhia, is completely culverted in the tidal zone, and no estuarine habitat remains. There is still some access for migratory freshwater fish species (Blaschke 2011) although a recent electrofishing survey only found shortfin and longfin eels and inanga (D. Moss, DOC 2016, pers. comm.). Two other small streams flow through Takapuwāhia to Onepoto Arm Hukatai and Takapuwāhia.

There is a small area of saltmarsh just inside the mouth of the Porirua Stream, consisting of oioi, saltmarsh ribbonwood, three-square, and flax (Fig. 17.5). Otherwise, the banks of the stream have been hugely modified, with plantings of native shrubs on the steep western bank, and a turf of exotic grasses in the railway reserve on the eastern. The Keneperu Stream, a tributary of the lower Porirua Stream, is also modified but patches of toetoe, flax and raupō still remain.

The lagoons on the eastern side of the transport causeway still retain elements of saltmarsh, despite a diminished tidal influence. Romesdale Lagoon contains the most significant example of an intact saltmarsh ecosystem, consisting mainly of sea rush and oioi, with a few specimens of



Figure 17.3. Te Onepoto Bay contains some of the most intact saltmarsh vegetation in the Onepoto Arm, fringing the margins of the bay. The submerged causeway lies across the mouth of the bay. *Photo: Matt Todd*.



Figure 17.4. Oioi, raupō and saltmarsh ribbonwood on the mudflats of Te Onepoto Bay. Photo: Matt Todd.



Figure 17.5. Patches of three-square and harekeke are all that remain of the original vegetation along the margin of the Porirua Stream. *Photo: Matt Todd.*

giant umbrella sedge (Blaschke 2011). Anecdotal observation suggests significant numbers of eel species exist in the lagoons, and possibly marine fish (K. Calder, PCC 2015, pers. comm.). Inanga spawning sites were identified in the Kenepuru Stream and the Porirua Stream mainstem during surveying in 2016 (Taylor & Marshall 2016).

A large range of shore-birds, waders, and waterfowl, many being migratory, visit the sandflats of the Onepoto Arm to feed and roost. Southern black-backed gulls, red-billed gulls, pied stilts, little shags, black shags, white-faced herons, banded dotterels, Caspian terns and variable

oystercatchers are all frequent visitors. Royal spoonbills, white herons, Australasian shovelers, bar-tailed godwits and wrybills are more seasonal in their visitation. The estuarine area was included in the OSNZ (2007) river mouth bird survey.

Ten migratory native freshwater fish species have been found in the catchment, including six species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga, kōaro, redfin bully and lamprey; Allibone et al. 2010. Taylor & Kelly (2001) noted shoals of inanga in both the Porirua and Keneperu Streams, but deemed only the Keneperu to be suitable for spawning habitat. Large numbers of mullet are known to come into the Porirua Stream on incoming tides (K. Calder, PCC 2015 pers.comm.).

A range of coastal marine species are commonly found in the harbour; kahawai prey on smaller species such as yellow-eyed mullet and smelt. Flatfish, including flounders and stingrays, are well known. Less common visitors include stargazers and leatherjackets. Onepoto Arm is known to be a nursery area for juvenile elephant fish, rig, sand flounder, and kahawai (Jones & Hadfield 1985; Francis et al. 2012, Lyon et al. 2013). The harbour is the southern-most nursery area for rig in New Zealand (Francis et al. 2012). Sand flounder and kahawai form two important fisheries on the west coast of the North Island (Te Ika-a-Māui) (Ministry of Fisheries 2009).

Healy (1980) and Jones & Hadfield (1985) recorded a total of 43 species of marine and freshwater fish in Te Awarua-o-Porirua Harbour. This was considered a high figure compared to other similar estuarine systems, the Ahuriri (275 ha) and Avon-Heathcote (800 ha) with 28 and 29 recorded fish species, respectively. Orca and dolphins are also regular visitors to the harbour.

In the sandflats, polychaete worms dominate the marine invertebrate animals (Robertson & Stevens 2008), along with cockles, whelks, and amphipods. These areas are important bird feeding areas.

Wellington green gecko was once recorded in the area (Whitaker 1965), while raukawa gecko and spotted skink are both known in the area.

Table 17B lists native species present in, or utilising, the Te Awarua-o-Porirua Harbour estuarine system (Onepoto Arm and Pāuatahanui Inlet).

17.3.2 Recreational

The harbour is a popular recreational destination; surf-boarding, rowing, sailing and waka ama (outrigger canoe) are all activities mostly centred on the Porirua Rowing Club adjacent to Onepoto Park. There is a fully-used 300 berth marina for recreational fishing boats and yachts at Mana, near the mouth of the harbour. Whitireia Regional Park, on the Whitireia/Titahi Bay headland, is popular with walkers and mountainbikers and is known for its coastal fishing (see below). A small amount of seasonal Whitebaiting occurs on the tidal reach of the Porirua Stream. Seasonal catches are highly variable, with as much as 7lb (sic) being caught by an individual in a day. Before reclamation and other modification, it was not unusual to catch 15 lb per day (M. Jones, via K. Calder, PCC 2015 pers. comms.).

17.4 Onepoto Arm catchment properties

The majority of the Onepoto Arm catchment (around 6600 ha; Porirua City Council 2012) is drained by the Porirua Steam (including the Kenepuru Stream). Nearly 40% of this is pasture, 30% urban, and the remainder is in forest, bush and scrub (MacDonald & Joy 2009). The stream drains significant urban areas, and has recently been affected by new development: the Lincolnshire Farm, Churton Park, Stebbings Valley in the southern headwaters and parts of Takapu Stream. Erosion in Belmont Regional Park is a known source of sediment in the Kenepuru Stream (and other streams entering Pāuatahanui Inlet). There is a history of human contamination, which began as early as the late 19th century, when the original Porirua Mental Hospital discharged

Table 17B. Native species present in, or utilising, the Te Awarua-o-Porirua Harbour estuarine system (Onepoto Arm and Pāuatahanui Inlet).

| GROUP | SPECIES |
|---------------------------|--|
| Threatened/At Risk plants | Native musk* (Pāuatahanui) |
| | Seagrass* |
| Birds | Australasian shoveler |
| | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Caspian tern+ |
| | Gannet |
| | Grey duck/mallard hybrid (Pāuatahanui) |
| | Grey teal |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | New Zealand dotterel+ (Pāuatahanui) |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Royal spoonbill* |
| | South Island pied oystercatcher (Pāuatahanui)* |
| | Southern black-backed gull |
| | Spotless crake* (Pāuatahanui) |
| | Spotted shag |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White heron+ |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Banded parrotfish |
| | Barracouta |
| | Black flounder (Pāuatahanui) |
| | Blue mackerel |
| | Blue moki |
| | Blue warehou |
| | Common bully |
| | Common smelt |
| | Conger eel |
| | Dwarf common sole (speckled sole) |
| | Eagle ray |
| | Elephant fish |
| | Estuarine stargazer |
| | |

| GROUP | SPECIES |
|----------------------------|----------------------------------|
| Fish continued | Garfish |
| risti continuea | |
| | Giant bully (Pāuatahanui) |
| | Giant kōkopu* |
| | Graham's gudgeon |
| | Grey mullet |
| | Gurnard |
| | Inanga* |
| | Jack mackerel |
| | Kahawai |
| | Kōaro* |
| | Lamprey+ |
| | Leatherjacket (Pāuatahanui) |
| | Longfin eel* |
| | Long-snout pipefish |
| | New Zealand sole |
| | Pilchard |
| | Pipefish |
| | Red cod |
| | Redfin bully* |
| | Rig |
| | Robust blenny |
| | Rock cod |
| | Sand flounder |
| | Seahorse |
| | Shortfin eel |
| | Shortjaw kōkopu+ (Pāuatahanui) |
| | Snapper |
| | Spotted stargazer |
| | Spotty |
| | Tarakihi |
| | Torrentfish* |
| | Trevally |
| | Variable triplefin |
| | Warehou |
| | Yellow-eyed mullet |
| A | Yellowbelly flounder |
| Aquatic macroinvertebrates | Bubble shell Cockle |
| | |
| | Estuarine limpet |
| | Large wedge shell Mudflat snail |
| | Mudflat topshell |
| | Mudflat whelk |
| | Nut shell |
| | Pillbox crab |
| | Pipi |
| | Razorshell |
| | Spire shell |
| | Spionid Boccardiella magniovata+ |
| | (Pāuatahanui) |
| | Stalk-eyed mud crab |

Continued on next page

Table 17B continued

| GROUP | SPECIES |
|----------------------------|---------------------|
| Aquatic macroinvertebrates | Top shell |
| continued | Trophon |
| | Tunnelling mud crab |
| Herpetofauna | Copper skink |

| GROUP | SPECIES |
|------------------------|-------------------------|
| Herpetofauna continued | Northern grass skink |
| | Raukawa gecko |
| | Spotted skink* |
| | Wellington green gecko* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

untreated waste directly into the Porirua Stream. The streams are currently polluted by agricultural runoff, urban and rural earthworks, heavy metal contamination from unpainted roofing and road runoff, and sewage and stormwater. The Porirua Recycling Centre and the Wellington Northern Landfill site are both situated on Mitchell Stream, a tributary stream with potential to leach into the waterway, although leachates are currently successfully collected before reaching the stream. Water quality in the Porirua Stream is monitored at Wall Park (GWRC site RS16) and is usually rated as 'poor' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010; Perrie et al. 2012; Morar & Perrie 2013; Keenan & Morar 2015). Streambed sediment sampling was carried out by GWRC in the Porirua and Kenepuru Streams in 2005 and 2006. Sediment was found to contain levels of zinc, polycyclic aromatic hydrocarbons and DDT above both ANZECC low trigger values (concentrations at which biological effects may occur) and high trigger values (concentrations at which significant biological effects are likely to occur) (Milne & Watts 2008).

Two ecologically important scenic reserves are in the catchment: Rangituhi/Colonial Knob (PCC) and Porirua (Porirua City Council). Porirua Scenic Reserve is also part of the Porirua Western Forest Key Native Ecosystem (KNE). The GWRC KNE programme manages a representative sample of high biodiversity ecosystems in the region, throught the development and implementation of KNE plans. Other KNE sites in the catchment of the Onepoto Arm of the harbour include Karehana Bay Bush, Taupo Valley Wetlands and Whitireia Coast.

The headwaters of the Kenepuru Stream lie in the Belmont Regional Park (GWRC).

17.5 Onepoto Arm threats

The estuarine margins have been extensively modified by reclamation and infrastructure, causing loss of nearly the entire native edge habitat (Stevens & Robertson 2014) and allowing ecological weeds to colonise and dominate much of the landscape. This causes 'coastal squeeze', where the ability of the estuarine environment to respond to changes in sea level rise, sediment levels and water quality is compromised.

A range of mammalian and avian predators and browsers will be present but their impacts have not been assessed at the estuarine site. In urban areas, these are likely to include domestic cats.

Ecological weed species that grow commonly in the Onepoto Arm include gorse, crack willow, blackberry, and tall fescue. Boneseed and barberry are also present. These species all have the potential to compete with native saltmarsh species. Japanese honeysuckle is present on the tidal margins of the Keneperu Stream; if uncontrolled, this species will form large smothering masses that can inundate low growing vegetation. In terms of the aquatic environment, brown trout are present.

Excessive sedimentation, riverine and estuarine contamination and ecological degradation are all issues of concern. Changes in land use in the catchment have caused significant increases in rates of sediment deposition (Robertson & Stevens 2015), along with an increased percentage of fine-grained terrestrial 'muddy' content, particularly in the central depositional basin of the Onepoto Arm. Nutrient enrichment from sewer and stormwater pollution has

led to excessive growth of nuisance algae, including sea lettuce (Ulva sp.) and Gracilaria sp. Enrichment increases the chance of algal blooms occurring, and contributes directly to anoxia and eutrophication in the estuarine and, to a lesser extent, coastal ecosystem. The intertidal sediments at the southeastern end of the Onepoto Arm are also polluted with contaminants such as zinc, copper, lead, polycyclic aromatic hydrocarbons (PAH) and DDT. These are discharged to the harbour via stormwater and their concentrations are above sediment quality quidelines (Sorensen & Milne 2009). Concentrations of copper, lead, zinc, and to a lesser extent, mercury, are also elevated in the subtidal sediments of the Onepoto Arm (Milne & Sorenson 2009; Oliver & Conwell 2014). These contaminants enter the food chain and could eventually impact on the health and breeding success of waders who rely on marine macroinvertebrates in their diet. As a consequence of pollution, fishing or gathering shellfish in southern parts of the Onepoto Arm is no longer advised, and there are reports that prolonged exposure of unprotected skin to the water has caused rashes and infections (Taku Parai 2009, cited in Calman 2009). Bacterial contamination also occurs. GWRC recorded unacceptable levels of enterococci and faecal coliforms at their nearby recreational water quality monitoring site (Porirua Rowing Club) during the 2010/11 summer bathing season (Morar & Warr 2011), as well as in the 2014/15 summer season indicated (Keenan et al. 2015).

Historically, the tidal delta of Porirua Stream has accumulated litter and larger refuse (e.g. whiteware, road cones, shopping carts, tyres). PCC and programme coordination with community, school and businesss groups since 2009 means that these sand flats are significantly cleaner. There are also numbers of artificial structures on the margins of the estuarine area (e.g. seawalls, rip-rap, jetties).

Tidal influence on the lagoons on the eastern margins is maintained in a reduced form by culverts underneath the transport corridor causeway. This has resulted in the gradual diminishment of quality and ecological function in the lagoons, which could ultimately lead to the futher degradation of the tidal habitat, but it will continue to provide some level of habitat for fish and birdlife.

There has been a lot of urban development in the area since 2005 that increased the rates of pollution, erosion, and habitat loss but management actions aim to address this in the future. The Transmission Gully Highway will cross the headwaters of the Kenepuru Stream, and it is uncertain what real effects this will have on the estuarine ecosystem. The New Zealand Transport Agency has provided assurances that environmental impacts associated with major construction work will be alleviated as far as possible through best practice and impact avoidance techniques (New Zealand Transport Agency 2012). The local environmental group, Guardians of Pāuatahanui Inlet (GOPI), supports the construction of the Transmission Gully motorway (TGM) on the basis that removing the SH1 traffic from the immediate vicinity of the harbour and implementing best practice sediment and pollution control will be an improvement on the current state and therefore provide medium and long term benefits to the harbour.

Fifty percent of WCC's greenfield development will occur in the upper Porirua Stream catchment over the next twenty years – a fact recognised in, and being addressed through, the Harbour Strategy.

PĀUATAHANUI INLET

17.6 Pāuatahanui Inlet site description

Pāuatahanui Inlet is nationally significant and has long been considered the healthier of the two arms of Te Awarua-o-Porirua Harbour. This broad, shallow arm of the Harbour is the largest (524 ha) estuarine environment in the lower North Island and makes up 63% of the total estuarine area of Te Awarua-o-Porirua Harbour (Table 17A.2, Figs 17.2 & 17.6). The southern shores are fringed by SH58 but large areas of saltmarsh fringe the northern and eastern parts. Several streams enter the Pāuatahanui Inlet, and most streams have associated wetlands. The intertidal sand and mudflats, which make up 33% of the area below the high tide mark (Stevens & Robertson 2008), provide important habitat for cockles, other marine animals and birds. Roads almost completely encircle the inlet, such that every stream is bridged or culverted under a road. Urban development in the suburbs of Camborne, Mana, Paremata and Whitby enclose the western and southern parts, while the settlement of Pāuatahanui is at the eastern end of theInlet.

17.7 Pāuatahanui Inlet conservation values

17.7.1 Ecological

The intertidal area in the estuarine ecosystem largely consists of firm mudflats (Milne & Watts 2008; Stevens & Robertson 20013a). There are two large banks of seagrass in the estuarine area, both in the western part of the inlet, near the base of Moorehouse Point (Fig. 17.7) (Stevens & Robertson 20013a). With a few smaller patches along the southern shore, the seagrass beds in the inlet cover over 41 ha. Saltmarsh vegetation is similarly represented, with approximately 42 ha cover, or nearly 10% of the inlet.

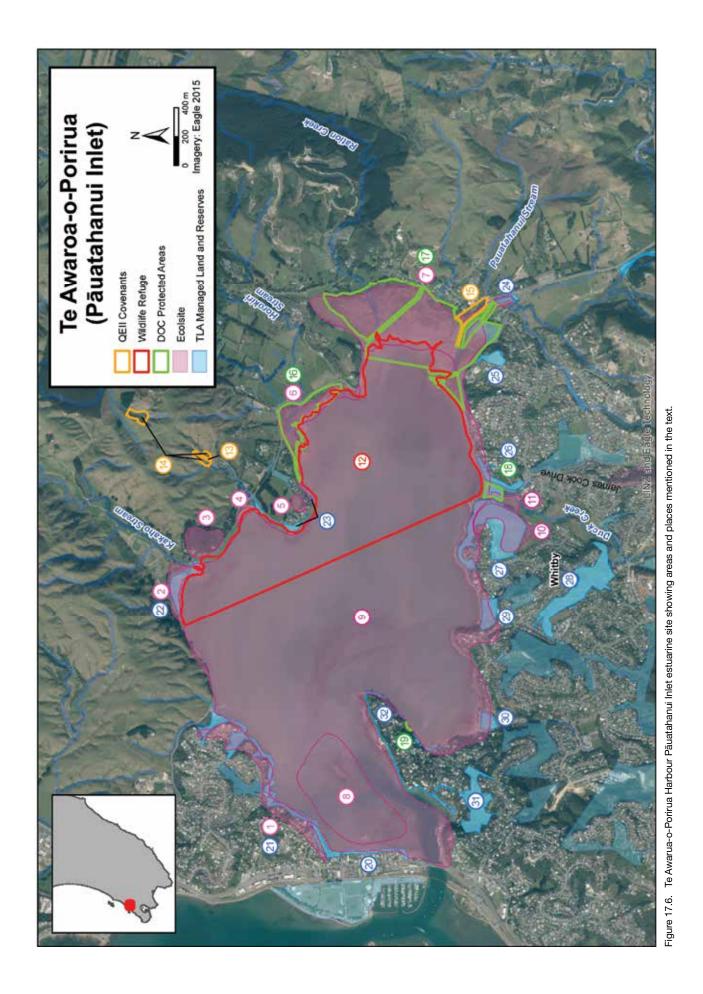


Figure. 17.7. Seagrass beds on the mudflats of Pāuatahanui Inlet. White-faced herons (and other birds) utilise the flats for feeding. Photo: Wriggle Coastal Management, © Greater Wellington Regional Council.

Table 17A.2. Te Awarua-o-Porirua Harbour Pāuatahanui Inlet site information (see also Figs 17.1 & 17.6).

| SITE NAME | TE AWARUA-O-PORIRUA HARBOUR – PĀUATAHANUI INLET |
|--|---|
| Location | Porirua |
| NZTM (coordinates) | 1754980 5449785 |
| NZ Topo50 | BP32 590 488 |
| Area | 524 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Porirua City Council, GWRC |
| Land status (tenure) | Private Mana Eastern Foreshore Recreation Reserve (Porirua City Council) Camborne Walkway Reserves (Porirua City Council) Kākaho Estuary Esplanade Reserve (Porirua City Council) Motukaraka Point Recreation Reserve (Porirua City Council) Yelverstons Recreation Reserve (Porirua City Council) Pāuatahanui Stream Esplanade Reserve North (Porirua City Council) Molyneux Close Recreation Reserve (Porirua City Council) Crows Nest Lookout Recreation Reserve (Porirua City Council) Bradley's Bay Park (Porirua City Council) Brown's Bay Park (Porirua City Council) Golden Gate Penninsula Esplanade Reserves (Porirua City Council) Ivey Bay Recreation Reserve (Porirua City Council) Pāuatahanui Inlet Wildlife Refuge (DOC) Horokiri Wildlife Reserve (DOC) Duck Creek Scenic Reserve (DOC) Moorehouse Conservation Area (DOC) |
| Existing rankings | Ecol Sites 31, 108, 391, 413, 422, 430, 445, 446, 447, 461, 466 WERI: 31, SSWI: Potential (Ecol Site 31) WERI: 4, SSWI: Moderate-High (Ecol Site 108) Area of Significant Conservation Value (GWRC) QEII Covenant (5/07/035) DOC Ecosystem Management Unit (proposed) rank 688 – Pāuatahanui Wildlife Reserve Key Native Ecosystem (GWRC) – Te Onepoto Bay as part of the Whitireia Coast KNE |
| Ecological district | Wellington |
| Estuarine classification | Category E |
| Threatened species (number) | 20 (whole harbour) |
| At Risk species (number) | 20 (whole harbour) |
| Ecosystem value (score 1–5) | 4 (whole harbour) |
| Social value (score 1–5) | 4 (whole harbour) |
| Restoration potential (score 1–5) | 3 (whole harbour) |
| Pressures (score 1–5) NB: 1 = high pressures | 2 (whole harbour) |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Flaxland Remuremu herbfield Raupō reedland Browntop grassland Seagrass Sandflats Mudflats Subtidal |

The saltmarsh areas around the eastern and northern shores are still relatively intact. The most significant of these occupies the eastern end of the inlet, between the mouths of the Pāuatahanui Stream and Ration Creek (Figs 17.8 & 17.9). The major component of the saltmarsh is rushland, dominated by sea rush and oioi. Other significant rush and sedge species include wīwī, cutty grass, pūkio, and giant umbrella sedge. Raupō is present in patches. Herbfields of remuremu, glasswort, saltgrass and shore primrose are common, particularly in the mid-tidal areas.



Estuarine systems in the lower North Island

Key to site numbers on Fig. 17.6.

| SITE NO. | NAME | CATEGORY |
|----------|--|-----------|
| 1 | Ecolsite # 413 | Ecolsite |
| 2 | Ecolsite # 446 | Ecolsite |
| 3 | Ecolsite # 391 | Ecolsite |
| 4 | Ecolsite # 447 | Ecolsite |
| 5 | Ecolsite # 430 | Ecolsite |
| 6 | Ecolsite # 31 | Ecolsite |
| 7 | Ecolsite # 445 | Ecolsite |
| 8 | Ecolsite # 466 | Ecolsite |
| 9 | Ecolsite # 108 | Ecolsite |
| 10 | Ecolsite # 422 | Ecolsite |
| 11 | Ecolsite # 461 | Ecolsite |
| 12 | Pāuatahanui Inlet Wildlife Refuge | Wildlife |
| 13 | 5/07/618 | QEII |
| 14 | 5/07/587 | QEII |
| 15 | 5/07/035 | QEII |
| 16 | Horokiwi Wildlife Reserve | PCL (DOC) |
| 17 | Pāuatahanui Wildlife Reserve | PCL (DOC) |
| 18 | Duck Creek Scenic Reserve | PCL (DOC) |
| 19 | Moorehouse Conservation Area | PCL (DOC) |
| 20 | Mana Eastern Foreshore Recreation Reserve | TLA |
| 21 | Camborne Walkway Reserves | TLA |
| 22 | Kakaho Estuary Esplanade Reserve | TLA |
| 23 | Motukaraka Point Recreation Reserve | TLA |
| 24 | Pāuatahanui Stream Esplanade Reserve North | TLA |
| 25 | Yelverstons Recreation Reserve | TLA |
| 26 | Molyneux Close Recreation Reserve | TLA |
| 27 | Crows Nest Lookout Recreation Reserve | TLA |
| 28 | Bradley's Bay Park | TLA |
| 29 | Brown's Bay Park | TLA |
| 30 | Ivey Bay Recreation Reserve | TLA |
| 31 | Golden Gate Peninsula Foreshore and Esplanade Reserves | TLA |
| 32 | Whitby Walkway Scenic Reserve | TLA |

Bachelor's button and New Zealand spinach are also found in these areas. Saltmarsh ribbonwood, toetoe, and flax grow over the rushes in the upper tidal areas. Along the high tide margin, shrubs such as tauhinu, taupata, and karo are common.

In the south, Duck Creek has a well-developed wetland, but this is isolated from the main inlet by the causeway of SH58 across the mouth of the stream but connected via a large culvert under the bridge (Fig. 17.10). Oioi is the dominant species in the rushland that takes up most of the basin, although sea rush has a significant presence further upstream and around the rear of the saltmarsh (Fig. 17.11). Along the true left of the stream, saltmarsh ribbonwood forms a thick band of shrubland, which blends into a more diverse area that also includes toetoe, flax, and tauhinu. Herb species grow amongst the rushes along the stream margins; these include remuremu, glasswort, shore primrose, and bachelor's button. In all, Wassilieff et al. (1986) listed 31 native species in the Duck Creek saltmarsh, none of which are threatened.

The lower reaches of Pāuatahanui Stream have been planted with a range of native trees and shrubs overhanging the water in the riparian zone. The other three streams (Fig. 17.6) that flow into the north/east saltmarsh (Ration Creek, Horokiri and Kākaho Streams) are undergoing restoration. The upper reaches of the Duck Creek tidal area is now the site of an extensive residential development.

Two plant species uncommon in the region have been recorded in the saltmarsh at the mouth of Pāuatahanui Stream. These are native musk and bog-rush (Ogle 1982).



Figure 17.8. Pāuatahanui Wildlife Reserve saltmarsh area with Ration Creek in the north and Pāuatahanui Stream in the south.



Figure 17.9. Intact saltmarsh at the Pāuatahanui Stream mouth. Note the range of habitat types in a small area, including open water, mudflats, oioi rushland, and saltmarsh ribbonwood shrubland, maximising the habitat options for birdlife. *Photo: Matt Todd.*



Figure 17.10. Oioi rushland in the lower tidal reach of Duck Creek. Note the road causeway across the mouth of the waterway. *Photo: Matt Todd.*



Figure 17.11. Shrubland on the tidal margins of Duck Creek. Photo: Matt Todd.

Pāuatahanui Inlet is a nationally important site for migratory shorebirds and wading species attracted by the large, marine invertebrate-rich tidal flats. Bar-tailed godwits and other migratory waders gather during the summer months, and wrybills during the non-breeding season. Royal spoonbills seem to have become permanent residents in the last few years. Several pied shag (Fig. 17.12) nesting areas are present in locations around the inlet. Other species, such as gannets and Caspian terns, are regular visitors to feed or roost. Many species of common waders and waterfowl, such as paradise shelducks, pied stilts, and black swans, are resident in the estuarine



Figure 17.12. Birdlife is abundant in the ecosystem. Here, a pied shag roosts in harekeke flaxland. Photo: Matt Todd.

system, while less common species, such as Australasian shovelers and grey teal, also occur. The estuarine area was included in the OSNZ (2007) river mouth bird survey.

The Duck Creek saltmarsh is a haven for waders and waterfowl, many of which have been known to nest in the sheltered wetland. Shorebirds are less frequent visitors, despite the proximity of the Pāuatahanui mudflats. During the survey, white-faced herons, kingfishers, paradise shelducks and black shags were observed.

Thirteen migratory native freshwater fish have been found in the streams flowing into the estuarine system, including species listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, torrentfish and lamprey; Allibone et al. 2010). A range of coastal marine species are commonly found in the inlet; kahawai prey on smaller species such as yellow-eyed mullet and smelt. Flatfish, including flounders and stingrays, are well known. Less-common visitors include stargazers and leatherjackets. Pāuatahanui Inlet is known to be a nursery area for juvenile elephant fish (*Callorhynchus milii*), rig (*Mustelus lenti-culatus*), sand flounder (*Rhombosolea plebeia*), and kahawai (*Arripis trutta*) (Jones & Hadfield 1985). Flounder and kahawai form two important fisheries on the west coast of the North Island (Te Ika-a-Māui) (Ministry of Fisheries 2009).

Historically, the tidal reaches of Pāuatahanui Stream had deep pools where yellow-eyed mullet spawned (J. Mikoz, Wellington Recreational Marine Fishers Association 2010, pers. comm.). These pools were filled during the construction of the Pāuatahanui roundabout on SH58. Inanga spawning sites were identified in the Kākaho, Horokiri, and Pāuatahanui Streams during surveys in 2016 (Taylor & Marshall 2016). Some suitable spawning habitat was also identified in Duck Creek, although egg searches were not carried out at this site.

Forty-three species of marine and freshwater fish have been recorded in Te Awarua-o-Porirua Harbour (Jones & Hadfield 1985). This was considered a high figure compared to other similar estuarine systems, such as the Ahuriri (275 ha) and Avon-Heathcote (800 ha) with 28 and 29 recorded fish species, respectively. Pāuatahanui Inlet is known to be a nursery area for juvenile elephant fish, rig (the southern-most nursery), sand flounder and kahawai (Jones & Hadfield 1985; Hendry 2004; Francis et al. 2012).

The estuarine ecosystem has rich marine invertebrate animals. Polychaete species dominate in terms of number of species and abundance (Robertson & Stevens 2015), but the New Zealand cockle leads in terms of biomass. In 1976, the large cocklebank in the centre of the Pāuatahanui Inlet contained a population of over 500 million cockles, estimated at the time to contain 80% of the biomass of the intertidal zone. In the 20 years following, the population declined to a figure of 277 million (Guardians of Pāuatahanui Inlet 2007) but the most recent survey records an increase of 21%, to 336 million, since 2010 (Michael & Wells 2014). The next survey in late 2016 will add further weight to whether this is a positive trend. The decline is attributed to urbanisation and associated sediment run-off. The rest of the animals include mud snails, whelks, mud crabs, and at least 59 other species, several of which are currently undescribed (Robertson & Stevens 2008, 2015). The abundance and diversity of the subtidal invertebrate animals is the primary reason that wading birds are attracted to the harbour, and this food source is critical for most species.

The inner Pāuatahanui Inlet is one of only five locations in New Zealand where the nationally critical threatened species of polychaete worm, *Boccardiella magniovara*, has been found (Hitchmough et al. 2007, National Aquatic Biodiversity Information System 2010).

Three species of lizards have been recorded around the fringes of the estuarine area; northern grass skink, raukawa gecko, and copper skink (Brown 1985, 1987), while Wellington green gecko (Miskelly 1998) has also been found locally.

17.7.2 Recreational

With a substantial urban population immediately adjacent, particularly around the southern, western and eastern shores, Pāuatahanui Inlet is a playground of Porirua City and the wider region. Canoes, surfboards, and sail boats are all common sights on the water, with a marina at Paremata Point and boatsheds just inside the mouth of the Inlet. Jet skiers also use the waterski lanes at the western ends. There are several walking tracks around the shore, and birdwatcher hides in the saltmarshes. An estuarine-edge walkway/boardwalk joining Pāuatahanui and Camborne is at the halfway stage (Fig. 17.13). The final sections from Motukaraka Point to Camborne is likely to be completed in the next 5–10 years. A wind surfing school and paddleboarding are new activities using the Inlet. Fishing and cockle collecting are also popular activities. Some whitebaiting occurs in the streams around the Inlet.



Figure 17.13. The section of Te Ara Piko, between Motukarara Point and Pāuatahanui village, was completed in 2014. Photo: Helen Kettles

17.8 Pāuatahanui Inlet catchment properties

The catchment is drained by several streams and covers an area of 10 600 ha (approx.). In 2009 more than 85% of this was pasture, forestry and scrub, with the urban areas of Whitby, Silverwood and Cambourne making up less than 10% of the catchment (MacDonald & Joy 2009; Blaschke, Woods & Forsyth 2010). Urban areas have now expanded to 15% but there has also been a revival in regeneration (both from planting and natural regeneration) of native bush (now approximately 19%) and grassland has reduced to 59%. Exotic plantation forestry now also makes up 13% of the catchment (Ammundsen 2015). The underlying substrate is largely sedimentary rock (MacDonald & Joy 2009).

GWRC monitors water quality in the Pāuatahanui Stream at Elmwood Bridge (GWRC site RS14) which consistently rates as 'fair' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015). Streambed sediment sampling was carried out by GWRC in the Pāuatahanui Stream in 2005 and 2006. Sediment was found to contain levels of DDT that exceeded both ANZECC low trigger values (concentrations at which biological effects may occur) and high trigger values (concentrations at which significant biological effects are likely to occur) (Milne & Watts 2008).

Two regional parks (both managed by GWRC) are in the catchment: Belmont, at the headwaters of Pāuatahanui Stream and Duck Creek, and Battle Hill in the Horokiri Valley. Battle Hill Bush, located in the park, is the only GWRC Key Native Ecosystem site in the Pāuatahanui Inlet catchment.

PCC has recently worked with residents in the Pāuatahanui–Judgeford area on a structure plan and consequent plan change, to allow Rural-Residential intensification in return for protection of remnant native vegetation and riparian retirement and planting.

17.9 Pāuatahanui Inlet threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. With a large urban population nearby, domestic cats are also likely to be in the area. These will all pose a threat to wildlife. Stock have access to the margins of several of the streams near the upper limit of the tidal zone, although the saltmarshes are largely isolated by roads.

Weeds in the saltmarshes and around the disturbed margins are mainly pasture species, such as tall fescue and gorse. Around the whole inlet, gorse, boneseed, tree lupin and a variety of other common ecological weed species may be found. Grey willow is known to be present in the Pāuatahanui Stream catchment (Townsend 1997). *Ulva* sp. is a significant nuisance algae in the intertidal zone, while Asian kelp has established in the subtidal zone; this is a highly aggressive, prolific seaweed that can significantly change an ecosystem. It is not tolerant of freshwater so its potential spread would be confined to areas in the mouth of the harbour.

On the western side of Moorehouse Point the intertidal area is used as a road (consented for a limited number of trips per year) by residents to service their houses which have limited road access. There is potential for this traffic to impact cockle beds and habitat such as seagrass along this part of the foreshore.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci and faecal coliforms at their nearby recreational water quality monitoring site (Pāuatahanui Inlet at Motukaraka Point) during the 2010/11 summer bathing season (Morar & Warr 2011). There are many artificial structures on the margins of the estuarine area (e.g. seawalls). The expanding Porirua population has driven development of new subdivisions in the southern catchments. Removal of vegetation and earthworks for the construction of roads and housing has greatly increased the rate of erosion along the southern shore. Sediment derived

from the rural catchment is also of concern. Sedimentation rates in the Inlet, were excessive (9 mm/year) in the 35-year period between 1974 and 2009 (the major development phase for Whitby). A more recent survey indicates that this rate dropped to less than 2 mm/year in the 5-year period between 2009 and 2014 which experienced few, if any, major storm events (Cox 2015). There has been an increased 'muddiness' in the sediment content, caused by the deposition of fine-grained particles (Robertson & Stevens 2015). This leads to an acceleration of eutrophication in the ecosystem as oxygenation of the sediments is reduced. As in the Onepoto Arm, Gibb & Cox (2009) recommended that immediate action was needed to reduce the net average rates of deposition from 5–9 mm/year to 1.0–2.0 mm/year. They emphasise the importance of re-vegetation and silt traps in the catchments of the streams feeding into the harbour. Te Awarua-o-Porirua Sediment Reduction Plan (GWRC 2015) addresses these issues more specifically.

Modification of the catchment has long-term effects such as the drainage or infilling of wetland areas, and the channelising of streams. Pollution from road runoff, sewer overflow and stormwater may also increase if future development is not carefully undertaken. Sediments in the intertidal areas along the southern shore have elevated concentrations of a range of contaminants. Concentrations of some of these, such as DDT, lead and PAHs exceed sediment quality guidelines (Sorensen & Milne 2009) and are influencing the health of marine macroinvertebrates and wildlife (Hooper 2002; Oliver & Conwell 2014).

The Transmission Gully motorway (TGM) will traverse most of the headwaters of the Pāuatahanui Inlet (except Kākaho & Brown), and follow the upper three-quarters of the Horokiri Stream. The New Zealand Transport Agency has provided assurances that environmental impacts associated with major construction work will be alleviated as far as possible through best practice and impact avoidance techniques (New Zealand Transport Agency 2012). The local environmental group, GOPI, supports the construction of TGM on the basis that removing the SH1 and SH58 traffic from the immediate vicinity of the harbour and implementing best practice sediment and pollution control will be an improvement on the current state and therefore provide medium and long-term benefits to the harbour.

Porirua City's rural area is experiencing pressure for change. However, the eastern urban boundary has been established by Silverwood, while recent changes to allow rural-residential intensification in the Pāuatahanui-Judgeford area will be offset by native vegetation protection and riparian retirement. The recent sewer reticulation of the Pāuatahanui village will improve water quality at the head of the Inlet as well the wildlife reserve. Pressure to create a transport hub at the planned Pāuatahanui interchange is likely once Transmission Gully Highway is completed. But this is not imminent and the joint Councils and Ngāti Toa Rangatira are committed to ongoing improvement in the health of Te Awarua-o-Porirua Harbour, including Pāuatahanui Inlet.

17.10 Conservation management - whole of harbour

17.10.1 Current

Because so many agencies are involved in management of the harbour, and because Pāuatahanui Inlet is ranked nationally significant, it is important that effort is coordinated to ensure the protection, and improvement, of the health of the Harbour. Porirua City Council is leading an interagency approach to do this. In December 2008 Porirua City Council also set up a Porirua Harbour Inter-agency Advisory Group and a Science Group, which should prove very valuable as forums for improving the status of the estuarine ecosystem.

In response to public interest, in December 2008, the Porirua City Council initiated an interagency and public consultation process to develop a strategy to improve the condition of the harbour and in April 2012 the Porirua Harbour and Catchment Strategy and Action

Plan was released (Porirua City Council 2012). This document was the result of a partnership between Porirua City Council, Te Rūnanga o Toa Rangatira, Wellington City Council and Greater Wellington Regional Council. The Strategy provides a framework for multi-agency coordination and cooperation and details actions (current, immediate and longer-term) to improve the health of the harbour and tributary streams. An Action Plan is discussed within the document to address three key issues facing the Harbour: reduce sedimentation rates, reduce pollutant inputs, and undertake ecological restoration of the harbour and catchment. Key aspects of the Strategy are integrated management of the harbour and its catchments; priority given to restoration, conservation, and enhancement of the waterways; environmental sustainability and an adaptive management approach; fostering effective community involvement and stewardship, as well as recognising the special relationship of mana whenua Ngāti Toa Rangātira with the harbour. Ngāti Toa has a significant interest in the management of the harbour. Their issues particularly revolve around improving water quality and restoration of the health of shellfish beds and fisheries.In December 2012 a Deed of Settlement was signed between Ngāti Toa Rangitira and the Crown. This deed recognises the role of Ngāti Toa as kaitiaki of the coastal marine area of Te Awaruao-Porirua Harbour (and gives official recognition of place name). The Deed also gives Statutory Acknowledgement to Te Onepoto Bay, and various reserves including Pāuatahanui Wildlife and Horokiri Wildlife Management Reserves. The Deed therefore recognises the association of the iwi with the area and enhances their ability to participate in specified Resource Management processes. A Deed of Recognition also obliges the Crown to consult with the iwi on specified matters and have regard to their views because of this special association with these places.

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A revised version of the Porirua Harbour and Catchment Strategy and Action Plan was released in 2015 (Porirua City Council 2015).

DOC has responsibility for the saltmarshes at the mouths of the Horokiri Stream (Horokiri Wildlife Reserve; Fig. 17.14), as well as Ration Creek and Pāuatahanui Stream (both within the Pāuatahanui Wildlife Reserve). In addition, the whole eastern third of the inlet is within the Pāuatahanui Inlet Wildlife Refuge, also administered by DOC (but managed by Forest & Bird on DOCs behalf). GWRC & PCC administer the wetland at the mouth of Kākaho Stream as an esplanade reserve, along with several other shore side recreation and esplanade reserves around the inlet. GWRC is responsible for the remainder of the bed of the harbour. The Ministry of Primary Industries regulates recreational fishing and shellfish gathering, including the cockle beds. Several other government agencies are responsible for the management of various infrastructural assets that are associated with the harbour. GWRC is responsible for controlling pests and ecological weeds and managing the tidal area of the Harbour, along with flood risk management issues that affect the riparian and estuarine areas of the Kākaho, Horokiri, Pāuatahanui, Porirua and Kenepuru Streams.

GWRC is leading an ongoing research programme for Te Awarua-o-Porirua Harbour. GWRC has undertaken habitat mapping of the estuarine site and margins (Stevens & Robertson 2008, 2013a), intertidal macroalgal monitoring (Stevens & Robertson 2009, 2010, 2012a, 2015a), fine-scale intertidal sediment and sediment biota monitoring (Sorensen & Milne 2009, Robertson & Stevens 2008, 2009, 2010, 2015, Stevens & Robertson 2011, 2012b, 2013b), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). GWRC also monitors sediment quality and benthic ecology in subtidal locations (Milne & Sorenson 2009; Stephenson 2009,



Figure 17.14. Saltmarsh ribbonwood shrubland transitions to remuremu herbfield (obscured, centre rear) at the mouth of the Horokiri Stream. *Photo: Matt Todd.*

Oliver & Conwell 2014) and has undertaken mapping of subtidal habitat (Stevens & Robertson 2014a). Sediment plates to measure sedimentation rates have been deployed in several locations (Stevens & Robertson 2014b, 2015b). PCC has led two international-standard bathymetric surveys (2009 & 2014) and associated comparisons of sedimentation pattern and rates (this work will be led by GWRC in future).

Boffa Miskell Limited has undertaken two years of baseline studies of Te Awarua-o-Porirua Harbour and tributaries for the Wellington Gateway Partnership prior to TGM commencing. Boffa Miskell Limited are responsible for monitoring TGM performance in conjunction with GWRC.

A long-term bird monitoring programme for the whole of the Pāuatahanui Inlet is conducted by the OSNZ. The Guardians of Pāuatahanui Inlet (GOPI) are a community group who carry out environmental operations throughout the inlet, including shoreline plantings, and water quality and cockle population monitoring (in association with GWRC), along with public education efforts in Porirua. The Pāuatahanui Inlet Community Trust (PICT) has recently dissolved after 25 years of public and political advocacy for the Inlet. This role has been absorbed into GOPI and the new (integrating) Porirua Harbour and Catchment Community Trust (PHT).

The Pāuatahanui Wildlife Reserve is managed on a day-to-day basis by volunteers from Forest & Bird, who carry out maintenance of the facilities, weeding and planting sessions, control of stoats and rats and monitoring of bird populations. There are plans to translocate fern birds to the reserve in 2017.

In Duck Creek, the saltmarsh is administered as the Duck Creek Scenic Reserve by DOC, but daily management and monitoring is organised by members of Guardians of Pāuatahanui Inlet. These organisations carry out monitoring of water quality in the stream, and ecological weed and pest control in the saltmarsh.

There are several areas in or around the Pāuatahanui Inlet that are in the process of ecosystem restoration. These include the riparian strip of the Pāuatahanui, Duck Creek and Kākaho streams, the saltmarsh at Horokiri Stream, and areas along the Camborne water frontage. A number of

the organisations are associated with these projects or the reserves in which they are found, and have maintained formed access tracks (often with boardwalks) throughout the restored areas and erected public information panels at strategic points.

There has been fencing of riparian areas or streams although the properties along the northern shore of Pāuatahanui Inlet are mostly fenced on the far side of the road. There has been riparian planting along the lower part of Horokiri Stream and Kākaho Valley. Only in Ration Creek does saltmarsh extend significantly up the stream bed, and this area is fully fenced to exclude stock.

Since 2006, the Pāuatahanui Revegetation Framework project run by GWRC & PCC has engaged landowners in 28% of the Inlet catchment to reduce stock access to riparian margins as well as retirement of erosion-prone land. This work will be replaced and extended by Te Awarua-o-Porirua Sediment Reduction Plan (GWRC 2015). The introduction of a dedicated, full-time GWRC Land Mangement Officer to lead and oversee implementation of the Plan will hasten improved erosion control and riparian management.

Whitireia Park is overseen by a management board representing a partnership by GWRC and Ngāti Toa. GWRC carries out day-to-day management of the park. Te Onepoto Bay and part of the stream flowing in to it are part of the Whitireia Coast Key Native Ecosystem (KNE) site. Operational activities planned to manage and protect the biodiversity values of the KNE site are set out in the KNE plan for the area (GWRC 2014). These activities include ecological weed control, pest animal control and management of human activies. Trapping of predators (hedehogs and mustelids) is being carried out in the bay and stream valley by members of Whitireia Park Restoration Group. This group also undertakes restoration of native ecosystems through native planting and pest control in other parts of Whitireia Park. In 2010 they planted 100 sea sedge at the head of Te Onepoto Bay, sourced from the Waikanae Estuary population. Schools have also been involved in restoring the edges of. this bay.

Until recently, the Porirua Stream delta has been a receiving area and illegal dumping location for domestic and business refuse. The delta is now maintained significantly clear of 'macrorubbish'since a radical clean-up by PCC in 2009. Regular PCC and community work continues to collect new litter from the area.

The estuarine edge from Takapuwāhia through to the previously exotic grasses on the railway reserve on the eastern side of the Porirua Stream mouth are now subject to a joint PCC, GWRC and NT restoration project. The Porirua Stream Mouth Estuary Enhancement Plan (PSMEEP; Blaschke et al. 2014) seeks to improve the habitat and visual amenity of the Porirua Stream mouth area. Ecological weed control and replanting with native species took place on the eastern reserve area in 2014. Development of a small wetland behind 'Pak 'N Save' will receive stormwater from carparking areas and provide additional bird habitat. Planting of other native edge vegetation and stabilisation of eroding edges are planned elements of the Plan. Interpretive boards will eventually be designed and installed to improve public awareness and appreciation of this modified and once neglected area of the harbour.

The Takapūwāhia community with the support of Takapūwahia Marae Committee have also developed a strategy (Takapūwāhia community 2014) which includes objectives for improving stormwater quality, and the restoration of Takapūwāhia, Mahinawa and Hukatai Streams which flow into Onepoto Arm.

In Onepoto Arm, the Ōkowai Lagoons have been the subject of a joint restoration project between Carrus Corporation, GWRC, Porirua City Council and DOC to transform the poorly functioning freshwater southern portion of these lagoons to an improved waterfowl wetland habitat (Figs 17.15 & 17.16). Substantial earthworks and restoration planting were undertaken in this area over 2010 and 2011 to assist with water quality and habitat enhancement (M. Parks, Boffa Miskell Limited 2013, pers. comm.). Carrus have now built a state-of-art three-tier sediment pond and wetland at the base of the subdivision, to receive stormwater/sediment, before discharging into the freshwater lagoon. They have also most recently extensively planted the slope faces leading to to the sediment pond/wetland.



Figure 17.15. The southern part of Ōkowai Lagoon is currently being restored as a freshwater wetland. Photo: Helen Kettles.



Figure 17.16. The northern part of Ōkowai Lagoon is degraded, but still retains saline function. This site will be restored in the future. Photo: Helen Kettles.

In recent years, the Growing Places Charitable Trust has been established to help restore parts of Wellington transport corridors with plantings undertaken in the small tributaries around Linden Station, in late 2014, and the lower Kenepuru Stream in 2013. At the latter site Greater Wellington have not mowed the edges, in order to enhance inanga spawning habitat (P. Warren, DOC 2014, pers. comm.).

In March 2011 the new Porirua Harbour and Catchment Community Trust (PHT) was created to advocate for and monitor agency performance in improving the condition of the harbour as per the Porirua Harbour Strategy and Action Plan. This Trust is a development and expansion of the Pāuatahanui Inlet Community Trust, which has been running for 25 years. The establishment of PHT means that formal interest expands to the whole harbour and catchment, and also to include the formal involvement of Wellington City Council in the Te Awarua-o-Porirua Harbour catchment. As a result PICT has now dissolved, and a number of its functions taken up by PHT and GOPI.

The Trust acts as a community advocate for Te Awarua-o-Porirua Harbour, particularly focused on improving its condition and public enjoyment. The Trust is also involved in education and awareness-raising and has arranged for a a part-time school Education Coordinator funded by the Philipp Family Foundation Charitable Trust to promote and support environmental education about the harbour and associated waterways in schools around the catchment. At the time of writing, there are 28 schools actively involved in this programme and this is likely to expand to 50 during 2016. The Trust develops its own priorities and activity plan and provides input to implementation of the Harbour Strategy and Action Plan.

In 2011, a 12-part mini documentary series on Te Awarua-o-Porirua Harbour was produced ('Living Waters' 2011) which is a significant resource for public education and awareness of harbour values.

⁹ http://www.gw.govt.nz/whaitua-committiees/

This series forms the basis for a new curriculum-based teacher and school resource and facilitated by the PHT Education Coordinator mentioned above.

The Trust has also completed, promoted and distributed a single 30 minute Samoan-language version of 'Liviing Waters' to reach this single largest Pacific Island group in the catchment.

GWRC funds the delivery of the Healthy Harbours Porirua programme to predominantly low decile schools in the catchment. This intensive programme involves guided harbour snorkelling and stream water quality testing fieldtrips and student action projects.

PCC has recently adopted a Stormwater Bylaw (Aug 2015) banning a range of common domestic and industrial pollutants, such as detergent, paint and concrete slurry from being tipped or washed into stormwater drains. The public education campaign associated with this Bylaw aims to improve stream and harbour ecology.

17.10.2 Potential

Following the successful restoration and protection of saltmarsh habitat in public areas, many private landowners are considering wetland protection on their own properties, particularly around the streams on the northern shore. Porirua City Council and GWRC jointly fund and oversee a voluntary retirement, fencing and planting programme (Pāuatahanui Vegetation Framework) with landowners in the entire catchment. This is aimed at reducing erosion and sedimentation and protecting habitat. This programme has been going since 2006, and is about to be replaced and extended by a full-time GWRC Land Management Officer implementing a Farm Environment Plan programme across the whole Te Awarua-o-Porirua Harbour catchment.

The potential effects of urban development, forest harvesting and roading pose risks to both arms of the Harbour. There are techniques to minimise the effect of these developments on the harbour and it will be important to ensure sensitive development occurs if values of the estuarine ecosystem are to be protected. Impacts of sedimentation and contamination (especially of heavy metals) both have potential to impact the ecosystem.

An assessment was undertaken of the impacts of dredging on harbour flushing. The study concluded that localised strategic dredging of the Pāuatahanui Inlet would be ineffective and temporary. Any further marine sand incursion has ceased, and the report reinforced that improving erosion control and earthworks management within the catchment is a key management task for reducing excessive sedimentation rates and effects in the harbour (Tuckey 2011).

The land surrounding Te Onepoto Bay, adjacent to Whitireia Park, would be a good candidate for the status of a scenic reserve, an upgrade from its current status as a recreation reserve. This is strengthened by the presence of existing tracks around the bay which are part of the park. There is also no apparent reason for the continued existence of the causeway across Te Onepoto Bay, as it acts as a barrier to optimal flushing of the saltmarsh by the tide. Opportunities for enhancement of safe wildlife habitat in the bay could be investigated. The whole of Te Onepoto Stream being under a single management structure may allow for greater stream and catchment wide restoration opportunities. Restoration of the full length of the stream and riparian area would greatly support biodiversity values in the bay.

The restoration of the southern part of Ōkowai Lagoon as a freshwater wetland is complete (Fig. 17.15). Plans for similar restoration of the northern section of Ōkowai Lagoon (Fig. 17.16) has been considered, but so far no plan prepared. This northern part of the Ōkowai Lagoon still retains connectivity to the harbour, and a degree of tidal influence. It would be desirable for this area to keep its estuarine habitat. The tidal connection beneath the transport corridor causeway could be improved, but is unlikely in the foreseeable term as any potential disruption to the rail or road would be resisted by infrastructure owners. Similarly, the health of the estuarine wetland in Romesdale Lagoon would also benefit from improved tidal connectivity.

The harbour would benefit from a wider saltmarsh restoration programme around the shoreline. This would have the effect of improving water quality, as well as enhancing the environment. While the margin has been stabilised to allow development around the harbour, there is no reason for the banks to be as steep as they are. Stevens & Robertson (2008) suggested selected areas have their gradients decreased, allowing the restoration of saltmarsh vegetation. Given the amount of public interest in the state of this estuarine system (Calman 2009), and the harbour's strong significance to Ngāti Toa Rangatira, it would seem likely that expanding community support for such a project would not be difficult. The joint GWRC/PCC/NT Porirua Stream Mouth Estuary Enhancement Concept Plan (Blaschke et al. 2015) followed identification by Councils, iwi and community environmental groups as a priority for estuarine restoration within the Te Awarua-o-Porirua Harbour. Funds have been allocated for a three-year programme and ecological weed control, planting and more detailed planning is already underway.

Areas of concentrated pollutants in the catchment require ongoing management. Although the GWRC and Porirua City Council monitor pollution, there is opportunity for local businesses and the larger community to better manage pollution before it enters the waterway. There is also opportunity to better manage stormwater and road runoff disposal systems. GWRC has moved its successful 'Take Charge' business education and monitoring programme to Porirua. The first year has focused on businesses in the Wall Place industrial area, and then likely to shift to the Broken Hill Road industrial area leading up to Spicer Landfill. PCC hopes to work with new infrastructure manager, Wellington Water Ltd, to address significant contaminant issues from the Prosser Street industrial area to reduce significant contaminant inputs to the Harbour from the Semple Street stormwater outfall. Public education around the new Stormwater Bylaw may also assist here.

Gibb & Cox (2009) recommend that immediate action is needed to reduce the net average rates of deposition in the harbour from 5–9 mm/year to 1.0–2.0 mm/year. They emphasise the importance of re-vegetation and silt traps in the catchments of the streams feeding into the harbour. This is a target adopted by the Harbour Strategy and sought to be addressed by the Sediment Reduction Plan (GWRC 2015).

Locating, documenting, and restoring potential inanga spawning sites in all the stream entering the harbour would be valuable.

Because roost sites have been removed historically, there may be future potential for the construction of roosting structures/frames for coastal birds that would provide refuge, especially at high tide.

The population of Asian kelp requires monitoring and (if necessary) control, although general opinion suggests there is very little suitable habitat within the harbour for it to establish (other than at the inlet mouth and on boatsheds and boat club facilities). There is no control technique for this species in New Zealand, but methods tested at other New Zealand sites include physical removal, chemical application to infested piles followed by plastic sheathing (both in Stewart Island and Bluff), and hot water application (to a very small infestation of a sunken hull at the Chatham Islands).

The Porirua Harbour and Catchment Strategy and Action Plan (Porirua City Council 2012) and its 2015 revised version (Porirua City Council 2015) is the key framework for future management of the catchment and improvement in the health of the Harbour. A new governance body has been established – the Te Awarua-o-Porirua Harbour and Catchment Joint Committee – representing the four key stakeholders, to oversee the implementation of the Harbour Strategy. An annual report and an annual work plan will be prepared for the Committee to scrutinise and adopt.

In December 2014, GWRC established the Te Awarua-o-Porirua Whaitua Committee to enable the integrated management of land and water and to establish water quality and quantity objectives and limits in the catchment⁹. The whaitua process is part of GWRC's programme

to progressively implement the requirements of the National Policy Statement for Freshwater Management 2014, including to develop methods to maintain or improve fresh water quality.

In considering ways to maintain or improve water quality, the committee will engage with the whaitua community and users of fresh and coastal water over the next two years. The values the community hold for the receiving waters of Te Awarua-o-Porirua Harbour will be critical in setting water quality limits for freshwater in the catchment. Final recommendations on how to integrate land and water management in the catchment will be made to GWRC in the Te Awarua-o-Porirua Whaitua Implementation Programme, which will in turn be considered for inclusion in the Proposed Natural Resources Plan by way of a plan change.

17.10.3 More information

There is much more detailed information available on this estuarine system and catchment than is within the scope of this report to cover (Swales et al. 2005; Blaschke et al. 2010; Oliver & Milne 2016 and references therein). In addition to this, there are several proposed restoration and management strategies relating to different parts of the harbour (e.g. Blaschke & Anstey 2004; White 2005).

More recent reports are generally available on either the GWRC website or the PCC harbour webpages (News, Programme & Q&A) – www.pcc.govt.nz keyword: 'harbour strategy'.

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18. Mākara Stream

18.1 Site description

The mouth of Mākara Stream is constrained by a gravel bank and a small rocky outlet, but the estuarine basin behind includes a comparatively large lagoon and an area of saltmarsh vegetation (3 ha) (Table 18A; Figs 18.1 &18.2), where Hawkins Stream confluence has formed a wetland delta. An island to the true left of the stream marks an historic path of the river; the channel remaining is now a backwater. The estuarine system provides significant habitat for birds and marine life including native fish.

The settlement of Mākara Beach is immediately adjacent on the southern bank of the river. The estuarine system has been modified by the construction of boat sheds and a boat ramp just inside the outlet. The dunes at the river mouth were flattened during World War II, as part of the war effort; an event that is likely to have altered the character of the estuarine system by exposing the ecosystem to onshore winds. The dunes are only now showing rudimentary signs of reforming (Anstey & GWRC 2007).

Table 18A. Makara Stream site information (see also Fig. 18.1).

| SITE NAME | MĀKARA STREAM |
|--|--|
| Location | Mākara Beach |
| NZTM (coordinates) | 1743679 5435487 – 1743879 5434787 |
| NZ Topo50 | BQ31 437 355 – BQ31 439 348 |
| Area | 15 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Wellington City Council, GWRC |
| Land status (tenure) | Private Mākara Beach Foreshore and Reserves (Wellington City Council) |
| Existing rankings | Ecol Sites 64, 435, 925 WERI: 2, SSWI: Potential Area of Important Conservation Value (GWRC Coastal Plan) Wellington City Council Conservation Site in the District Plan Key Native Ecosystem (GWRC) |
| Ecological district | Cook Strait |
| Estuarine classification | Category B |
| Threatened species (number) | 6 |
| At Risk species (number) | 16 |
| Ecosystem value (score 1–5) | 4 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Three-square sedgeland Tall fescue grassland Glasswort herbfields Raupō reedland Mudflats Subtidal |

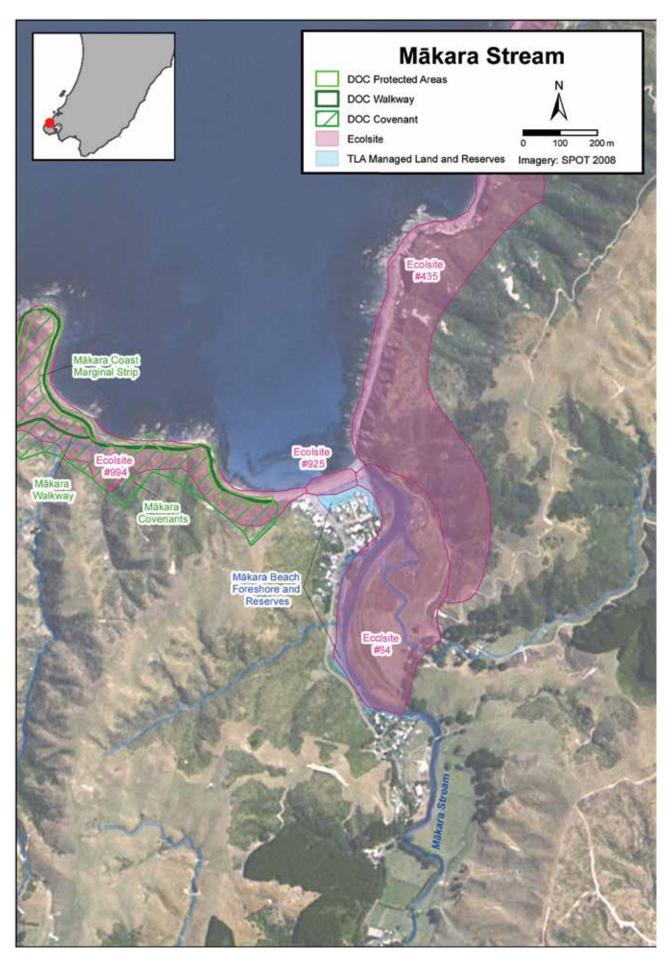


Figure 18.1. Mākara Stream estuarine site showing areas and places mentioned in the text.



Figure 18.2. The tidal basin at the mouth of the Mākara Stream. Horse's mane is visible in the water. Photo: Tanya Piejus.

18.2 Conservation Values

18.2.1 Ecological

The margins of the stream mouth are largely herbfields, dominated by glasswort (Fig. 18.3). Smaller patches of remuremu, bachelor's button, shore primrose, and native musk are also common in this area. Further up the tidal reaches, there is a bank of rushes: sea rush and oioi, overtopped by saltmarsh ribbonwood and small-leaved pōhuehue. Flax, toetoe, and cutty grass grow throughout the rushes, while three-square fringes the low tide line (Fig. 18.2). This habitat lines the bank of the stream for around 400 m. A patch of raupō marks the confluence of a small stream near the high tide limit. Horses' mane is abundant in the sub-tidal parts of the lagoon. Wassilieff (1992) listed 43 native species in the estuarine area and around the mouth. A very small amount of seagrass is present (Robertson and Stevens 2007).

On the gravel flats near the mouth is the small foreshore reserve dominated by a local variety of scabweed and Strathmore weed. Pīngao and kōwhangatara are both present here. Dwarf musk is known to be present in Hawkins Gully, just upstream from the estuarine site (Mitcalfe & Horne 1992).

A wide range of birds use the estuarine ecosystem to feed, roost and nest. Birds, including Caspian terns, congregate on the beach, while many waders and waterfowl frequent the saltmarsh and open water of the stream. A macrocarpa on the island to the true left of the stream is the location of a breeding colony of pied shags which established in 1996 and has grown to an extent that it is thought to be at least partly responsible for the increase in Wellington's regional population (Powlesland et al. 2008) (Fig. 18.4). Australasian shovelers and reef herons are resident and breeding here. White herons and royal spoonbills are occasional visitors. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Twelve migratory native freshwater fish species have been found in the catchment, including seven species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, inanga, redfin bully, bluegill bully and lamprey; Allibone et al. 2010). Taylor & Kelly (2001) noted that



Figure 18.3. Glasswort herbfield adjacent to the mouth of the Mākara Stream. Photo: Tanya Piejus.



Figure 18.4. An overview of the saltmarsh in the upper tidal reach of the Mākara Stream. The pied shag colony is in the macrocarpas in the foreground. *Photo: Matt Todd.*

the estuarine system contained good spawning habitat for inanga. Later surveys by Taylor & Marshall (2016), again recorded numerous sites containing suitable inanga spawning habitat, although no spawning sites were confirmed. Small coastal marine species are likely to frequently enter the estuarine waters, and black flounder have been found in the tidal zone.

Two lizards are known to be present in the estuarine environment: northern grass skink, copper skink and the Marlborough mini gecko. Historically, katipō spiders are known to occur in the beach adjacent to the mouth (Patrick 2002).

Table 18B lists native species present in, or utilising, the Mākara Stream estuarine system.

Table 18B. Native species present in, or utilising, the Mākara Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Native musk* |
| | Seagrass* |
| Birds | Australasian shoveler |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Caspian tern+ |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Reef heron+ |
| | Royal spoonbill* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |

| GROUP | SPECIES |
|-----------------|------------------------|
| Birds continued | Welcome swallow |
| | White heron+ |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Black flounder |
| | Bluegill bully* |
| | Common bully |
| | Common smelt |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Lamprey+ |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Variable triplefin |
| | Yellow-eyed mullet |
| Herpetofauna | Copper skink |
| | Northern grass skink |
| | Marlborough mini gecko |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

18.2.2 Recreational

The estuarine site is used mainly for recreational purposes; Mākara Beach is a popular spot during summer with sunbathers, picnickers, and walkers. The boat ramp just inside the river mouth serves small fishing boats, runabouts, and jetskis. A low level of whitebaiting takes place during the season. The estuarine system is also a good site for birdwatching.

18.3 Catchment properties

The Mākara Stream drains a large swathe of the western Wellington coast, around 7840 ha of mainly pasture (70%) hill country (MacDonald & Joy 2009). Included in this catchment is one major tributary, the Ōhariu Stream, which is mostly fringed by pasture. Water quality is monitored in the Mākara Stream (GWRC site RS17) and is consistently rated as 'fair' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015), mainly due to moderate levels of agricultural runoff and faecal contamination. The Ōhariu Stream has particularly high phosphorus levels and turbidity. In the steep hill country, soil erosion leading to increased sedimentation can exacerbate any water quality issue.

18.4 Threats

The presence of animal pests around the estuarine margins and saltmarsh is well documented. Anstey & GWRC (2007) have recorded goats, mustelids, feral cats, rodents, possums, hedgehogs, rabbits, hares and pest fish (trout) in the area. These can all impact on either the local bird and lizard populations, or the native vegetation. In addition to the wild population of pests, domestic cats and dogs are resident in the settlement or visit the site with owners.

Damage caused by stock is a problem on parts of the estuarine margins that are privately owned. Trampling damage to wetland species not only inhibits the development of the native plants, but promotes conditions for the invasion by ecological weed species.

There are a variety of ecological weeds present in the estuarine ecosystem. Of these, tall fescue and buck's horn plantain are possibly the most widespread. Tall fescue, a pasture species, colonises the rushland and clogs up interstitial spaces, while buck's horn plantain forms thick mats that inundate herbfields. Both species take advantage of habitat disturbance to colonise new ground. Thick banks of buffalo grass are particularly conspicuous around the boat sheds.

The beach is popular during the summer, and the estuarine site receives a high level of disturbance during this time. This is particularly true around the boat ramp, where useage is elevated, and where cars and boat trailers are frequently parked on the vegetation of the stream margin. Jetskiers regularly make circuits of the lagoon.

Poor water quality in the catchment continues to be of concern. Sedimentation rates affect the water quality and it has been suggested that a significant portion of the faecal contamination in the stream is due to poorly constructed septic tanks leaching into the waterway in the upper catchment (D. Hansford, Makaracarpas 2009, pers. comm.)

18.5 Conservation management

18.5.1 Current

The northern shore is privately owned and farmed, while the southern shore is part of the Mākara Beach Foreshore and Reserve, administered by Wellington City Council. The estuarine area is actively managed by 'Makaracarpas', a community group formed in 2006 and financially supported by a variety of organisations, both governmental and non-governmental. Along with GWRC, they have developed a Restoration Plan (Anstey 2007), and have taken responsibility for ecological weed and pest control and monitoring, fence construction and maintenance, restoration planting, monitoring of native fish, and regular rubbish removal. They are supported by the local community and work in partnership with local landowners to rehabilitate parts of the estuarine system where stock have access. The Mākara Primary School has close ties with the group, and regularly involves the pupils as part of environmental education. The Wellington Botanical Society regularly assists with operations such as predator control. The community group has historically been supported by *Take Care* funding and Biofunds.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for Mākara Estuary is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site. GWRC has included the estuarine site in the draft KNE Plan and jointly funds the ecological weed and animal pest control and revegetation with Wellington City Council under a memorandum of understanding. The KNE site does not include the foreshore reserve area.

GWRC also provided funding through the former Wetland Incentive Programme, together with Wellington City Council to fence private land. This was also supported by the Makaracarpas, Forest & Bird and DOC.

Most of the riverbank on the true left of the river within the current management area is part of the reserves administered by Wellington City Council. The council also manages the foreshore reserve, containing the protected turf community of scabweed and Strathmore weed. As such, intensive ecological weed control is carried out regularly, and ecosourced native plants are propagated and provided by Wellington City Council's nursery. Wellington City Council also provides large numbers of ecosourced native plants to the Makaracarpas, along with advice and technical support. A sign advises that dogs are restricted in the foreshore reserve, which is sectioned off by a low fence. However, Mākara Beach itself is listed in the Dog Control Policy (Wellington City Council 2009) as a beach where dogs may be exercised off leash. Wellington City Council also administers the boat ramp and parking area on the southern margin of the site.

DOC has little role in the management of the estuarine system, but is responsible for the nearby Mākara Walkway, Mākara Coast Marginal Strip, and Mākara Covenants. DOC assists with animal pest control in the estuarine area through advice and provision of traps and materials, as well as providing funding.

The population of dwarf musk in Hawkins Gully is not physically protected with fencing, but persists satisfactorily under a light grazing regime (B. Tandy, DOC 2009, pers. comm.).

GWRC has undertaken habitat mapping of the Mākara Stream estuarine site and margins, fine-scale intertidal sediment and sediment biota monitoring (Stevens & Robertson 2006), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). Stream mouth mechanical opening for flood risk management purposes is also carried out by GWRC within the rules of the Regional Coastal Plan.

18.5.2 Potential

The Restoration Plan laid out by Anstey & GWRC (2007) includes full schedules for planting, pest control and maintenance until 2012. This document is yet to be updated. Longer-term ideas envisioned by the Makaracarpa members include habitat improvement for blue penguins and lizards, improved interpretation for visitors, and eventually, predator proofing a much larger area of the catchment to provide a refuge for rare species such as brown teal (D. Hansford, Makaracarpas 2009, pers. comm.).

There are several fragile habitats and threatened species in the area which would benefit from greater physical protection. The scabweed herbfield in the foreshore reserve is particularly vulnerable to damage by trampling in a high human traffic area. Updating and reconditioning the information panel may help protect vulnerable sites by increasing awareness of resident and visitors. The herbfields including the threatened dwarf musk appear to benefit from light sheep grazing. Ongoing liaison with the landowner is essential to continue the management of the site. Investigation of the estuarine site as a Wildlife Reserve would be warranted given the values.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

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19. Kaiwharawhara Stream

19.1 Site description

The Kaiwharawhara stream mouth has been largely modified by the development of road and rail into Central Wellington (Table 19A; Fig. 19.1). Apart from a short stretch of gravel at the stream mouth, most of the lower tidal reaches have been constrained by open concrete culverts (Fig. 19.2). The mouth is bounded on one side by reclaimed land for the Interislander ferry marshalling area and on the other by the Kaiwharawhara Reclamation, owned by the CentrePort. During spring tide the tidal influence extends approximately 500 m up the stream. In the upper tidal area, the banks are still lined with concrete walls but the riparian strip has been restored by Wellington City Council business in conjunction with GWRC, providing overhanging native vegetation (Fig. 19.3).

19.2 Conservation values

19.2.1 Ecological

Due to the highly modified nature of the environment, the lower tidal area, below the railway culvert, is mostly bare of vegetation except for green algae (*Enteromorpha* sp.) on the margins and sea lettuce in the stream. Above the tide line there has been some planting of native shrubs including pōhutukawa, taupata, and koromiko. Further up the tidal reaches, where the stream runs through a commercial area, the native planting includes lowland ribbonwood, taupata, flax, koromiko, and toetoe overhanging the water (Fig. 19.3). There are no threatened plant species present (Stevens et al. 2004).

Table 19A. Kaiwharawhara Stream site information (see also Fig. 19.1).

| SITE NAME | MĀKARA STREAM |
|--|--|
| Location | Kaiwharawhara, Wellington Harbour |
| NZTM (coordinates) | 1749978 5430787 |
| NZ Topo50 | BQ31 500 308 |
| Area | Approx. 1 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Wellington City Council, GWRC |
| Land status (tenure) | Private Fort Buckley Reserve (Wellington City Council) Trelissick Park and Western Reserves (Wellington City Council) Kaiwharawhara Stream Conservation Area (DOC) Kaiwharawhara Reclamation Marginal Strip (DOC) Railway Land (NZ Rail) |
| Existing rankings | None |
| Ecological district | Wellington |
| Estuarine classification | Category B |
| Threatened species (number) | 2 |
| At Risk species (number) | 9 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1-5) | 2 |
| Pressures (score 1–5) NB: 1 = high pressures | 1 |
| Dominant habitat | Treeland Taupata shrubland Gravelfield |

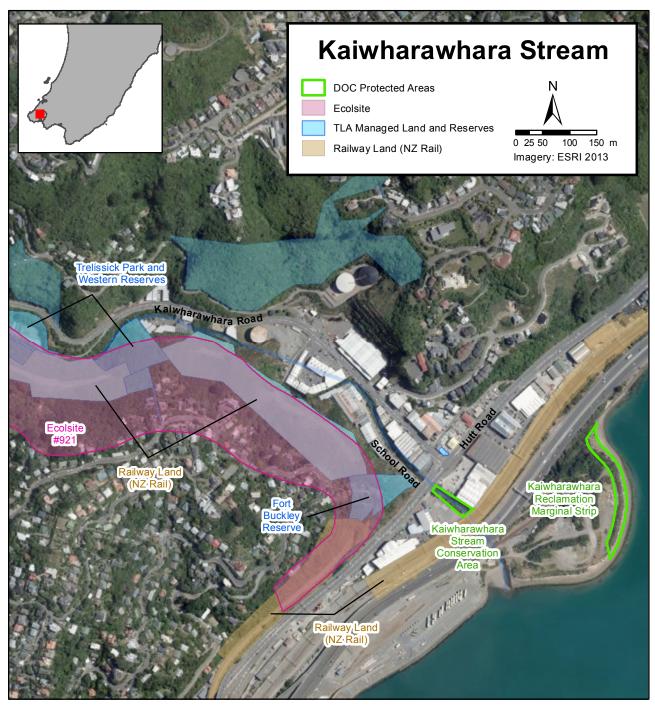


Figure 19.1. Kaiwharawhara Stream estuarine site showing areas and places mentioned in the text.

Eleven migratory native freshwater fish species have been found in the catchment, including seven species that are listed as 'At Risk: Threatened' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully and bluegill bully; Allibone et al. 2010). Below the railway culverts, the estuarine site offers little habitat for birdlife or for fish. The modified margins and gravel beds of the estuarine area (Fig. 19.4) offer no suitable habitat for inanga spawning. Out of 21 catchments in the greater Wellington area Kaiwharawhara was ranked lowest (Taylor & Kelly 2001), and the catchment population, which has been monitored since the mid-1990s, is known to have declined (Trelissick Park/Ngāio Gorge Working Group 1995). The estuarine site is included in Wellington Harbour bird surveys conducted by the OSNZ.

The seashore gravel bank may be used by roosting birds but it is regularly inundated by the tide. However, trees and shrubs lining the upper tidal reaches provide suitable habitat for foraging kingfishers and black shags (Fig. 19.5).

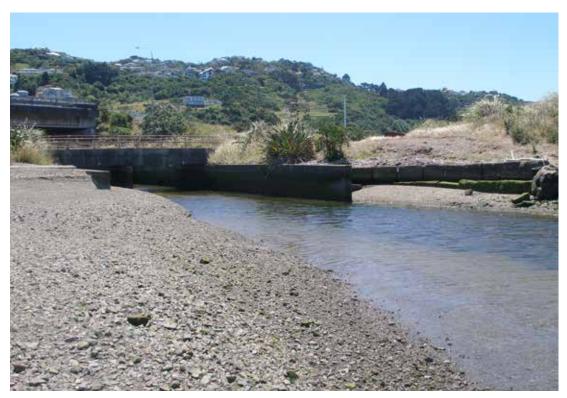


Figure 19.2. The mouth of the Kaiwharawhara Stream is highly modified as it passes underneath the transport corridor. *Photo: Matt Todd.*



Figure 19.3. A concrete wall constrains the western margin in the upper tidal reach of the Kaiwharawhara Stream, but the eastern side has been planted with native vegetation. *Photo: Matt Todd.*

Table 19B lists native species present in, or utilising, the Kaiwharawhara Stream estuarine system.

Table 19B. Native species present in, or utilising, the Kaiwharawhara Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Black shag* |
| | Black swan |
| | Kingfisher |
| | Little shag |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spotted shag |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-fronted tern* |
| | |

| GROUP | SPECIES |
|-------|------------------|
| Fish | Banded kōkopu |
| | Bluegill bully* |
| | Common bully |
| | Giant bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Shortjaw kōkopu+ |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.



Figure 19.4. The mouth of the Kaiwharawhara Stream crosses gravel banks on the shore of Wellington Harbour. *Photo: Matt Todd.*

19.2.2 Recreational

In past years the area has been enjoyed by the public for fishing, boating, picnicking, dog walking, etc., but now access to most of it is restricted.

19.3 Catchment properties

The estuarine system is located in an urban/commercial area. It is at the beginning of a valued ecological corridor for birds and fish, linking the harbour with the hills behind Karori and Khandallah. The catchment, about 1700 ha, is mainly urban, although the stream passes through



Figure 19.5. Lowland ribbonwood treeland is present alongside the waterway between Hutt Road and the main transport corridor. *Photo: Matt Todd*.

native bush in the Trelissick Park Scenic Reserve for the majority of its course, and the head waters lie within the Karori Sanctuary. Korimako Stream is the main tributary which drains the northern part of the catchment. Wellington City Council carries out extensive native planting, pest control and monitoring programmes within the catchment. A number of community groups, supported by Wellington City Council, undertake planting, monitoring of pollutants and management of pest species. Despite these efforts, water quality remains low and is rated as 'poor' to 'fair' at the Regional Council monitoring site at Ngāio Gorge (GWRC site RS19; Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015). Streambed sediment sampling was carried out by GWRC in the Kaiwharawhara Stream in 2005 and 2006. Sediment was found to contain levels of DDT that exceeded both ANZECC low trigger values (concentrations at which biological effects may occur) and high trigger values (concentrations at which significant biological effects are likely to occur (Milne & Watts 2008).

19.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. These will likely include domestic predators. Ecological weeds are flourishing.

The adjacent Kaiwharawhara Reclamation has been used at times as a storage site for heavy materials and logs. A number of plant pest species are rampant here. Pampas grass, gorse, brush wattle, and tree lupin are all present as established populations. These species are aggressive colonisers of disturbed and open environments.

This part of the Wellington Harbour has an issue with pollution. The long-term use of the area for shipping activities has led to elevated levels of heavy metals in the sediments around the mouth of the stream. Levels of both lead and zinc exceed sediment quality guidelines (Boffa Miskell Limited 2011). Shellfish were also found to have high lead levels (Stevens et al. 2004, and references therein).

19.5 Conservation management

19.5.1 Current

Neither KiwiRail, which runs the Interislander facility on the south side of the stream mouth, nor CentrePort, which has title to most of the Kaiwharawhara Reclamation, actively manage the environmental aspects of the site. During 2005/06, GWRC carried out restoration and landscaping on the south side of the stream mouth as well as upstream from the Hutt Road in the small commercial area. There is a public information board at the stream mouth regarding this work. The Trelissick Park Group has occasionally organised clean-up sessions to remove litter from the area (Figs 19.4 & 19.5).

In 2010, Boffa Miskell undertook a project to look at restoration and access issues around the estuarine site (Boffa Miskell 2011). This initiative is being led by the Trelissick Park Group, with support from Wellington City Council, Project Kaiwharawhara (Holmes 2005) and CentrePort.

A small section on the south side of the stream, between the railway culvert and Hutt Road, is administered by DOC as the Kaiwharawhara Stream Conservation Area. Wellington City Council has undertaken a weeding and planting programme on this site, under agreement with DOC. Upstream of Hutt Road the stream bed is the responsibility of Wellington City Council. In 2006, Wellington City Council and GWRC removed ecological weeds and planted natives along the streambank of School Road. Wellington City Council completed planting at the School Road site in 2008, and has removed large willows from this stretch and undertaken ongoing ecological weed control. Some local businesses have taken responsibility for maintaining the GWRC plantings by undertaking ecological weed control and rubbish removal directly outside their premises (GWRC 2006).

Water quality is monitored throughout the catchment by the various community groups, Wellington City Council and GWRC (at Ngãio Gorge). GWRC has also assessed stormwater contaminants in streambed sediments (Milne & Watts 2008). No water quality monitoring is carried out in the estuarine site.

GWRC has undertaken habitat mapping of the Kaiwharawhara Stream estuarine site and margins (Stevens et al. 2004), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

In December 2012, a Deed of Settlement was signed between Ngāti Toa Rangitira and the Crown. This deed recognises the role of Ngāti Toa as kaitiaki of the coastal marine area of Wellington Harbour (Port Nicholson). The Deed therefore recognises the association of the iwi with the area and enhances their ability to participate in specified Resource Management processes.

19.5.2 Potential

The area is also proposed for the terminus of the Wellington City Council's 'Sanctuary to Sea' walkway. In addition, a circum-harbour cycle path has also been mooted by the City Council, which could possibly pass through the reclamation. The two paths would probably meet at the stream mouth.

The spawning habitat for inanga in the estuarine eocosystem could be improved by the planting of rushes and flax, particularly on the south bank of the middle section of the tidal reaches, where the bed is not so stony. The planting of riparian shrubs could be further extended on both sides of the stream to provide extra vegetation cover of the stream bed, and to discourage the growth of ecological weeds. This would also enhance the 'green corridor' access for birdlife, linking Ngāio Gorge to the harbour. Boffa Miskell Limited (2011) point out that significant modification of the concrete channelling along the margins may need to be considered for such a strategy to be completely effective.

This estuarine site is currently severely degraded, and it would take a significant investment of time and resources to control the ecological weed problem. The site contains invasive plant species that have the potential to quickly devalue any restoration efforts in the estuarine system. Any plans to enhance the ecosystem values at the estuarine site would ideally also include strategies to control ecological weeds on the reclamation, and prevent re-invasion.

The stormwater and urban runoff has improved significantly over the last decade as Wellington City Council has upgraded sewer lines and wastewater drainage. However, the harbour sediment pollution problem is long-term and ultimately may require dredging if it is to be resolved. If this scenario should eventuate, careful consideration would need to be given to containment of the dredged sediments, in order to prevent both the smothering of the benthic ecosystem elsewhere in the harbour (Wear & Haddon 1992) and the release of heavy metals into the water column (Boffa Miskell Limited 2011).

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20. Korokoro Stream

20.1 Site description

The estuarine system of this small stream has been significantly modified, and is largely constrained by concrete culverts and channels as it passes under the Hutt motorway/rail corridor before emptying into Wellington Harbour (Table 20A; Fig. 20.1). The lowest reaches, however, pass through the Honiana Te Puni Local Purpose Reserve (formally Korokoro Gateway Reserve), a reclaimed recreational area where there is a section of partially restored saltmarsh and a 100 m long sand/gravel/shell bank providing some habitat for birds (Fig. 20.2). In the upper reaches of the tidally influenced zone, there is a stretch of some 50 m where the stream still retains its natural character, with a stony bed lined with grasses, suitable in places for inanga spawning (Taylor & Kelly 2001). A weir restricts the stream in the motorway culvert at the top of the tidal reaches.

Table 20A. Korokoro Stream site information (see also Fig. 20.1).

| SITE NAME Location Petone, Wellington Harbour NZTM (coordinates) 1755978 5434786 NZ Topo50 BQ31 560 348 Area 1 ha DOC Office Kāpiti Wellington Office Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) Social value (score 1–5) 3 Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Water pepper herbfield Tall fescue grassland Gravelfield | | |
|--|-----------------------------------|--|
| NZTM (coordinates) NZTopo50 BQ31 560 348 Area 1 ha DOC Office Kāpiti Wellington Office Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Water pepper herbfield Tall fescue grassland | SITE NAME | KOROKORO STREAM |
| Area 1 ha DOC Office Kāpiti Wellington Office Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wivīr rushland Water pepper herbfield Tall fescue grassland | Location | Petone, Wellington Harbour |
| Area 1 ha DOC Office Kāpiti Wellington Office Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 2 Pressures (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wiwī rushland Water pepper herbfield Tall fescue grassland | NZTM (coordinates) | 1755978 5434786 |
| DOC Office Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) At Risk species (number) Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Water pepper herbfield Tall fescue grassland | NZ Topo50 | BQ31 560 348 |
| Councils Hutt City Council, GWRC Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wiwī rushland Water pepper herbfield Tall fescue grassland | Area | 1 ha |
| Land status (tenure) Private Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) At Risk species (number) Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wiwī rushland Water pepper herbfield Tall fescue grassland | DOC Office | Kāpiti Wellington Office |
| Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) Railway Land Existing rankings Ecol Site 1054 Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Councils | Hutt City Council, GWRC |
| Key Native Ecosystem (GWRC) Ecological district Wellington Estuarine classification Category B Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 2 Pressures (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wāwīr rushland Water pepper herbfield Tall fescue grassland | Land status (tenure) | Honiana Te Puni Local Purpose Reserve (Tenths Trust/Vested in Hutt City Council) |
| Estuarine classification Category B Threatened species (number) At Risk species (number) Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Existing rankings | |
| Threatened species (number) 2 At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 2 Pressures (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Ecological district | Wellington |
| At Risk species (number) 10 Ecosystem value (score 1–5) 2 Social value (score 1–5) 3 Restoration potential (score 1–5) 2 Pressures (score 1–5) 1 NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Estuarine classification | Category B |
| Ecosystem value (score 1–5) Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Threatened species (number) | 2 |
| Social value (score 1–5) Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | At Risk species (number) | 10 |
| Restoration potential (score 1–5) Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Ecosystem value (score 1–5) | 2 |
| Pressures (score 1–5) NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Social value (score 1–5) | 3 |
| NB: 1 = high pressures Dominant habitat Karamū shrubland Wīwī rushland Water pepper herbfield Tall fescue grassland | Restoration potential (score 1-5) | 2 |
| Wīwī rushland Water pepper herbfield Tall fescue grassland | , | 1 |
| I I | Dominant habitat | Wīwī rushland Water pepper herbfield Tall fescue grassland |
| | | GraveItield |

20.2 Conservation values

20.2.1 Ecological

Where the stream flows through the Honiana Te Puni Local Purpose Reserve there are planted and maintained riparian strips consisting of oioi and wīwī backed by a mixture of toetoe, taupata, and flax. In the deeper parts of the stream, green algae (periphyton) forms mats on the stones.

New Zealand spinach was recorded here by Borger (1996), and has been regularly monitored by DOC staff ever since.

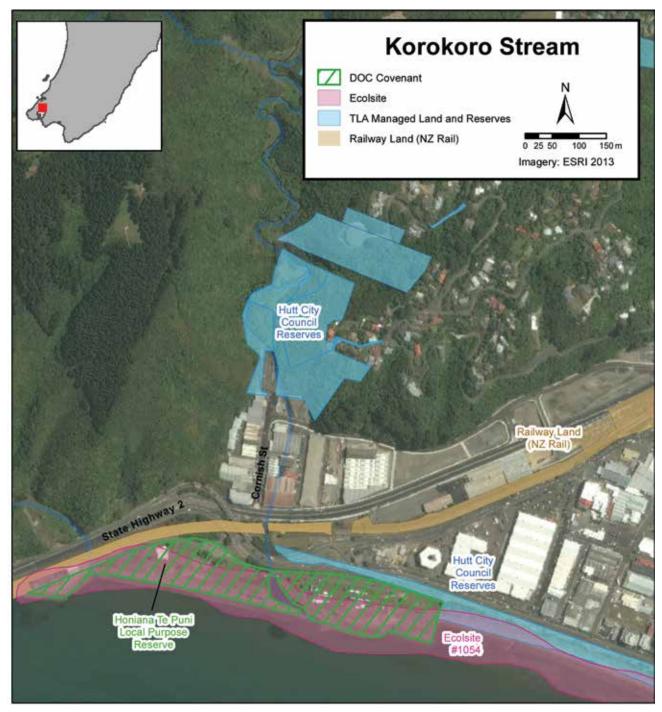


Figure 20.1. Korokoro Stream estuarine site showing areas and places mentioned in the text.

Red-billed gulls are numerous on the sand bank, black-billed gulls less so. However, there is no evidence of them nesting in the vicinity, and both species are attracted to Petone Beach as much by anthropogenic food sources as by the natural foods (Stevens et al. 2004). An assortment of birds, including variable oystercatchers, white-fronted terms and paradise shelducks are known to visit the area.

Ten migratory native freshwater fish species have been found in the catchment, including six species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, inanga, redfin bully and bluegill bully; Allibone et al. 2010). The rushes in the lower estuarine area and the grassy banks in the railway reserve provide good conditions for inanga spawning (Taylor & Kelly 2001). Unfortunately, the weir at the top of the tidal zone probably restricts migration between the stream and the harbour (Taylor & Kelly 2001).



Figure 20.2. The banks of the Korokoro Stream have been restored with native vegetation downstream of culverts that pass under the transport corridor. *Photo: Matt Todd.*

A specimen of spotted skink was last recorded here in 1980 (Waddington 1980). It would be significant record if a population still exists today.

Table 20B lists native species present in, or utilising, the Korokoro Stream estuarine system.

20.2.2 Recreational

The Honiana Te Puni Local Purpose Reserve (formally Korokoro Gateway) is mainly used for recreation; it is popular as an access to the beach for swimming, fishing, or walking dogs.

Table 20B. Native species present in, or utilising, the Korokoro Stream estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------------|
| Threatened/At Risk plants | New Zealand spinach* |
| Birds | Black-billed gull+ |
| | Little shag |
| | Paradise shelduck |
| | Pied stilt* |
| | Red-billed gull+ |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-fronted tern* |

| GROUP | SPECIES |
|----------------------------|-----------------|
| Fish | Banded kōkopu |
| | Bluegill bully* |
| | Common bully |
| | Common smelt |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| Aquatic macroinvertebrates | Pipi |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

20.3 Catchment properties

The vast majority of the Korokoro catchment is within the Belmont Regional Park and is a mixture of native bush and pasture. The catchment is managed by GWRC under the Parks Network Plan (GWRC 2011). However, where the stream exits Korokoro Valley, before it reaches the coast, it passes through an industrial estate where stormwater and other contaminants may be directly discharged. Additional contamination from the road and rail corridors adjacent to the estuarine eocosystem is also likely.

GWRC has responsibility for flood risk management of the lower Korokoro Stream, which is complicated by the extensive industrial development. GWRC has a consent to carry out gravel extraction in the stream to keep the channel clear for flood conveyance.

20.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. These will likely include domestic predators. Dogs are prohibited from the beach but are nevertheless regularly present.

Ecological weeds, including water pepper, montbretia, water celery and monkey musk, are present in the waterway and along the banks, particularly upstream of the culverts. Montbretia will become increasingly difficult to control once it gets established, due to its rhizomatous nature. It can form thick colonies, particularly on disturbed sites, and will smother any low growing plants.

Human activity has an impact on the environment adjacent to the estuarine area, particularly through disturbance of any bird roosting or nesting or through habitat loss. Petone Beach is raked mechanically in order to remove debris, reducing the availability of habitat for shore birds. The area is constantly disturbed by the presence of recreational beach visitors.

Bacterial contamination poses a threat to human health. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Petone Beach at water ski club) during the 2010/11 summer bathing season (Morar & Warr 2011), as well as during the 2014/15 summer season (Keenan et al. 2015).

A link road between the Petone interchange and SH1 at Grenada has been proposed as part of the Regional Land Strategy (GWRC 2007). The indicated route would intersect with SH2 at the point where the Korokoro Stream flows under the road/rail corridor. Such major roadworks will require careful management if it is to avoid impact upon the estuarine system.

20.5 Conservation management

20.5.1 Current

The Honiana Te Puni Local Purpose Reserve is a privately owned reserve administered by Hutt City Council. As such, it is managed by the rangers of the Parks and Gardens Division. They are responsible for plantings, landscaping, and ecological weed and pest control. The Wellington Water-ski Club also manages litter control. The upper estuarine system flows through the railway land between Western Hutt Road and the Petone motorway interchange. Access is restricted and there is no active management of the stream conservation values.

GWRC has undertaken habitat mapping of the Korokoro Stream estuarine site and margins (Stevens et al. 2004), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). The estuarine site is included in the Wellington Harbour bird surveys conducted by the OSNZ.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for Belmont-Korokoro is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

In December 2012 a Deed of Settlement was signed between Ngāti Toa Rangitira and the Crown. This deed recognises the role of Ngāti Toa as kaitiaki of the coastal marine area of Wellington Harbour (Port Nicholson). The Deed therefore recognises the association of the iwi with the area and enhances their ability to participate in specified Resource Management processes.

20.4.2 Potential

Apart from the cleanup of the ecological weed problem, the greatest potential for estuarine system improvement would be the restoration of the wetland margins within the railway land, and the lowering or removal of the weir in the motorway culvert which restricts fish passage. This would have to be planned carefully in order to avoid bed lowering and bank destabilisation as the weir may have been placed for bed level control purposes. Locating, documenting, and restoring potential inanga spawning sites would also be valuable. The planting of rushes such as wīwī and oioi, along with flax, saltmarsh ribbonwood (known to occur elsewhere in the harbour), and toetoe along the margin would create a relatively quiet wildlife habitat in the stream, and have the added bonus of filtering contamination from the Western Hutt Road and the industrial estate.

20.5 References

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- Stevens, L.; Robertson, B.; Robertson, B. 2004: Broad scale mapping of sandy beaches and river estuaries—Wellington Harbour and South Coast. Report prepared for Greater Wellington Regional Council by the Cawthron Institute, Nelson.
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21. Te Awa Kairangi/Hutt River

21.1 Site description

Te Awa Kairangi/Hutt River mouth is a large tidal estuarine system which runs through a highly urbanised area (Table 21A; Fig. 21.1). The estuarine wetland complex once covered a large part of the valley floor (Treadwell 1959; Park 1995; and see Fig. 21.2), but the river mouth is now constrained by reclaimed banks and edge protection works and is regularly dredged.

The Shandon Golf Course used to be an island, but an embankment was put across the northern end, the water blocked off and most of the bed filled in (Treadwell 1959).

The estuarine system is now approximately 3 km long, with the tidal influence as far up the river as the Ewan Bridge, at the south end of the Lower Hutt CBD. It is crossed by two other bridges, the Estuary Bridge just above the mouth, and a rail bridge a further kilometre upstream. The western arm of the estuarine system, between the mouth and the Estuary Bridge, is the last remaining soft sediment estuarine mudflat in the lower North Island (Te Ika-a-Māui) (Stevens et al. 2004), and has been rated as an SSWI (moderate) (Fig. 21.3).

Table 21A. Te Awa Kairangi/Hutt River site information (see also Fig. 21.1).

| SITE NAME | HUTT RIVER (TE AWA KAIRANGI) |
|--|---|
| Location | Petone/Lower Hutt |
| NZTM (coordinates) | 1759278 5433286 |
| NZ Topo50 | BQ32 593 333 |
| Area | Approx. 50 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Hutt City Council, GWRC |
| Land status (tenure) | Private Hikoikoi Recreation Reserve (Hutt City Council) Shandon Golf Course (Hutt City Council) Memorial Park (Hutt City Council) McEwan Park Recreation Reserve (GWRC) Sladden Park (GWRC) Ava Park (GWRC) Strand Park (GWRC) Reserves along Hutt River Trail (GWRC) Seaview Marginal Strips (1 & 2) (DOC) |
| Existing rankings | Ecol Sites 32 & 1054 WERI: 2, SSWI: Moderate |
| Ecological district | Wellington |
| Estuarine classification | Category B |
| Threatened species (number) | 6 |
| At Risk species (number) | 13 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 5 |
| Restoration potential (score 1–5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 2 |
| Dominant habitat | Browntop grassland Riparian shrubland Restiad rushland Saltmarsh ribbonwood shrubland Mudflats Subtidal |

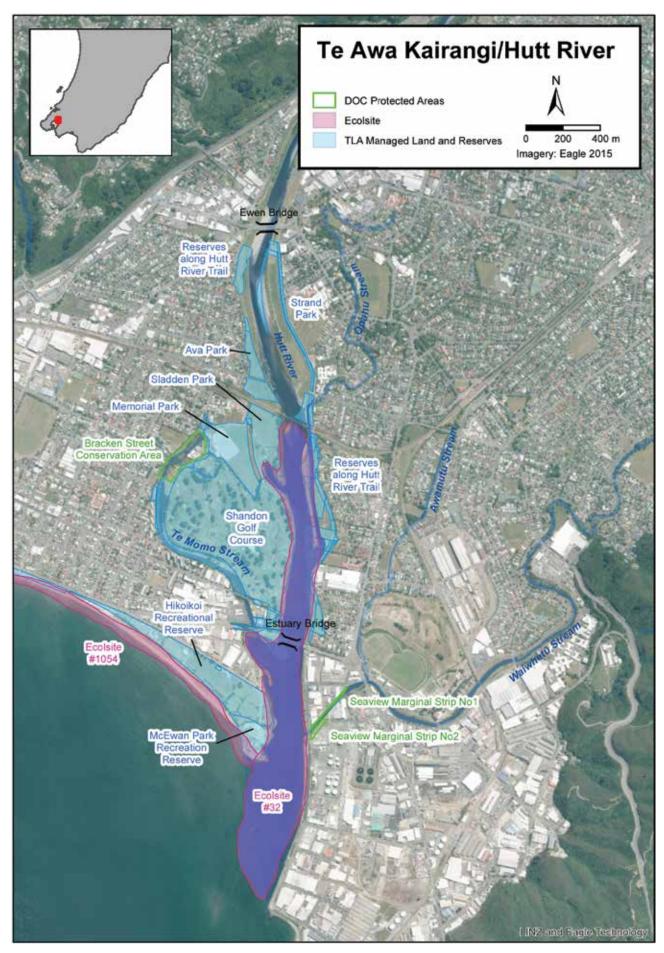


Figure 21.1. Te Awa Kairangi/Hutt River estuarine site showing areas and places mentioned in the text.

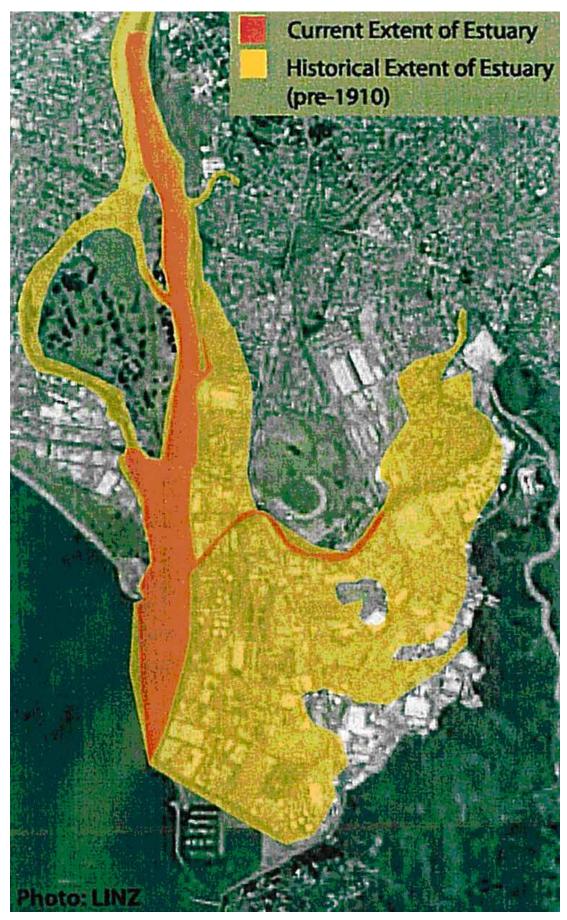


Figure 21.2. Diagram of historical (1909) extent of Te Awa Kairangi/Hutt River mouth, compared with 2011 (from Bell 1910, cited in Stevens & Robertson 2011).



Figure 21.3. The high conservation value mudflats at the mouth of Te Awa Kairangi/Hutt River. Photo: Helen Kettles.

Four tributary streams join the estuarine system; two of which (Te Mome Stream and Sladden Park Creek) (Figs 21.4 & 21.5) are minor enough to be entirely tidally influenced. The Ōpahu Stream (also called Black Creek and historically Ōkautu, approximately 2 km in length) is regulated by tidegates where it passes though the stopbank to Te Awa Kairangi/Hutt River. Only approximately 500 m of the stream running parallel to the river is tidal. The Waiwhetū Stream is discussed in a separate section of this report (see page 198).



Figure 21.4. Wīwī rushland and raupō reedland along the margins of the tidal area of Te Mome Stream. Photo: Matt Todd.

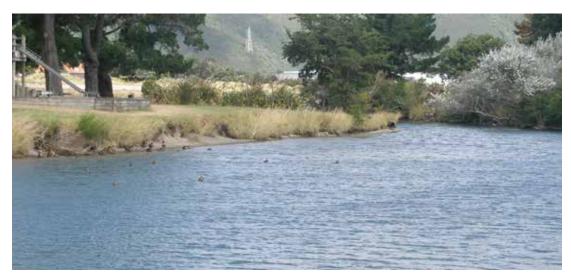


Figure 21.5. The banks of Sladden Park Creek show potential as spawning habitat for inanga. Photo: Matt Todd.

21.2 Conservation values

21.2.1 Ecological

For the majority of the river's tidal zone, the banks are consolidated with rip-rap boulders, topped with browntop-dominated exotic grasses, forming a green corridor between the river and the stopbanks. Below the Estuary Bridge, the riverside trail has been planted with a variety of common shrubs and bushes, including karamū, koromiko, flax, and tauhinu. A small patch of partially restored saltmarsh is on the true right of the river, on the downstream side of the Estuary Bridge, consisting of saltmarsh ribbonwood and taupata shrubs, along with tauhinu, toetoe, and ngāio. There are no threatened plants currently present, although sea sedge was recorded by Zotov (1941).

The creek at Sladden Park is lined with exotic grasses (Fig. 21.5); although here the dominant species is tall fescue, which forms thick clumps on the creek margin, particularly on the shallower south bank. The tidal end of Ōpahu Stream (Black Creek) on the true left of the river has some rock edge protection around the culvert entrance to Te Awa Kairangi/Hutt River, largely to reduce erosion risk at this entrance. The remaining stream length is now planted with native plants such as sea rush, oioi, and flax in order to facilitate the reestablishment of inanga habitat (Figs 21.6 & 21.7) (Mitchell 2004).

Te Mome Stream has undergone restorative planting, with stretches of raupō, umbrella sedge, wīwī, and flax lining the upper reaches (Fig. 21.4) (Wellington Regional Council 2001a). The lower reach of the stream is overhung with pōhutukawa and taupata, with clumps of tall fescue lining the banks.

Given the fundamental changes to the estuarine system's surrounding environment since the 1900s (Treadwell 1959), there has been a massive loss of habitat for wildlife. Despite this, the estuarine area is still an important ecosystem, particularly as an access corridor for migratory fish and birds. Common native species such as little black shags (Fig. 21.8), white-faced herons and black swans regularly visit to forage. Rarer species such as red-billed gulls, Caspian terns, and variable oystercatchers will also congregate to feed at the mudflats in the western arm of the estuarine site. The estuarine site was included in the OSNZ (2007) river mouth bird survey and is also included in Wellington Harbour bird surveys conducted by OSNZ.

Thirteen migratory native freshwater fish species have been found in the catchment, including seven species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, inanga, redfin bully, bluegill bully and lamprey; Allibone et al. 2010). Historically, Te Awa Kairangi / Hutt River has supported a large galaxiid population, and the estuarine ecosystem was an important inanga spawning ground. However, with the rock rip placed along the riverbanks, most of the suitable spawning habitat has been destroyed. The only remaining suitable habitat is found



Figure 21.6. Concept design for Strand Park (Ōpahu Stream) restoration. Reproduced from Hutt River Environmental Strategy, Wellington Regional Council 2001a.



Figure 21.7. The restoration planting along the tidal margins of the Ōpahu Stream. Photo: Matt Todd.

in the tall fescue clumps of Sladden Park Creek, and the sea rush in Ōpahu Stream; however, there is no evidence that spawning occurs (Taylor & Kelly 2001). Further surveying in 2016 (Taylor & Marshall 2016), concluded that there is no potential for inanga spawning in the Ōpahu downstream of the Wai-iti Crescent culvert, however there is a slim possibility of spawning habitat being present upstream of this culvert. Possible spawning habitat was also identified in the Sladden Park boat ramp area, the bunded backwater of the lower Ōpahu, and the Te Mome Stream. (Taylor & Marshall 2016).

The estuarine system is a nursery area for juvenile flatfish, particularly black flounder (Stevens et al. 2004, and references therein). Kahawai, grey mullet, and other fish species found in the harbour also visit regularly to feed. Grey mullet have been observed spawning in the river in early spring (J. Mikoz, Wellington Recreational Marine Fishers Association 2010, pers. comm.).



Figure 21.8. Shags, here shown roosting on a gravel bank, are just a part of the variety of birdlife that utilises the estuarine reaches of the river. *Photo: Matt Todd.*

The marine invertebrate animals are dominated by gastropod snails and shellfish (cockles and pipi), with an assortment of polychaete worms and amphipods also present in the sediments (Stevens et al. 2004). An extensive cockle bed is known to lie around the mouth of the river, but the effects of the dredging in the vicinity of this population are uncertain. Te Awa Kairangi/ Hutt estuarine system is one of only five locations nationally where the polychaete *Boccardiella magniovara* (collected upstream of the Estuary Bridge) has been found (National Aquatic Biodiversity Information System 2010).

Table 21B lists native species present in, or utilising, the Hutt River (Te Awakairangi) estuarine system.

21.2.2 Recreational

Much of the land in the immediate vicinity of the lower reaches of the estuarine system is given over to industry, although Hikoikoi Reserve straddles the point between the river mouth and Petone Beach, and Shandon Golf Course occupies the true right bank just upstream of the Estuary Bridge. Riverside trails run the length of the estuarine area on both banks, and are popular with walkers and joggers.

21.3 Catchment properties

The Te Awa Kairangi/Hutt River, 54 km long from its source in the Tararua Range to the mouth in Wellington Harbour, drains a catchment that covers 65 500 ha. While the upper reaches of the East and West branches of Te Awa Kairangi/Hutt River, and two of its major tributaries, the Akatarawa and Pākuratahi, are deep in the forested Tararua and Rimutaka ranges, Te Awa Kairangi/Hutt River valley is highly urbanised, containing all of Upper Hutt and most of Lower Hutt City. From Te Marua, the river flows through nearly 25 km of urban land. The third major tributary, the Mangaroa, drains a valley that is over half indigenous forest and exotic forest and a third pastoral. GWRC monitors water quality at four sites in the river, including downstream

Table 21B. Native species present in, or utilising, the Hutt River (Te Awakairangi) estuarine system.

| GROUP | SPECIES |
|-------|----------------------------------|
| Birds | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Caspian tern+ |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Red-billed gull+ |
| | Reef heron+ |
| | Royal spoonbill* |
| | South Island pied oystercatcher* |
| | Southern black-backed gull |
| | Spotted shag |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | White heron+ |
| | White-faced heron |
| Fish | Banded kōkopu |
| | Black flounder |
| | Bluegill bully* |
| | Common bully |

| GROUP | SPECIES |
|----------------------------|--|
| Fish continued | Common smelt |
| | Giant bully |
| | Giant kōkopu* |
| | Grey mullet |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Lamprey+ |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Variable triplefin |
| | Yellow-eyed mullet |
| Aquatic macroinvertebrates | Cockle |
| | Mud snails (P. antipodarum and estuarinus) |
| | Mudflat snail |
| | Mudflat whelk |
| | Pipi |
| | Pillbox crab |
| | Spionid Boccardiella magniovata+ |
| | Stalk-eyed mud crab |
| | Tunnelling mud crab |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

at Boulcott Street (GWRC site RS22) and reports fluctuating Water Quality Index (WQI) scores, ranging from 'good' to 'excellent' (Perrie et al. 2012, Morar & Perrie 2013). In the 2014/15 monitoring year, all four sites scored 'excellent' (Keenan & Morar 2015). Recreational water quality grades produced from seven monitoring sites in the river ranged from 'poor' to 'good' during 2014/15. When samples after rain are included, most sites were graded as 'poor' (Keenan et al. 2015). Toxic algal blooms are also a seasonal hazard, forming anywhere in the river downstream of Te Marua during the summer months.

Flood risk management in such a densely populated floodplain (which has over time resulted in straightening and stopbanking of the lower river and draining of the surrounding wetlands) is an issue that affects the estuarine ecosystem (for further information see the Hutt River Floodplain Management Plan, Wellington Regional Council 2001b). GWRC has responsibility for flood risk management within Te Awa Kairangi/Hutt River floodplain for those parts of the river and tributaries which are covered by the Hutt River Floodplain Management Plan.

21.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

The presence of spartina observed in the Ōpahu Stream in 2009 near the confluence with Te Awa Kairangi/Hutt River (M. Todd 2009 pers. obs.; C. Howell, DOC 2009, pers. comm.) is of some concern; it is an aggressive, colony-forming species that can take over considerable areas of estuarine mudflats, and can spread both vegetatively and rhizomatously. Even following successful control, vigilance will be required to ensure that no re-establishment occurs.

Reed sweetgrass was recorded as an emergent weed in the Ōpahu Stream by Taylor & Kelly (2001); this is no longer present.

Extensive growth of macroalgae is present throughout the estuarine system. Nuisance algae conditions are not present intertidally but exist in some subtidal areas, possibly due to catchment or localised nutrient inputs (Stevens & Robertson 2010, 2012, 2015a). The nearby recreational water quality monitoring site (GWRC – Petone beach at kiosk) registered levels of enterococci which exceeded guidelines during the 2014/2015 summer bathing season (Keenan et al. 2015).

Although the river has frequent water quality problems, the estuarine sediments are in good health (Stevens et al. 2004; Robertson & Stevens 2010; Stevens & Robertson 2013, 2015b), with heavy metal levels well below those that might be expected, and described by Robertson & Stevens (2010) as 'good'. However, due to the nature of the catchment, contamination from urban stormwater and industrial sources remains a risk.

21.5 Conservation management

21.5.1 Current

Te Awa Kairangi/Hutt River is managed by GWRC through the Hutt River Floodplain Management Plan (Wellington Regional Council 2001b). This document considers flood risk management, the protection of existing ecosystems and the restoration of native habitat. A key component of the Floodplain Management Plan is the Hutt River Environmental Strategy (Wellington Regional Council 2001a). It describes a long-term vision for the river and sets the direction for the management and development of the river, and its margins, at a strategic level. The proposed improvements to Te Awa Kairangi/Hutt River flood defence system will be guided by the vision of the Environmental Strategy.

In December 2012 a Deed of Settlement was signed between Ngāti Toa Rangitira and the Crown. This deed recognises the role of Ngāti Toa as kaitiaki of the coastal marine area of Wellington Harbour (Port Nicholson). The Deed therefore recognises the association of the iwi with the area and enhances their ability to participate in specified Resource Management processes. Statutory Acknowledgement is also given to Te Awa Kairangi/Hutt River and its tributaries which obliges the Crown to consult with the iwi on specified matters and have regard to their views because of this special association with the river.

Te Ātiawa maintains a strong interest in the management of the river, particularly the estuarine area, regarding it as a taonga. As such, they have advocated for the planting of native bush and restoration of wetlands on the river margins, and tighter restrictions on industrial discharge.

GWRC has undertaken habitat mapping of Te Awa Kairangi/Hutt River estuarine site and margins (Stevens et al. 2004), intertidal macroalgal monitoring (Stevens & Robertson 2010, 2012, 2013a, 2014b, 2015a), fine-scale intertidal sediment and sediment biota monitoring (Robertson & Stevens 2010, 2011, 2012; Stevens & Robertson 2013b, 2014b, 2015b), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). The site is part of GWRC's long-term estuarine state of the environment monitoring programme, with the first round of intertidal ecological monitoring (sediment quality and benthic plants and animals) conducted in January 2010 (Robertson & Stevens 2010). Sedimentation plates have also been deployed in the estuarine area.

A condition of the consent for the Ewen to Ava flood protection works was a number of environmental enhancement projects. Community planting days were arranged in 2008 and wetland species such as oioi, sea rush and giant umbrella sedge were planted alongside Ōpahu Stream. Taupata, karamū, toetoe and mountain flax were planted in a 3–4 m wide strip along 500 m of the stream on both banks. The restoration site is monitored according to the 'best practice restoration' guidelines provided by GWRC (2004). In addition to this, Mitchell (2004) proposed strategies for improving inanga spawning conditions in the stream, based

on recommendations in the Hutt River Environmental Strategy (Wellington Regional Council 2001a). Elsewhere, community efforts have gone into the restoration of native riparian vegetation in Te Mome Stream and Strand Park.

21.5.2 Potential

Although it is unfeasible to restore the greater area of the Te Awa Kairangi/Hutt River estuarine system to its pre-European state, restoration of its smaller tributary streams is not only possible, but in the case of Te Mome and Opahu Stream, already underway. These projects require ongoing management, however, particularly in the exposed habitat of the Ōpahu Stream where faster growing weeds could colonise the restoration area.

The Hutt River Environmental Strategy (Wellington Regional Council 2001a) has various proposals for restoration. These include proposals to plant the bank edges between the river mouth and the Estuary Bridge with eco-sourced native estuarine and coastal species (Fig. 21.6); enhance Te Mome Stream, Black Creek, the bunded backwater of the Ōpahu Stream, and Sladden Park boat ramp area with plantings of native grasses and sedges suitable to enhance inanga spawning habitat (Mitchell 2004; Taylor & Marshall 2016) (Fig. 21.5); and investigating the feasibility and benefits of re-introducing throughflow to Te Mome Stream. It also proposes a walkway linking the Hutt River Trail to the Seaview Marina. However, the latter proposal contains no provision for environmental restoration in the concept designs.

The creek at Sladden Park has restoration potential along the north bank, where the margin is uneven. A native planting scheme/plan, similar to that of the Ōpahu Stream, is appropriate and could include planting of rushes in the intertidal zone, backed by flax and possibly tauhinu and ngāio. In this area of high recreational use, the area could be protected with a low wooden barrier, and an information panel put in place regarding the conditions for a healthy estuarine wetland.

Perhaps the most valuable conservation site on river is the estuarine basin below the Estuary Bridge, listed as a Site of Special Wildlife Importance. The margins of this arm of the estuarine system have well established shrubs along the path of the Hutt River Trail. The small area of existing saltmarsh requires maintenance, as this is the only location of saltmarsh ribbonwood in the estuarine system, and tall fescue and other weeds are starting to encroach into the area. The public could be included in the restoration process by being made aware of the estuarine ecosystem, and the unique features of this site, through information signs. Apart from the SSWI listing, it currently has no status as a conservation asset, either for DOC or GWRC. Given its value as an uncommon environment and as a feeding site for birdlife, this part of the river could be protected as a Wildlife Reserve, possibly as an adjunct of the River Trail, administered by GWRC.

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22. Waiwhetū Stream

22.1 Site description

The Waiwhetū Stream is a lower tributary of Te Awa Kairangi/Hutt River which drains into Wellington Harbour adjacent to Te Awa Kairangi/Hutt River mouth and is tidal for over 1 km upstream (Table 22A; Fig. 22.1 & 22.2). The small tributary, Awamutu Stream, is also tidally influenced. Historically it was part of a large saltmarsh wetland area at the Te Awa Kairangi/Hutt River mouth (Fig. 21.2). Passing through the industrial areas of Gracefield and Seaview, the Waiwhetū Stream is now largely constrained between high banks and retaining walls and is crossed by four roads and a railway bridge.

For over 60 years, industrial waste was discharged directly into the stream from surrounding factories, a practice that ceased only in 1978, leading to the stream to be popularly held as 'the most polluted urban waterway in New Zealand' (e.g. Green Party 2008). Heavy metals, such as cadmium and nickel, and sulphides contributed to the dull black colour of the mudflats. In 2001, Sheppard & Goff found high levels of contaminants even beyond 1 m depth. They estimated there were 30 000 cubic metres of highly contaminated sediment in the stream.

Between November 2009 and May 2010 remediation work was carried out by GWRC and Hutt City Council, with the objectives of (a) restoring water quality, (b) creating habitat for fish and other species in its lower reaches (Halliday 2010), and (c) widening and deepening the waterway for flood control purposes. This entailed the use of diggers to remove contaminated sediment (56 331 tonnes), and some vegetation, over a length of around 1460 m between Bell Road Bridge

Table 22A. Waiwhetū Stream site information (see also Fig. 22.1).

| SITE NAME | WAIWHETŪ STREAM |
|--|--|
| Location | Lower Hutt |
| | |
| NZTM (coordinates) | 1759478 5433286 |
| NZ Topo50 | BQ32 595 333 |
| Area | Approx. 4 ha |
| DOC Office | Kāpiti Wellington Office |
| Councils | Hutt City Council, GWRC |
| Land status (tenure) | Private Hutt Park Raceway (Hutt City Council) Motor Camp (Hutt City Council) River Recreation Reserves (Hutt City Council) Seaview Marginal Strips 1 & 2 (DOC) |
| Existing rankings | Ecol Site 32 |
| Ecological district | Wellington |
| Estuarine classification | Category B |
| Threatened species (number) | 2 |
| At Risk species (number) | 5 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1-5) | 4 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 1 |
| Dominant habitat | Restiad rushland |
| | Gorse shrubland |
| | Browntop grassland |
| | Ngāio treeland |
| | Mudflats |
| | Subtidal |
| | I . |



Figure 22.1. Waiwhetū Stream estuarine site showing areas and places mentioned in the text.



Figure 22.2. Waiwhetū Stream restoration plantings, over a kilometre inland, are inundated by high tides. Photo: Helen Kettles.

and Port Road Bridge. The sediment was replaced with clean gravel, sand and cobbles. The end result is a wider and deeper channel with erosion and scour protection works with some plantings between Bell Road Bridge and the location of the saltmarsh downstream of Seaview Road Bridge.

22.2 Conservation values

22.2.1 Ecological

A small area of saltmarsh is present just downstream from the Seaview Road Bridge. This area (0.06 ha, 2.1% of the estuarine system; Stevens & Robertson 2009) consisted mainly of oioi, with some sea rush, saltmarsh ribbonwood, and flax. Glasswort herbfield was present on the mudflats. This habitat was excavated completely during the remediation process, and the marsh sediment profile rebuilt following the removal of contaminated material (Fig. 22.3) (Halliday 2010). Post-remediation planting, mainly consisting of sea rush and oioi, increased the total saltmarsh area to 0.14 ha or 4.5% of the estuarine system in 2010 (Stevens & Robertson 2012). Riparian shrubs and trees, including taupata, karo, ngāio, and pōhutukawa, line the rear of the saltmarsh site. However, the glasswort herbfield was not re-established, and is no longer present in the environment. There has been a loss of shade trees in the upper estuarine area.





Figure 22.3. Saltmarsh walkway below the Seaview Road bridge, in the Waiwhetū Stream, before (A) and after (B) remediation. *Photo: Wriggle Coastal Management*, © *Greater Wellington Regional Council*.

There were few areas of intertidal mudflats present prior to remediation (1.28 ha) and the redevelopment has further reduced this habitat by 65% to 0.46 ha. The area of margins covered by scrub/forest, mostly in the upper tidal area, has also been reduced by half since 2009. The planting of native tussocks has tripled the presence of this vegetation type at the margins (Stevens & Robertson 2012) (Fig. 22.4).





Figure 22.4. The banks of the upper tidal reaches of the Waiwhetū Stream, before (A) and after (B) remediation. *Photo: Wriggle Coastal Management*, © *Greater Wellington Regional Council*.

There are no threatened plant species known to occur here.

Very few native birds were observed at the time of visiting in 2009. A black shag was seen in the mudflats near Hutt Park, and red-billed gulls were seen around the mouth of the stream. The OSNZ has recorded paradise shelduck and black swan in the estuarine area and, in late 2010, one brown teal.

Eight migratory native freshwater fish species have been found in the catchment, including four species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro and inanga; Allibone et al. 2010). Marine species are also known to enter the tidal area. Tremblay et al. (2005) surveyed the Waiwhetū Stream and did not find common bullies despite earlier records of their presence. An inanga spawning site was identified in the river near Hayward Terrace during surveying in 2016 (Taylor & Marshall 2016).

Tremblay et al. (2005) also noted that numbers of marine macroinvertebrates were lower than average, although the species range was similar to that expected in an estuarine environment. *Potamopyrgus* snails and oligochaete worms were the groups listed as being most abundant. In 2009 the marine invertebrate community living in and on the sediments was similar to other estuarine systems but the abundance of most species, apart from mud snails, was low (Stevens & Robertson 2009). Overall the species present are ones that tolerate moderate organic enrichment. Surveys carried out in 2012 showed a slight improvement in macroinverebrate life since remediation of the site (Stevens & Robertson 2012).

Table 22B lists native species present in, or utilising, the Waiwhetū Stream estuarine system.

22.2.2 Recreational

A raised walkway has been built over the saltmarsh area, with access from Seaview Road as part of the remediation works, and a recreational track was added to connect Seaview Road Bridge to Port Road Bridge. The upper reaches of the estuarine site is valued for recreational uses such as walking.

Table 22B. Native species present in, or utilising, the Waiwhetū Stream estuarine system.

| GROUP | SPECIES | GROUP | SPECIES |
|-------|----------------------------|----------------------------|-----------------------------|
| GROOF | 01 20120 | | 0. 20.20 |
| Birds | Black shag* | Fish continued | Longfin eel* |
| | Black swan | | Shortfin eel |
| | Little shag | | Variable triplefin |
| | Paradise shelduck | | Yellow-eyed mullet |
| | Pied shag+ | Aquatic macroinvertebrates | Arthritica sp. |
| | Red-billed gull+ | | Cockle |
| | Southern black-backed gull | | Mud snails (P. antipodarum, |
| Fish | Banded kōkopu | | P. estuarinus) |
| | Common smelt | | Pillbox crab |
| | Giant bully | | Pipi |
| | Giant kōkopu* | | Stalk-eyed mud crab |
| | Inanga* | | Tunnelling mud crab |
| | Kōaro* | | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species. Note also this list was compiled prior to stream remediation works.

22.3 Catchment properties

The stream rises in the hills behind Naenae, with a catchment of around 1960 ha. Land use is mainly residential urban, although the hills (perhaps 30% of the catchment) are covered in regenerating bush (MacDonald & Joy 2009). As noted above, the lower reaches of the stream flow through an industrial area, although two DOC-administered marginal strips (Riverside Drive and Gracefield) line the river along the Riverside Road. bend.

22.4 Threats

Prior to remediation the lower Waiwhetū Stream was rated poor in terms of eutrophication, sedimentation, toxicity and habitat loss (Stevens & Robertson 2009). The current state of the estuarine ecosystem was assessed in 2012 (Stevens & Robertson 2012) and found to still be rated poorly for these categories. Macroalgal growth was more widespread in 2012 compared to 2009 with sea lettuce present over the majority of the intertidal area. Although these weren't at nuisance levels it does indicate an excess of nutrients in the estuarine system.

Soft mud areas are no longer present intertidally as they were removed at remediation. However, soft muds have accumulated subtidally since the remediation works which indicates problems with muddiness may be likely in the future (Stevens & Robertson 2012). The subtidal sediments were also found to have excessive organic matter. These results indicate that inputs to the estuarine system will need to be managed to maintain or improve the condition of the ecosystem.

Intertidal slopes have been replaced with vertical concrete walls in many parts of the tidal zone, precluding the re-establishment of intertidal habitats. This greatly reduces the area available in the estuarine ecosystem for the natural formation of saltmarsh or invertebrate populations (Stevens & Robertson 2012).

Heavy metal concentrations in the estuarine system are still of concern. Some metal concentrations still exceed ANZECC low or high trigger values as do polycyclic aromatic hydrocarbons, organochlorines and petroleum hydrocarbons (Stevens & Robertson 2012). In some cases contamination levels were greater after remediation. At one site this was linked to a seam of capped contaminated material in the stream bank being exposed by stream erosion.

Hutt City Council retains the right to allow waste overflow, including untreated sewage, to enter the stream during times of flood (MacDonald & Joy 2009).

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Tall fescue and gorse are well established along the banks, and are difficult to remove. Cape pondweed is established further upstream; this is an invasive aquatic species that can clog waterways if uncontrolled. Yellow flag iris is known to occur in the catchment (MacDonald & Joy 2009). This species forms thick floating mats that smother other aquatic plants and spreads through vegetative dispersal.

Spartina was well established in the saltmarsh prior to the remediation works when it was removed. This species forms dense swathes that smother other intertidal vegetation. The infestation was mechanically excavated as part of the removal of contaminated sediments, and the species is no longer present. However, this species is known to have the ability to re-invade intertidal habitats by regenerating from remaining buried fragments of rhizome.

Changes in the hydrology of the stream have led to unexpected consequences in terms of waterway dynamics. Some areas of planted tussock and saltmarsh have been subject to erosion as a result of this (Stevens & Robertson 2012).

The Hutt River Environmental Strategy (Wellington Regional Council 2001a) includes a proposal to create a recreation link along Waiwhetū Stream and a concept design for widening the stream mouth to create a boat harbour. The latter appears to have no provision for environmental restoration.

22.5 Conservation management

22.5.1 Current

GWRC manages the waterway and tidal area of the Waiwhetū Stream. Following the removal of the contaminated sediments and the initiation of restoration of saltmarsh and riparian habitats, the stream is to be managed under the Waiwhetū Floodplain Management Plan, currently still in preparation (GWRC 2012).

The banks of the estuarine area are managed by a variety of interests and authorities, including Hutt City Council, adjoining industrial sites, and DOC, who administers the Seaview Marginal Strips (1 & 2) on either side of the river mouth. A raised walkway has been built to allow access to the small saltmarsh area.

The Friends of Waiwhetū Stream have developed a variety of goals and objectives in relation to the stream environment which include objectives for fish spawning, ecological weed control and pollution reduction (Friends of Waiwhetū Stream 2012). In association with Hutt City Council, they organise community volunteer workdays. They have been involved with the initial restoration planting efforts along the banks of the tidal zone following the remediation work.

Te Ātiawa maintain a strong interest in the management of the stream.

GWRC has undertaken baseline habitat mapping of the Waiwhetū Stream estuarine site and margins, and fine-scale intertidal sediment and sediment biota monitoring (Stevens & Robertson 2009, 2012).

Extensive flood control work was carried our in November 2009 and May 2010 by GWRC and HCC as part of ongoing rehabilitation efforts. This included recontouring of the sides and removal of 88,665 tonnes of contaminated sedment. Repeat monitoring was undertaken to assess any change to ecological values (Stevens & Robertson 2012). Further monitoring is planned.

22.5.2 Potential

The Waiwhetū Floodplain Management Plan, once completed by GWRC, will outline the goals and management strategies for the restoration of the habitat in and around the lower reaches of

the Waiwhetū Stream, including the intertidal areas. This will be the document that will direct the restoration efforts of all stakeholders in the Waiwhetū Stream (GWRC 2012). A Waiwhetū Stream Environmental Strategy will also be completed by GWRC.

The erosion noted occurring along the stream banks requires monitoring. Plans to redress this situation, and guard against reoccurrence, should be included in the Floodplain Management Plan. This would include a strategy for reinstating areas of failed plantings and managing the residual sediment contaminants present, and prevent ongoing contaminant inputs to the estuarine system.

The potential reinvasion of spartina should be monitored in the replenished saltmarsh area near the Seaview Road Bridge. In the event of its reappearance, GWRC Biosecurity should be alerted.

Locating, documenting, and restoring any potential inanga spawning sites would be valuable.

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23. Parangarahu Lakes

23.1 Site description

The two lakes east of Pencarrow Head (Te Rae-akiaki), Lake Kōhangapiripiri and Lake Kōhangatera (known collectively as the Parangarahu Lakes, or formerly the Pencarrow Lakes) (Table 23A; Fig. 23.1). Kōhangatera is classified as a lake of national significance but iwi consider the combined area to be a taonga warranting the highest level of conservation and protection.

We have included the lakes in this report as they are periodically open to the sea and, in the future, with climate change-induced sealevel rise, will become increasingly estuarine in nature. They were historically estuarine systems that were then blocked off from the sea by a series of earthquakes that raised the entire area by up to 8.5 m. Now, gravel banks block the outlets to the point so that discharge is tenuous. Prior to a major flood event in 2003, Lake Kōhangapiripiri breached this barrier only occasionally (every 7–15 years) and Lake Kōhangatera every 5–10 years (O. Spearpoint, Eastbourne resident 2015, pers. comm). Kōhangapiripiri has a smaller catchment, where stream flows are smaller, therefore breaches the barrier less often. The beach profile changed so much during the 2003 flood that it has been much easier for both the lakes to breach since.

The water level fluctuates seasonally; the outlet channels are usually dry during summer, while seepage through the gravel normally accounts for most of the drainage during winter. Despite the two lakes being predominantly freshwater systems, they still possess the estuarine characteristics of brackish shallow water, saltmarsh vegetation, and extensive wetlands at the upstream end (Fig. 23.2). With predicted future sealevel rise estuarine conditions could become more prevalent.

Table 23A. Parangarahu Lakes site information (see also Fig. 23.1).

| SITE NAME | PARANGARAHU LAKES |
|--|--|
| Location | Pencarrow Head |
| NZTM (coordinates) | 1755276 5419587 and 1756076 5418787 |
| NZ Topo50 | BQ31 553 196 and BQ32 561 188 |
| Area | Combined area 30 ha |
| DOC Office | Kāpiti / Wellington Office |
| Councils | Hutt City Council, GWRC |
| Land status (tenure) | Lake Bed/Esplanade Reserves (Private – Port Nicholson Block Settlement Trust) East Harbour Regional Park (GWRC) Lake Kōhangatera Wildlife Reserve (DOC) Lake Kōhangatera and Lake Kōhangapiripiri Scientific Reserve (DOC) Lake Kōhangatera and Lake Kōhangapiripiri Covenant (DOC/Trustees) |
| Existing rankings | Ecol Sites 47, 48, 1036, 1037, 1069 WERI: 3, SSWI: Moderate (Ecol Site 47) WERI: 4, SSWI: High (Ecol Site 48) Key Native Ecosystem (GWRC) |
| Ecological district | Tararua |
| Estuarine classification | Category A |
| Threatened species (number) | 7 |
| At Risk species (number) | 15 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 5 |
| Dominant habitat | Raupō reedland Restiad rushland Scabweed herbfield Aquatic |

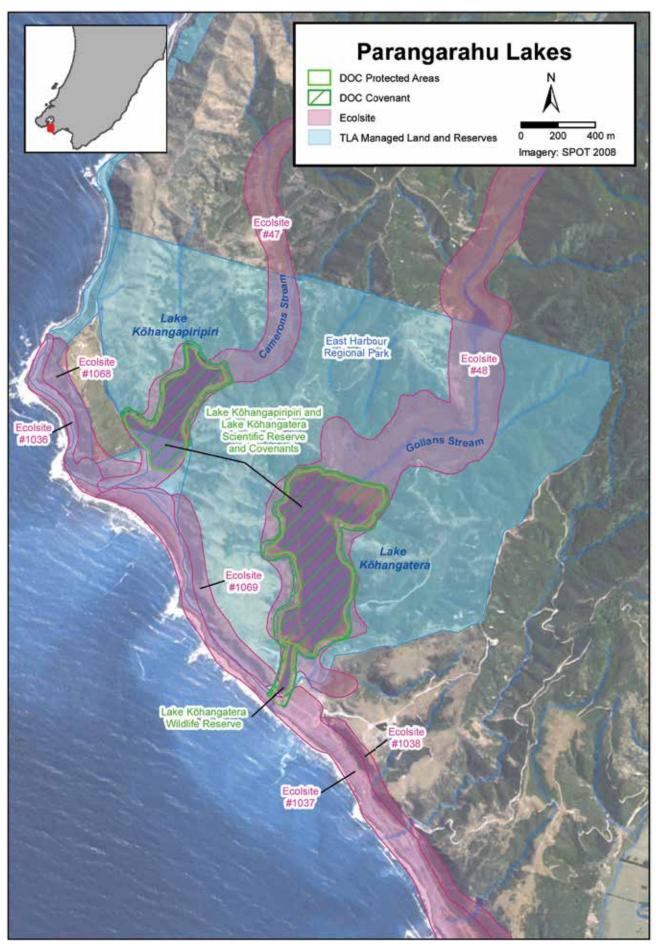


Figure 23.1. Parangarahu Lakes estuarine site showing areas and places mentioned in the text.



Figure 23.2. Saltmarsh vegetation at the head of Lake Kohangatera with panoramic views to the Wellington south coast in the background. *Photo: DOC.*

While the lakes have remained unmodified, the immediate environs have been farmed for nearly 150 years (Gibbs 2002). In addition, an access road has been built across the outlets of both lakes (Fig. 23.3), with concrete pipes laid to funnel the outflow. Nicholson (2008) suggests that it was this development during the 1960s that hastened the complete blockage of the lakes' outlets. The beach adjacent to the outlet of Lake Kōhangatera has been extensively quarried for sand, but that of Lake Kōhangapiripiri is intact. Quarrying is now confined to areas further down the beach. Other than the lighthouse at Pencarrow Head, the only structures in the vicinity are a small concrete pumping station to the southwest of Lake Kōhangapiripiri and a corrugated iron woolshed near the Lake Kōhangatera outlet.

23.2 Conservation values

23.2.1 Ecological

Although the surrounding hills historically have been burned and grazed, the indigenous plant communities of the wetlands and lake margins are relatively unmodified today. In 2006 Landcare Research ranked the Lake Kōhangapiripiri wetland as being in excellent condition, second out of the 177 swamps assessed in New Zealand (Bev Clarkson pers. comm. 2013, in Te Roopu Tiaki 2014).

The wetlands are dominated by raupō, flax, and cutty grass while around the lake margins oioi and sea rush are most common, with intermittent patches of toetoe (Clelland 1984). Gibbs (2002) listed 61 indigenous species within these communities and in the open water and a further 18 on the beach ridges. Most are dicotyledonous herbs, or rushes and grasses; the beach ridges are dominated by mat species such as scabweed and pinātoro. Several of these species are of significance, such as pīngao, or regionally threatened swamp buttercup; one, dwarf musk found on the gravel, is nationally threatened.

The Parangarahu Lakes have been assessed according to Lake Submerged Plant Indicators (SPI) (see de Winton et al. 2011) which characterises lakes according to the composition of their native and exotic plant communities. Lake Kōhangatera was assigned a score of 'excellent'



Figure 23.3. The entrance to Lake Kohangapiripiri with the roadway built across the outlet. Photo: DOC.

and Kōhangapiripiri was rated as 'high'. Lake Kōhangatera was listed as 10th best out of 206 lakes surveyed in New Zealand and Kōhangapiripiri 47th. De Winton et al. (2011) described the botanical values of Lake Kōhangatera as 'Nationally Outstanding' and noted that other examples of indigenous lagoon vegetation in New Zealand have largely disappeared due to human impacts. Species present of note include: fennel-leaved pondweed, Einadia allanii, Lepilaena bilocularis (Lake Kōhangapiripiri only), Glossostigma diandrum and G. elatinoides.

There are various Threatened or At Risk plant species present in the estuarine system. Other plants of interest are gratiola, mudwort, kuāwa, prickly couch and swamp buttercup, the latter of which is listed in the threat classification as Data Deficient.

Mitcalfe & Horne (1997) reported the presence of approximately 50 exotic plant species in the vicinity. Most of these are terrestrial pasture weeds, but six are noteworthy for their weediness; Mercer grass, briar, tree lupin, and gorse are present around the lake margins and outlets, water buttercup is in the open water of both lakes (see also Orchard 1995), and marram is found on the gravel banks.

Pīngao and kōwhangatara are found in nearby dunes and there are several small groves of karaka adjacent to the wetlands at the head of both lakes. The East Harbour Regional Park Resource Statement (GWRC 2007) speculates that these were plantings associated with seasonal occupation by Māori, a theory supported by the presence of dendroglyphs on several trees.

The lakes and beaches are an important habitat for a variety of bird species, particularly waterfowl. Common species, including black swan, are present in large numbers. Australasian shovelers, grey teal, black shags and pūkeko occur. Pūkeko are less common now than in the 1950s (I. Armitage., OSNZ 2010, pers. comm.). Dabchicks have become established since 2004 and are breeding—the southern-most breeding population of dabchicks in New Zealand. Scaup have also become established since 2005. Pied stilts are periodic visitors. Parrish (1984) recorded the presence of two rare species—bitterns and spotless crakes—and commented that the lakes offered suitable habitat for breeding. It is unclear whether these species now exist here. On the beach adjacent to the outlet of Lake Kōhangapiripiri are nesting colonies of banded dotterels

(one of only two sites in the western part of the region; GWRC 2007) and variable oystercatchers. OSNZ completes regular bird counts on the lakes.

Ten migratory native freshwater fish species have been found in the lakes and their catchments (Nicholson 2008; Joy & Hewitt 2002), including six species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, kōaro, inanga, redfin bully and lamprey; Allibone et al. 2010). However, due to the infrequent breaching of Lake Kōhangapiripiri, the obligatory diadromous species (e.g. inanga) are restricted to Lake Kōhangatera and the Gollans Stream catchment. Only the longer-lived species that require only intermittent recruitment, or can process their entire lifecycle in freshwater, are found in Lake Kōhangapiripiri and Camerons Stream.

The Lakes area has the greatest abundance of lizards of all the regional parks and is a significaint mainland site for Wellington (Te Roopu Tiaki 2014). A herpetological survey was undertaken in 2009 (Romijn 2009) and found northern grass skinks, raukawa geckos and copper skinks. Most animals were found in coast cliffs, shoreline or boulderbanks. Spotted skinks were historically found at the site. There is little monitoring of frogs or invertebrates at the Lakes. Frogs and tadpoles observed are widespread Australian species (Te Roopu Tiaki 2014). The lakes have various notable freshwater species. Kōura are known to be present in Gollans Stream (Gibbs 2002); it is likely that they will also be found in Lake Kōhangatera or, indeed, Lake Kōhangapiripiri and Cameron's Stream, as they are non-migratory and do not require access to the sea. One native dragonfly, Uropetala carovei, has been noted (Brown 1992), and Patrick (2004) noted several nationally and locally important terrestrial invertebrates, including the threatened moth species Notoreas perornata "Wairarapa/Wellington" on the beaches and nearby coastal cliffs. Finally, the threatened New Zealand freshwater mussel (kākahi) is abundant in both lakes (de Winton et al. 2011).

Table 23B lists native species present in, or utilising, the Parangarahu Lakes estuarine/freshwater system.

Table 23B. Native species present in, or utilising, the Parangarahu Lakes estuarine system.

| GROUP | SPECIES |
|-------------------------------|--|
| Threatened and At Risk plants | Dwarf musk* |
| | Fennel-leaved pondweed* |
| | Kirk's crassula* |
| | Sea holly* |
| Birds | Australasian shoveler |
| | Banded dotterel+ |
| | Bittern+ |
| | Black shag* |
| | Black swan |
| | Caspian tern+ |
| | Dabchick+ |
| | Grey duck/mallard hybrid |
| | Kingfisher |
| | Little shag |
| | New Zealand dotterel+ (only in Lake Kōhangatera) |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Scaup |
| | Southern black-backed gull |

| GROUP | SPECIES |
|-----------------|---|
| Birds continued | Spotless crake* |
| | Spotted shag |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Banded kōkopu |
| | Common bully |
| | Common smelt |
| | Giant bully |
| | Giant kōkopu* |
| | Inanga* (only in Lake Kōhangatera) |
| | Kōaro* (only in Lake Kōhangatera) |
| | Lamprey+ (only in Lake Kōhangatera) |
| | Longfin eel* |
| | Redfin bully* (only in Lake Kōhangatera) |
| | Shortfin eel |
| Herpetofauna | Copper skink |
| | Northern grass skink |
| | Raukawa gecko |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

23.2.2 Recreational

The lakes lie within the southern block of the East Harbour Regional Park (GWRC), and are visited almost exclusively for the purposes of recreation, conservation or science. Some duck shooting is permitted during the season. Due to a combination of isolation and the exposed nature of the coastline, the level of visitation is low—less than 2% of East Harbour Regional Park users (GWRC 2007).

23.3 Catchment properties

While the two lakes are often thought of as a single unit, their respective catchments are quite different. Cameron's Stream, which feeds Lake Kōhangapiripiri, is 5 km long and drains an area composed entirely of farmland and regenerating bush, about 280 ha. Gollans Stream, which flows into Lake Kōhangatera, is some 14 km long, draining the undisturbed beech forest of the Eastbourne hills (including the northern block of the regional park), a large area of farmland, and about 150 ha of wetland, covering a total area of around 1700 ha. The Gollans catchment also includes a popular picnic area at the confluence of Butterfly Creek and a disused domestic refuse landfill site. There is little quantitative information regarding water quality in either of the catchments, but it is generally regarded as significantly better than that of comparable systems, such as Lake Forsyth in Canterbury (Gibbs 2002). GWRC conducted one-off water quality sampling in the Parangarahu Lakes in 2011 and classified Lake Kōhangapiripiri as eutrophic and Lake Kōhangatera as bordering between eutrophic and mesotrophic (Perrie & Milne 2012).

23.4 Threats

Feral pests, such as stoats, weasels, rodents, cats and possums are present around the lakes. The damage done by rabbits is conspicuous amongst the mat communities of the beaches (Gibbs 2002). However, this species has been the subject of control by both the regional park management since 2004 and the farm lease owner before that, and their numbers are currently not considered serious. A stoat trapping programme run by GWRC has been in place since 2008 and possums are controlled under Operational Solutions for Primary Industries' (OSPRI's) TbFree New Zealand programme.

A recent aquatic vegetation survey (de Winton et al. 2011) found water buttercup in Lake Kōhangapiripiri and the invasive oxygen weeds *Elodea canadensis* in Lake Kōhangatera and *Egeria densa* in the wetland upstream of this lake. Both these invasive species have the potential to outcompete native plants for space. Mercer grass on the lake margins is also concerning, as it forms dense mats that overwhelms other groundcover species. The regional park managers are reluctant to apply herbicide in an aquatic system, and continue to monitor the spread of the weeds (GWRC 2007). The potential introduction of the aggressively invasive weed hornwort which is present in many waterbodies in the region poses the biggest threat to the aquatic ecosystems of the Parangarahu Lakes. De Winton et al. (2011) recommend control or preferably exclusion of vehicle and boat access as the most effective means of avoiding transfer of ecological weeds and pest fish species into the lakes. Brown trout are present in Lake Kōhangatera (Nicholson 2008).

In 2004, the grazing lease ended and the area now has a more recreational focus with walkers and mountain-bikers. This has reduced the widespread impacts caused by the trampling of stock while the area was farmed (Gibbs 2002; GWRC 2007).

Since the 1960s the outlets of both Lakes have been culverted to provide for the coastal road. This has impacts fish passage to and from the sea, especially at Lake Kōhangapiripiri.

A coastal traffic route between Eastbourne and Wainuiomata via Fitzroy Bay has been considered by regional and transit authorities over the years (Gibbs 2002, and references therein). Any such

development would have a major direct impact on the beach ridge and coastal cliff community, both identified as significant, and the already restricted recruitment of inanga and other diadromous fish species in Lake Kōhangatera and the Gollans catchment. It would also facilitate access by the public to the area, placing the ecosystem under further pressure.

The potential introduction of aquatic species including exotic fish species poses a serious threat to the diverse native fish communities. Brown trout are already present in the Lake Kōhangatera catchment. The near-pristine status of the Parangarahu Lakes makes them very rare in current times and means they warrant particularly careful management.

23.5 Conservation management

23.5.1 Current

Greater Wellington Regional Council and PNBST jointly manage the Parangarahu Lakes Area through a 'Roopu Tiaki' or guardianship group set up in 2012. A Co-Management Plan (as an amendment to the GWRC Parks Network Plan) has been developed through wide engagement with agencies and community by the Roopu Tiaki (Te Roopu Tiaki 2014).

Some key aspects of the Co-Management Plan are: the restoration of native fish habitat and fish migration passages from the lakes to the sea; continued native plantings, predator control and terrestrial and aquatic weed control; Mātauranga Māori is revitalised and enhanced; continued monitoring with the addition of Māori cultural health indicators; protection of significant cultural heritage, including the recording of oral histories and provision of visitor information; enabling Taranaki Whānui iwi members to exercise their kaitiaki responsibilities; establishing a new walking track to replace the removed boardwalk and advocating for secured links to the Rimutaka Cycle Trail.

The Department of Conservation manages crown land and assets. The Crown owns some of the recreation reserve, the outlet of Lake Kohangatera and the Crown stratum of both lakes (the space occupied by water and air above the lakebeds is a scientific reserve). The recreation reserve is vested to Greater Wellington Regional Council under the Reserves Act 1977 while DOC retains administration of the outlet and Crown stratum, including the ability to restrict access on the scientific reserve. GWRC manages the recreation reserve as part of East Harbour Regional Park. The beds of the lakes and two esplanade reserves were vested in a governance entity representing the Port Nicholson Block, under the Port Nicholson Block (Taranaki Whânui ki Te Upoko o Te Ika) Claims Settlement Act 2009.

The PNBST owns the lakebeds, former esplanade reserves of the lakes and the dendroglyph (tree carving) sites. There is also a special condition for the area which the owner, PNBST, to give authorisation to members of the Taranaki Whānui to collect medicinal plant material and traditional food plants and fibres. Weaving plants¹⁰ have been identified in the Co-Management Plan as priority taonga species for planting.

The entirety of Lake Kōhangatera and the upper two thirds of Lake Kōhangapiripiri are managed by DOC as the Lake Kōhangatera and Lake Kōhangapiripiri Scientific Reserve and Covenants. The lower outlet of Lake Kōhangatera is also managed by DOC as the Lake Kōhangatera Wildlife Reserve. GWRC manages the lakes as part of the surrounding East Harbour Regional Park southern block. The block was farmed until 2004, with stock allowed full access to the lake margins (Fig. 23.4), but this ceased upon the lease expiry (GWRC 2007). Since then a track network has been completed, linking the area to the nearby Pencarrow Head and providing better recreational access for walkers, runners and mountain bikers through the use of boardwalks as well as barriers to restrict unauthorised access.

¹⁰ http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/ethnobotany/weaving-plants

Hutt City Council (HCC) also hold a number of responsibilities for this area, as landowner, infrastructure provider and as the territorial authority responsible for the implementation of the District Plan for this area. HCC manages the Pencarrow Head sewer outfall, located immediately west of the Kōhangapiripiri outlet. The Pencarrow Coast Road follows the coast and is the primary access to Parangarahu Lakes Area, and is owned by HCC for the purpose of maintaining the sewer outfall. Part of the escarpment between the Pencarrow Coast Road and the Parangarahu Lakes is owned by HCC, as is the outlet of Lake Kohangapiripiri¹¹.

The Parangarahu Lakes Area is part of the GWRC Key Native Ecosystem (KNE) programme and operational activities planned to manage and protect the biodiversity values of the lakes are set out in the KNE plan for the area (GWRC 2014). Gorse and other ecological weed species are being controlled in the wetlands and around the lake margins, and on the coastal escarpment between the lakes but are being left alone elsewhere in order to act as nursery species for regenerating native bush. Other ecological weed species that are being controlled on the lakes margins are beggars' ticks and yellow flag iris. Marram, horned poppy and tree lupin are being controlled on the gravel beaches at the bottom of both lakes. Aerial spraying of Egeria densa and Elodea canadensis in the Kōhangatera wetland in 2015 had a significant impact on the density and distribution of these species. Further control will be carried out if considered necessary to prevent these species impacting lake and wetland values. Strict controls on activities are in place to prevent weed spread. Predator (mustelid and hedgehog) trapping is carried out across the whole Parangarahu Lakes Area by GWRC and members of the local community group Mainland Island Restoration Operation (MIRO). Feral goats are occasionally shot when observed in accessible locations. Dogs are not permitted at the Lakes due to the high ecological values however there has been an exception for dogs associated with duck shooting activities. Duck shooting is managed by DOC with a permit system.



Figure 23.4. The margins of Lake Kohangapiripiri were stocked until 2004 but the vegetation is now regenerating. Photo DOC.

¹¹ For a map of land ownership refer to map 2 in the Parangarahu Lakes Area Co-Management Plan and amendment to the GWRC Parks Network Plan 2014 on the GWRC website www.gw.govt.nz/parangarahu-lakes-area-co-management-plan-2/

MIRO has an established native species nursery in Seaview for the purpose of restorative replanting in the Parangarahu Lakes Area including the immediate surrounds of the lakes and gravel beaches. So far, over 2000 trees have been planted in the area, at eight locations. In 2013, GWRC registered a 50 year Forest Sink Covenant over the majority of the GWRC recreation reserve at Parangarahu Lakes. This recognises both the natural regeneration and planted native vegetation as a sink for storage of the greenhouse gas carbon dioxide.

Permanent vegetation plots are monitored by GWRC for changes that have occurred since grazing stopped and the Lakes are part of Landcare Research's national wetland condition monitoring and NIWA's LakeSPI (Submerged Plant Indicators) assessment. Taranaki Whânui have identified regular fish monitoring, species research and cultural environmental monitoring as management actions. Bird community composition and numbers are regularly surveyed by the OSNZ.

23.5.2 Potential

The intent in the future is that the whole area, including land held by the Crown, will be integrated for management purposes.

The construction of the access road across the bars at the coastal ends of the two lakes probably limits water discharge and has a stabilising effect on the beach. Survey photographs from the 1940s, before the road was built, clearly show both lakes as having permanent outlets to the sea. If the causeway were to be reconfigured, with the outlet bridged rather than piped, permanent flow could possibly be re-established. However, this would need to be achieved without significantly disturbing the fragile ecosystems of the bars.

Hydrological modelling of the lakes was undertaken to determine whether the current culverts impact on fish passage, and to assess changes in lake levels if the culvert altered (Sinclair Knight Merz 2007). The hydrological modelling work is ongoing. A recent report (McEwan 2013) recommended options to improve fish passage at the mouth of Lake Kōhangapiripiri. Culverts could be improved to enhance fish passage, particularly by increasing their size. This would help with Taranaki Whānui aspirations to improve the opening of the lakes at the sea outlets with a long-term goal to restore the once abundant eel fishery for customary purposes. Future planning for sealevel rise implications would be prudent given the Lakes will become more brackish over time.

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 Prepared by Greater Wellington Regional Council and Port Nicholson Block Settlement Trust.

24. Wainuiōmata River

24.1 Site description

This is an unusual estuarine system as the river displays all the characteristics of a tidal river mouth type, with a sand/gravel bar obstructing the mouth, backed by a wide, torpid river basin, with patches of rushes on the banks (Table 24A; Figs 24.1, 24.2). A series of historic earthquakes have raised the river mouth such that it is now several metres above the high tide line; the only influence of saltwater felt in this system comes from splashes over the bar during severe southerly storms. The estuarine system could therefore be classified as a coastal lake.

The river runs parallel to the coast for roughly a kilometre, separated by a low dune. On this exposed site, vegetation is scarce and patchy, right up to the southern bank of the river. The northern bank is farmed, and exotic pastureland dominates. The site has been rated as an SSWI (moderate).

24.2 Conservation values

24.2.1 Ecological

The pasture on the inland margin of the river is dominated by exotic grasses, particularly browntop, creeping bent, and tall fescue (Taylor & Kelly 2001). On the bank itself (Fig. 24.3), clumps of oioi and knobby clubrush are present, along with giant umbrella sedge, mingimingi, and thick-leaved māhoe. The coastal side of the river blends into a dune ecosystem almost immediately, with large areas of shingle or bare substrate. Clarke & Horne (1993) documented 32 species here, in the immediate vicinity of the river. Vegetation is densest in the lee of the dune,

Table 24A. Wainuiōmata River site information (see also Fig. 24.1).

| WAINUIŌMATA RIVER |
|---|
| Baring Head |
| 1757175 5413887 |
| BQ32 572 139 |
| 10 ha |
| Kāpiti Wellington Office |
| Hutt City Council, GWRC |
| Private East Harbour Regional Park (GWRC) Baring Head Recreation Reserve (GWRC) |
| Ecol Sites 156, 377, 1038 WERI: 2, SSWI: Moderate Key Native Ecosystem (GWRC) |
| Tararua |
| Category A |
| 6 |
| 14 |
| 2 |
| 2 |
| 4 |
| 5 |
| Browntop grassland Sandfield Aquatic |
| |

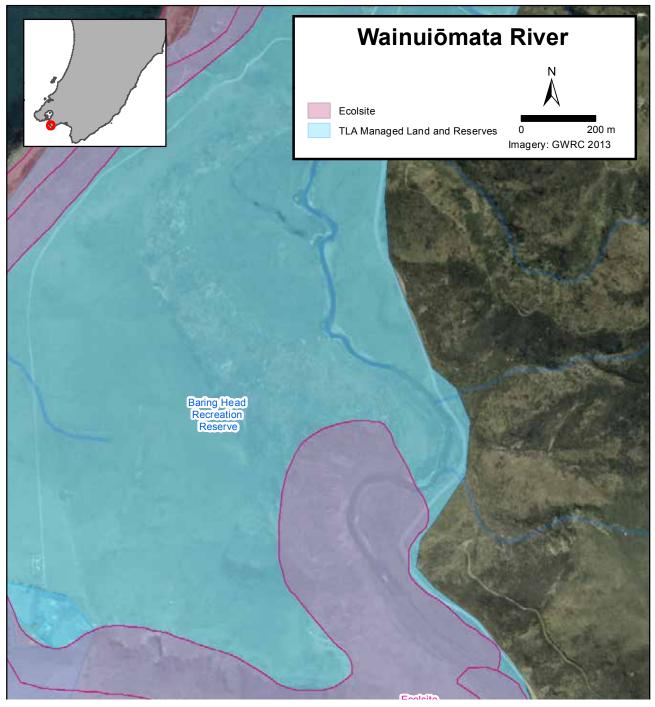


Figure 24.1. Wainuiōmata River estuarine site showing areas and places mentioned in the text.

and consists mainly of patches of sand tussock, kōwhangatara, and sand sedge. Mingimingi and thick-leaved māhoe are also present here, in low numbers. On the bare substrate, particularly along the riverbank, mats of mat daisy are present. There is no evidence of saltmarsh vegetation in the river.

A single plant of pīngao was noted near the mouth of the river by Clark & Horne (1993). Two bushes of shrubby tororaro are present on the river terrace not far upstream from the river mouth, and on the banks, near the river mouth, naturally uncommon species such as *Crassula mataikona*, Kirk's crassula and teasel sedge are also present (GWRC 2014). Sand pimelea was seen by A. P. Druce in 1972, but all plants perished in a southerly storm (Druce 1972).



Figure 24.2. Dunes and gravel banks flank the margin of the mouth of the Wainuiōmata River on the coastal side. *Photo: Matt Todd.*



Figure 24.3. The grassland on the northern bank of the Wainuiōmata River has been retired from grazing. It is hoped that the margins will now revert to rushland. *Photo: Matt Todd*.

There is a large colony of southern black-backed gulls nesting at the site; one of the largest in the region (Stephenson 1977). Other species that nest here include blue penguin, variable oystercatcher and banded dotterel. The estuarine area was included in the OSNZ (2007) river mouth bird survey.

Eleven migratory native freshwater fish species have been found in the catchment, eight of which are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, bluegill bully and lamprey; Allibone et al. 2010). Taylor & Kelly (2001) commented that good inanga spawning habitat could be found amongst the riparian grasses and rushes. Later spawning surveys (Taylor & Marshall 2016) recorded spawning habitats in the lower river. Brown trout are recorded here.

Northern skink, raukawa gecko and copper skink are all found here. Spotted skinks were probably once abundant but have declined to almost undetectable levels. One spotted skink was found in 2010 (R. Romijm, GWRC 2010, pers. comm.) and is significant in the region.

Fur seals, probably part of the nearby Cape Tūrakirae population, periodically haul out to rest on the beach.

Table 24B lists native species present in, or utilising, the Wainuiōmata River estuarine system.

24.2.2 Recreational

The area receives moderate recreational use, with some surfing and surf-casting activity on the adjacent beach. The river mouth is the access point for rock climbers using the popular boulders at Baring Head and Fitzroy Bay. Access is also via Baring Head by crossing the river mouth. There are plans for a 'Big Coast' cycle route to be developed along the coast from the Wairarapa and up the Wainuiōmata River.

24.3 Catchment properties

The catchment covers an area of 13 367 ha, draining the south-western part of the Rimutaka Range. Extensive areas of native forest and scrub dominate, as much of the catchment is within either the Rimutaka Forest Park or the GWRC-managed: Wanuiōmata/Ōrongorongo Water Collection Area. Much of the western branch of the river is regulated by a series of dams for the purposes of metropolitan water supply. The town of Wainuiōmata is in the middle of the catchment, while much of the lower catchment is farmland.

Table 24B. Native species present in, or utilising, the Wainuiōmata River estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Kirk's crassula* |
| Birds | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Caspian tern+ |
| | Grey teal |
| | Little shag |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Turnstone |
| | Variable oystercatcher* |

| GROUP | SPECIES |
|-----------------|----------------------|
| Birds continued | Welcome swallow |
| | White-fronted tern* |
| Fish | Bluegill bully* |
| | Common bully |
| | Giant bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Lamprey+ |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Shortjaw kōkopu+ |
| Herpetofauna | Copper skink |
| | Northern grass skink |
| | Raukawa gecko |
| | Spotted skink* |
| | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

Since the cessation of discharge of treated town wastewater into the river in 2001, water quality in the lower catchment has improved from 'poor' to 'fair' (MacDonald & Joy 2009) and is now consistently rated as 'fair' at the GWRC monitoring site just upstream of White Bridge (GWRC site RS29; Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Keenan & Morar 2015) although it was rated "good" in 2012/13 (Morar & Perrie 2013). The recreational water quality grade produced from the monitoring site in the river was 'poor' during 2014-15 (Keenan et al. 2015).

24.4 Threats

A range of mammalian predators and browsers are present and are likely to be having an impact on the ecological values of the site. For example, hedgehogs are present in high numbers and together with mustelids and cats are likely to be reducing the breeding success of ground-nesting birds (GWRC 2014). Dogs are occasionally brought here for exercise and have potential to disturb birds. Motorbike and 4WD tracks are also evident on the dune and have done significant damage and probably disturb bird nesting. A range of ecological weeds are also present and are displacing native plant species and preventing natural regeneration. Gorse, boxthorn, tree lupin, marram and pasture grasses are the dominant weed species. Historically, the beach area was mined for gravel.

While the water quality has improved during the last few years, the river is still affected by stormwater contamination, occasional leakage from the Wainuiōmata dump, fertiliser runoff, and sedimentation. Toxic algal bloom is known to occur in the river during summer months (MacDonald & Joy 2009). Brown trout are also present.

24.5 Conservation management

24.5.1 Current

In June 2010 the land around the river mouth and coastal dune, including Baring Head, was purchased by a consortium of GWRC, The Nature Heritage Fund, DOC, Hutt City Council and an anonymous benefactor. It now forms part of the East Harbour Regional Park. An amendment to the GWRC Parks Network Plan was prepared in 2012 to encompass management of Baring Head/Ōrua-pouanui as part of East Habour Regional Park.

The site is part of the Baring Head/Ōrua-pouanui Key Native Ecosystem (KNE) site. Operational activities planned to manage and protect the biodiversity values of the site are set out in the KNE plan for the area (GWRC 2014). These activities include ecological weed control, pest animal control and management of human activities. Intensive trapping of predators (hedehogs, mustelids, cats and possums) is being carried out by members of the Friends of Baring Head on the beaches surrounding the river mouth to protect ground-nesting birds such as banded dotterel. Members of this group also assist with weed control at the site. In 2014, the Friends obtained funding from the DOC Community Conservation Partnership Fund to implement a large-scale restoration planting programme in the KNE, as well as intensify pest control and contribute to stock fencing. These activities will assist the restoration of natural ecological processes at the river mouth. Sheep still have access to the site, but cattle were removed from the area in March 2011.

The beach is generally fenced from the road, but fences are regularly cut to allow vehicle access which is causing significant damage to the dunes. In 2015, GWRC dug a large trench to assist in preventing vehicles from accessing the beach. The public are able to walk through the dune area on the coastal side from the beach.

GWRC has undertaken habitat mapping of the Wainuiōmata River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

24.5.2 Potential

Now that cattle are no longer present, the northern margin of the river is likely to begin reverting naturally to emergent aquatic vegetation, as there is already a core of wetland species present. The riverside planting planned by the Friends will accelerate this process.

Enhancing the dune habitat would significantly improve the potential for the re-establishment of wetland along the southern river margin, as both weed incursion and the effects of erosion would be curtailed.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

The spotted skink population is significant for the region and warrants greater monitoring and protection.

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25. Lake Ōnoke and lagoons

LAKE ŌNOKE

25.1 Lake Ōnoke site description

Lake Ōnoke is a large (650 ha) Category C estuarine system (one of only two in this report), separated from Palliser Bay by a 3 km long shingle spit, into which flow the Ruamāhanga and Tūranganui Rivers (Table 25A.1; Fig 25.1). Together with Lake Wairarapa, it forms part of the largest wetland area (the Wairarapa Lakes) in the lower North Island (Te Ika-a-Māui) (Airey et al. 2000). Only Lake Ōnoke is currently estuarine, however. The lake is normally open to the sea near the settlement of Lake Ferry, but the outlet may be blocked during southerly conditions, particularly when combined with low river levels. If the blockage is sustained, the outlet is opened mechanically to avoid lake levels rising over farmland. Historically, a sustained blockage (an integral part of the natural system) of the outlet caused a backup of brackish water upriver. Records of saltmarsh vegetation (Ogle et al. 1990) indicated that this occurred regularly as far north as Lake Wairarapa.

Table 25A.1. Lake Ōnoke site information (see Fig. 25.1).

| SITE NAME | LAKE ŌNOKE |
|--|--|
| Location | Lake Ferry, Palliser Bay |
| NZTM (coordinates) | 1777974 5416783 |
| NZ Topo50 | BQ32 780 168 |
| Area | 650 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private Lake Ferry Road Esplanade Reserve (South Wairarapa District Council) Western Lake Road Esplanade Reserve (South Wairarapa District Council) Lake Wairarapa Wetland Conservation Area (DOC) Lower Ruamāhanga River Marginal Strip (DOC) Wairarapa Moana Wetlands Park (DOC, GWRC, South Wairarapa District Council, Ngāti Kahungunu ki Wairarapa, Rangitāne o Wairarapa |
| Existing rankings | Ecol Sites 52, 131, 579, 627, 1519, 2319, 2320 Ramsar candidate site WERI: 3, SSWI: Moderate (Ecol Site 52) RAP 17 (Ecol Sites 1519, 2319, 2320) Area of Significant Conservation Value (GWRC Coastal Plan) WONI Type 1 WONI Type 2 DOC Ecosystem Management Unit rank 111) |
| Ecological district | Wairarapa Plains |
| Estuarine classification | Category C |
| Threatened species (number) | 12 (whole system including lagoons) |
| At Risk species (number) | 20 (whole system including lagoons) |
| Ecosystem value (score 1-5) | 5 (whole system including lagoons) |
| Social value (score 1-5) | 5 |
| Restoration potential (score 1–5) | 3 (whole system including lagoons) |
| Pressures (score 1–5) NB: 1 = high pressures | 2 (whole system including lagoons) |
| Dominant habitat | Saltmarsh ribbonwood shrubland Tall fescue grassland Gorse shrubland Kõwhangatara grassland Mudflats Subtidal |

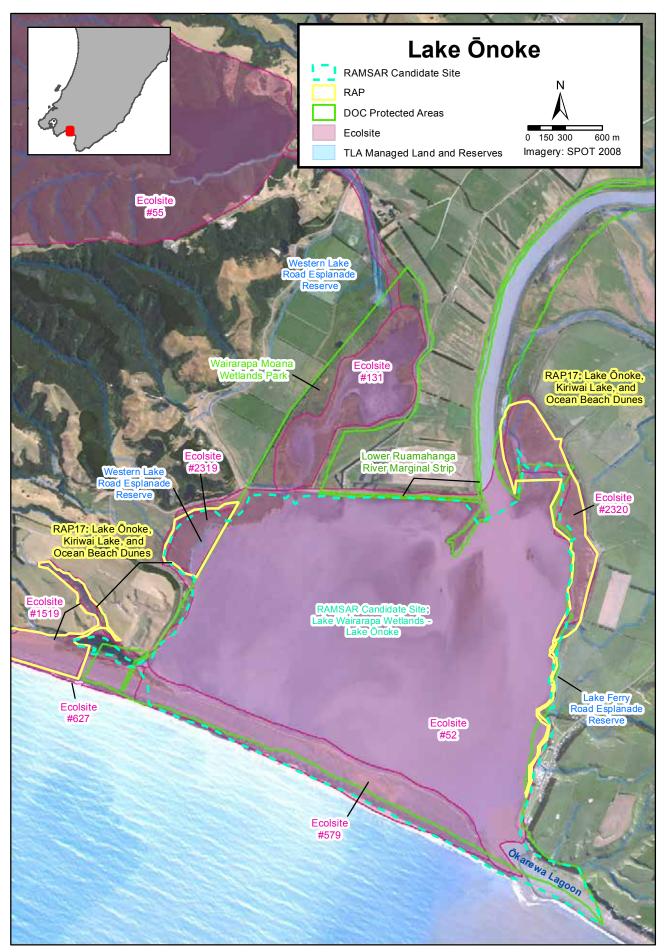


Figure 25.1. Lake Ōnoke estuarine site showing areas and places mentioned in the text.



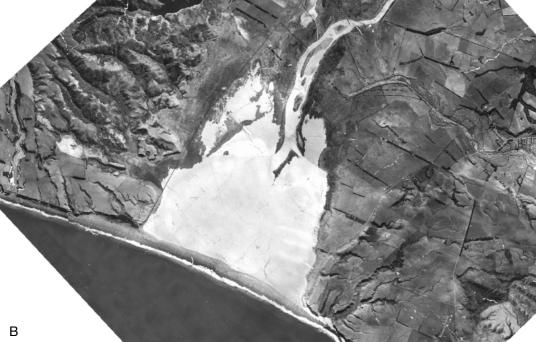


Figure 25.2. Lake Ōnoke and Ponui Lagoons (red dot) in A. 2007 showing the causeway between the lake and the lagoons and the floodbanks and B. 1940 when the saltmarsh was more extensive and the lagoons and lake more connected *Photos: Greater Wellington Regional Council*.

A large part of the original extent of the wetlands surrounding the lake (Fig. 25.2) has been drained and converted to farmland, with stopbanks built to prevent flooding.

Apart from the tidal margins of the lake itself, there are two significant contiguous estuarine ecosystems associated with, but somewhat separated from, the main body of the lake. These are Pounui Lagoon, in the northwest, and Kiriwai Lagoon in the southwest.

Another small lagoon, Ōkorewa, adjacent to the present lake outlet and the settlement of Lake Ferry in the south-east, marks the course of the original lake outlet (Fig. 25.2). A causeway for traffic access to the beach blocks it from the lake, although a culvert allows the passage of water.

25.2 Lake Ōnoke conservation values

25.2.1 Ecological

Wetlands line the western and northeastern margins around the outlets of Kiriwai and Pounui Lagoons (Figs 25.3, 25.4, and the eastern bank of the Ruamāhanga River. These are dominated by restiad rush species, particularly oioi and sea rush, and saltmarsh ribbonwood. Silbery & Enright (1998) listed a total of 39 indigenous species occurring in these wetlands, including a range of rushes, sedges, shrubs and dicot herbs. Species of significance include toetoe, mānuka, cabbage



Figure 25.3. The western shore of Lake Ōnoke is dominated by saltmarsh ribbonwood shrubland and sea rush rushland. *Photo: Matt Todd*.



Figure 25.4. The lower pond in Pounui Lagoon, surrounded by significant intact wetlands. Photo: Matt Todd.

tree, giant umbrella sedge, knobby clubrush, and three-square. Native musk, remuremu and shore primrose form patches of turf at the water's edge around the western arm of the lake. Sea holly (Sawyer 1997) has also been recorded here. Saltgrass may be found in the mudflats along the north shore of the lake.

Ōnoke Spit is a shingle spit/dune ecosystem, but the rear dune is influenced by Lake Ōnoke. Kōwhangatara and sand tussock dominate this area, along with sand pimelea/raoulia herbfield, although there are patches of wīwī and oioi. Pīngao is present in low numbers (Silbery & Rebergen 2000). This system is contiguous with the wetland at Kiriwai Lagoon.

Ōkorewa Lagoon is lined by intact saltmarsh, particularly on the northern bank. Sea rush and saltmarsh ribbonwood dominate, interspersed with flax and giant umbrella sedge. An area of three-square can be seen at the west end of the lagoon, and bachelor's button and shore bindweed are present in patches. The lagoon itself contains large patches of horse's mane. Aerial photographs taken in the 1940s (Robertson & Stevens 2007b) (Fig. 25.2) show that this lagoon was the original outlet for the lake, prior to the construction of the causeway (Lake Ferry Road) that separates it from the lake, and the outlet is now opened more or less directly downstream from the mouth of the Ruamāhanga River.

Ōnoke Spit has a high biodiversity value as a significant breeding site for banded dotterels and Caspian terns, and as a roosting site for a range of other shore birds (Milne & Sawyer 2002). Waterfowl, including grey teal favour the saltmarsh areas in the north-west fringes of the lake. Southern black-backed gulls also nest on Ōnoke Spit (I. Armitage, OSNZ 2010, pers. comm.). Lake Wairarapa and its surrounding wetlands have national significance as bird habitat and Ōnoke is an important part of this wider habitat. The lake was included in the OSNZ (2007) river mouth bird survey.

The lake has long been recognised as a significant habitat for both shortfin and longfin eels, and also provides the only conduit between the Ruamāhanga catchment and the sea for adult eels migrating to sea to spawn and for returning elvers migrating into freshwater. Fourteen migratory native freshwater fish species have been found in the Ruamāhanga Catchment, including eight species that are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga, redfin bully, bluegill bully, torrentfish and lamprey; Allibone et al. 2010). Ōkorewa Lagoon contains a healthy population of common bullies (T. Silbery, DOC 2009, pers. comm.). Taylor & Kelly (2003) reported that there is generally a paucity of suitable inanga spawning sites on the lake margins. This was finding was later repeated during surveying in 2016 (Taylor & Marshall 2016), although Rebergen (1997) observed inanga spawning at the mouth of the Ruamāhanga. Coastal marine fish species, including yellow-eyed mullet, triplefins, kahawai, stargazers, stingrays (all noted in Mitchell 1996) and sand flounder (Stevens 1993), may also be occasionally found within the lake. In addition to these, McEwan (2010) found black flounder, yellowbelly flounder, common smelt, estuarine triplefin and common bully when surveying the eastern and western shores. Some species generally considered marine (red cod, hoki, trevally and gurnard) have also been caught in Lake Ōnoke (Hicks 1993).

Invertebrates of note include the katipō spider, which may be found in driftwood on Ōnoke Spit and around the margins of the lake, and two moths: *Notoreas perornata* "Wairarapa/Wellington" and the endangered *Ericodesma aerodana* (Patrick et al. 2010). Hicks (1993) and McEwan (2010) both reported the presence of decapod (*Paratya curvirostris*) and mysid (*Tenagomysis* spp.) shrimps in the sediment of the lake. McEwan (2010) also found large numbers of hairy-handed crabs. Robertson & Stevens (2007b) recorded only amphipods as macroinvertebrates.

Table 25B lists native species present in, or utilising, the Lake Ōnoke (and lagoons) estuarine system.

Table 25B. Native species present in, or utilising, the Lake $\bar{\text{O}}$ noke (and lagoons) estuarine system.

| GROUP | SPECIES | LAKE ŌNOKE | POUNUI LAGOON | KIRIWAI LAGOOI |
|---------------------------|----------------------------------|------------|---------------|----------------|
| Threatened/At Risk plants | Native musk * | • | • | • |
| | Pygmy clubrush + | | | • |
| | Sea holly* | • | | |
| Birds | Australasian shoveler | • | • | • |
| | Banded dotterel+ | • | | • |
| | Bar-tailed godwit* | • | | • |
| | Bittern+ | • | • | • |
| | Black shag* | • | • | • |
| | Black swan | • | • | • |
| | Black-billed gull+ | • | • | • |
| | Black-fronted dotterel | • | | • |
| | Black-fronted tern+ | • | | • |
| | Caspian tern+ | • | • | • |
| | Dabchick+ | • | • | |
| | Grey duck/mallard hybrid | • | • | • |
| | Grey teal | • | • | • |
| | Kingfisher | • | • | • |
| | Little black shag* | • | • | • |
| | Little shag | | • | |
| | Paradise shelduck | • | • | • |
| | Pied shag+ | • | | • |
| | Pied stilt* | • | • | • |
| | New Zealand pipit* | | • | • |
| | Pūkeko | | • | • |
| | Red-billed gull+ | • | • | • |
| | Royal spoonbill* | • | • | • |
| | Scaup | • | • | • |
| | South Island pied oystercatcher* | • | | • |
| | Southern black-backed gull | • | • | • |
| | Spotted shag | • | | |
| | Spur-winged plover | • | • | |
| | Swamp harrier | • | • | • |
| | Turnstone | • | | |
| | Variable oystercatcher* | • | • | • |
| | Welcome swallow | • | • | • |
| | White heron+ | • | | |
| | White-faced heron | • | • | • |
| | White-fronted tern* | • | | • |
| | White-winged black tern | • | | |
| Fish | Banded kōkopu | • | • | |
| | Black flounder | • | | |
| | Bluegill bully* | • | | |
| | Brown mudfish | | • | |
| | Cockabully | • | | |
| | Common bully | • | • | • |
| | Common smelt | • | • | • |
| | Estuarine stargazer | • | | |
| | Estuarine triplefin | _ | | |

Continued on next page

Table 25B continued

| GROUP | SPECIES | LAKE ŌNOKE | POUNUI LAGOON | KIRIWAI LAGOON |
|--|------------------------|------------|---------------|----------------|
| | Giant kōkopu* | • | • | |
| | Grey mullet | • | | |
| | Gurnard | • | | |
| | Hoki | • | | |
| | Inanga* | • | • | • |
| | Kahawai | • | | |
| | Kōaro* | • | • | |
| | Lamprey+ | • | • | |
| | Longfin eel* | • | • | |
| | Red cod | • | | |
| | Redfin bully* | • | • | |
| | Sand flounder | • | | |
| | Shortfin eel | • | • | |
| | Shortjaw kōkopu+ | • | • | |
| | Torrentfish* | • | • | |
| | Trevally | • | | |
| | Yelloweyed mullet | • | • | • |
| | Yellowbelly flounder | • | | |
| Aquatic macroinvertebrates | Hairy-handed crab s | • | | |
| | Paratya curvirostri | • | | |
| | Tenagomysis sp. | • | | |
| | Tunnelling mud crab | • | | |
| Threatened/At Risk terrestrial invertebrates | Katipō spider* | • | | • |
| | Ericodesma aerodana* | • | | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species. Some reports are from Parrish 2003, Taylor 1990, and Taylor & Parrish 1994.

25.2.2 Recreational

The lake is currently used for a variety of recreational activities, including fishing, whitebaiting, birdwatching, boating, kayaking, and picnicking.

25.3 Lake Ōnoke catchment properties

The Ruamāhanga and Tūranganui Rivers and their associated catchments drain out through Lake Ōnoke. Taken together, these catchments drain over 330 000 ha, at least two-thirds of which is pastoral farmland. The headwaters of the Ruamāhanga River, and its western tributaries, lie in the indigenous forest of the Tararua and Rimutaka Ranges, where water quality is generally good. Most of the eastern tributary rivers, however, rise in the erosion-prone hills of the Eastern Wairarapa, where contamination by sandstone silt and fertiliser runoff from hill country stations is a common occurrence. The northern part of the Aorangi Range also drains into Lake Ōnoke, either directly, or through the Ruamāhanga River. Sources of water contamination come from urban centres and intensive farming throughout the catchment. GWRC monitors water quality in the river at Pūkio (GWRC site RS34) which is 'poor' to 'fair' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015). Recreational water quality grades produced from monitoring sites in the river mainstem ranged from 'fair' to 'very poor' during 2014/15, although when records following rain were included, all sites were graded as 'very poor' (Keenan et al. 2015). A targeted water quality survey of Lake Ōnoke was carried out by GWRC from 2009 to 2011 (Perrie & Milne 2012). This survey reported degraded water quality

on the eastern shore where the Ruamāhanga River flows through and speculated that water quality in other parts of the lake (where flushing doesn't occur) may be even worse. This report classed the lake as 'supertrophic', representing the highest classification of nutrient pollution. Further measurements taken over the period 2012–15 class Ōnoke as eutrophic (Perrie et al. 2015).

The Ruamāhanga River has periodic flooding with 20 000 ha of the surrounding land flooded during the largest event in 1948. The natural ecosystems of the lower valley were built around the occurrence of water spilling into the floodplain even when there was low flow in the river, as the outlet was periodically blocked with gravel from Palliser Bay. To maximise grazing opportunities, and reduce flood risk, a large programme of flood control was initiated during the 1960s, including the diversion of the Ruamāhanga from Lake Wairarapa, the installation of the Ruamāhanga barrage gates to cut off Lake Wairarapa from Lake Ōnoke, the construction of the Oporua floodway, and the building of 198 km of stopbanks as far upstream as the confluence of the Waiōhine River. As part of the scheme, the management of the barrage gates and the outlet of Lake Ōnoke meant that the lake levels in Lake Wairarapa could be kept low enough to act as a depository for floodwater at short notice. Lake Wairarapa, although quite far inland, can be a relatively saline environment, especially at the southern end and especially when the barrage gates are open to admit flood water from Lake Ōnoke (A. Perrie, GWRC 2010, pers. comm.).

McEwan (2010) found that fish communities at the southern end of Lake Wairarapa were more similar to those in Lake Ōnoke than at the northern end of Lake Wairarapa.

Despite flood protection works, the Ruamāhanga floodplain still includes one of the largest and most significant wetlands networks in the North Island (Te Ika-a-Māui), including both Lakes Ōnoke and Wairarapa, and a variety of smaller lagoons, ponds, and bogs. Much of this area is legally protected as conservation land or council reserves, and there is also a water conservation order on Lake Wairarapa designed to protect the wading bird habitat along the eastern shore.

25.4 Lake Ōnoke threats

Overall, the catchment was historically highly dynamic, with large areas of the estuarine system subject to periodic inundation and drying. The conversion of this dynamic system to a largely stable system has likely had consequences for all indigenous organisms and ecosystems that evolved to occupy a dynamic environment.

The alteration and ongoing control of water pathways threatens native ecology. The installation of the Ruamāhanga barrage gates has reduced fish passage between Lake Ōnoke and Lake Wairarapa (McEwan 2010). For example, black flounder were once abundant in Lake Wairarapa and would have provided a source of recruits to the lower estuarine system (McEwan 2010). The barrage gates are periodically partially opened for brief durations in an attempt to facilitate native fish passage between the lakes although it is doubtful that sufficient numbers are getting through to have a positive impact on populations.

The terrestrial area around Lake Ōnoke has various feral predators including cats, rodents, possum, mustelids, and hedgehogs. The nesting colonies of Caspian tern and banded dotterel on Ōnoke Spit are vulnerable to predators and disturbance and crushing from people and vehicles, especially during the breeding season. Vehicle disturbance not only impacts on breeding birds, but destroys habitat both for birds and for other animals. Mustelid control is currently occurring along the spit and there has been a programme to make the public aware of disturbance impacts, there would be significant benefit if this continued. Hares and rabbits also cause significant damage to the herbfields of Ōnoke Spit, many of which are critical to rare or specialist invertebrates, and the area would benefit from control.

The presence of exotic fish species in the lake and river is a threat to native fish populations. Perch, in particular, are of concern, as they are present in very high numbers in Lake Wairarapa and are voracious predators of other fish. In Lake Wairarapa, perch prey mainly on native common bullies

and smelt (McEwan 2009, 2010). Other exotic species in the system include brown trout, rudd and goldfish, all of which will be having negative impacts on native fish species.

Gorse and tall fescue from pasture areas tend to colonise the wetlands, and are difficult to remove once established. This is particularly noticeable along the flood barrages on the northern shores of the lake. Spartina has formed several clumps on the northern margin, and appears to be spreading in extent, although slowly. While small patches are easy to eliminate, spartina can, under ideal conditions, spread and overwhelm salt-flats, requiring ongoing monitoring and control after initial knock-down. This appears to have occurred here, as a patch some 200 m further along the stopbank, recorded by McAlpine & Sawyer (2003), was controlled. Robertson & Stevens (2007b) reported that there are no signs of any aquatic weeds or macroalgae on the lake bed.

The recent history of Lake Ōnoke is one of drainage and reclamation to convert wetland into grazing land and the corresponding loss of habitat. Aerial photographs from the 1940s, published by Robertson & Stevens (2007b), show that the lake and its wetland margins covered a significantly larger area than they do today. Drainage and reclamation has now mostly stopped, but there is an intensification of land use.

Nutrient pollution poses a significant threat to the indigenous values of Lake Ōnoke. The lake has been rated as 'supertrophic' (GWRC 2012), meaning that nutrient levels are elevated, water clarity is poor, and algal bloom is a regular occurrence. All five towns in the Ruamāhanga Catchment discharge stormwater and wastewater to streams that drain into Lake Ōnoke (Perrie & Milne 2012). However, the main contributor to nutrient enrichment is pastoral farming. Around 64% of the catchment is in pastoral land use and runoff from this land is resulting in poor water quality in the river and the lakes. Intensification of pastoral farming is also increasing—as of 2010/2011 there were around 69 000 dairy cows in the Ruamāhanga Catchment (Perrie & Milne 2012). Nutrient pollution degrades water quality and causes excessive aquatic plant growth, which in turn can alter fish habitat and food webs as well as deoxygenate the water to a degree that can kill or displace aquatic animals.

One of the biggest changes in the hydrology of Lake Ōnoke is the loss of filtering wetlands in the Ruamāhanga valley. This, combined with widespread deforestation, has resulted in large amounts of sediment entering Lake Ōnoke. Sedimentation is a major threat as fine sediment can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding and inhibits the growth of aquatic vegetation. It is likely that this increase in sediment has already caused significant damage to shellfish beds, fish, invertebrate and plantlife in the lake.

25.5 Lake Onoke conservation management

25.5.1 Current

The entirety of Lake Ōnoke and Ōnoke Spit, along with the lagoons, is managed via a partnership between GWRC, South Wairarapa District Council, Ngāti Kahungunu ki Wairarapa, Rangitāne o Wairarapa and DOC, as part of the Wairarapa Moana Wetlands Project. The margins of the western shores, and the margin immediately to the south-east of the Ruamāhanga mouth were identified as a Priority One Recommended Area for Protection (No. 17) (Beadel et al. 2000).

The wetland complex is managed under a multi-agency governance structure for the Wetlands Project. The goals of the Project are in accordance with the principles outlined in the Lake Wairarapa Wetlands Action Plan (Airey et al. 2000), namely:

- To protect and restore indigenous plant and animal communities and the ecological processes that ensures their survival
- · To protect and recognise the cultural and historic values of the Lake Wairarapa wetlands

- To allow for recreational use of the Lake Wairarapa wetlands whilst ensuring the protection of ecological, cultural and historical values
- To promote the public awareness of biological, cultural, historical and recreational importance of the Lake Wairarapa wetlands

Under these principles, key ecosystem values have been identified and targeted for protection and enhancement. In terms of Lake Ōnoke, these values include water quality, estuarine function, indigenous lake habitats, native fisheries, and native and migratory birds.

Water quality is an issue that must be managed on a catchment-wide basis. GWRC regulates nutrient contamination in the greater Ruamāhanga catchment. Environmental regulations in the Wairarapa are currently under review (GWRC 2012), but the Wairarapa Lakes, including Lake Ōnoke, have been targeted as sites of particular concern. The Ruamāhanga Valley is one of the first catchment areas where GWRC have set up an advisory group called the Ruamāhanga Whaitua to enable an integrated management approach.

GWRC has undertaken habitat mapping of the Lake Ōnoke estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007a,b). The site is intended to be part of GWRC's long-term estuarine state of the environment monitoring programme, with some initial intertidal and subtidal sediment quality and benthic animals sampling conducted in early 2010. Water quality monitoring is undertaken near the Ruamāhanga River confluence.

On a local basis, restoration of saltmarshes and freshwater wetlands in and around the lake is a strategy that can assist with the alleviation of nutrient contamination, as these act as natural water filters. DOC and GWRC are working in partnership with local community stakeholders to restore estuarine and dune habitats around Lake Ōnoke, and to promote public awareness of the natural ecosystem. The South Wairarapa Biodiversity Group have been working with GWRC and DOC, since 2012, undertaking restoration planting at the Ōnoke/Ōkorewa lagoon. GWRC also service a predator control programme in place at the lagoon. The Friends of Ōnoke Spit have long been involved with ecological weed control and replanting in the dunes contiguous with the lake on the coastal margin. Rope barriers and bollards at strategic positions have ensured that vehicle traffic is channelled away from these areas, reducing physical damage and the rate of weed spread. These measures have assisted with the protection and preservation of habitat



Fig 25.5. Signage at the entrance to the Ōnoke Spit provides information to recreational users about the values at the site and potential impacts. *Photo: Helen Kettles*.

for the birds, particularly Caspian terns and banded dotterels that utilise the dunes and lake for nesting and feeding. There has also been a targeted public awareness campaign to outline to recreational users the impacts of disturbance and vehicles to the animals and wider values at the site. This includes interpretation (Fig. 25.5).

Both DOC and GWRC have been carrying out programmes of ecological weed and predator control. These have mainly consisted of spraying and physical removal of ecological weeds (particularly horned poppy), and trapping of predators. Cats, rats, mustelids and hedgehogs are the feral species that are particularly targeted around the lake for control.

Whitebaiting around Lake Ferry and the mouth of the Ruamāhanga is being carefully regulated in order to preserve the native fish populations.

The western wetlands are privately owned. The Recommended Area for Protection is separated from pasture by a stopbank, and stock are effectively excluded from the site.

25.5.2 Potential

The biodiversity value of Lake Ōnoke is high but full restoration will be difficult. As a single entity, the lake has been modified greatly, and its fundamental structure has been significantly altered. The drainage of large areas of the surrounding wetlands and the construction of flood control schemes are processes that cannot feasibly be reversed without cooperation from all landowners, and it is these processes that have largely caused the loss of habitat and biodiversity in the lagoon itself.

Improvements to water quality could be achieved through fencing off and planting the riparian margins of streams throughout the catchment and by encouraging best farming practices on agricultural land. It would be beneficial to implement additional sedimentation monitoring in the lake bed, as recommended by Robertson & Stevens (2007a,b).

The continuation of research and instigation of trials regarding the control of exotic fish species within the Wairarapa Lakes would be of value to the native freshwater fish populations in the Pounui Lagoon.

Locating, documenting, and restoring potential inanga spawning sites throughout the Lake Ōnoke complex would be valuable.

The historical outlet of Lake Ōnoke, Ōkorewa Lagoon, has intact saltmarsh and is still regularly flushed by the rise and fall of the lake. The beach crest on the south bank is dominated by marram and tall fescue, but pīngao and kōwhangatara both grow locally and would expand if the exotic species were controlled. The Lake Ferry Residents and Ratepayers Association intends to expand their restoration efforts into the lagoon in the near future (T. Silbery, DOC 2012, pers. comm.).

POUNUI LAGOON

25.6 Pounui Lagoon site description

Pounui Lagoon was historically an arm of Lake Ōnoke but is now largely two separate bodies of water connected to Lake Ōnoke and to each other by a series of narrow channels (Table 25 A.2, Figs. 25.4 & 25.6). This has led to the saline wetland being replaced by a largely freshwater wetland. The margins of the lagoon are buffered by a significant area of relatively intact wetland providing habitat for a number of bird species. The lagoon is fed by Pounui Stream and Battery Stream, originating in the Rimutaka Range.

The entire system is constrained by stopbanks, to prevent flooding of the adjacent farmland, including a barrier separating the lagoon from the main body of Lake Ōnoke. Connectivity is maintained with the lake and its tidal influence by a pair of culverts (Fig. 25.7). Waterflow through each culvert is controlled by floodgates.

Table 25A.2. Pounui Lagoon site information (see also Fig. 25.6).

| 0.75 | |
|--------------------------|---|
| SITE NAME | POUNUI LAGOON |
| Location | North arm of Lake Ōnoke |
| NZTM (coordinates) | 1777974 5418783 |
| NZ Topo50 | BQ32 780 188 |
| Area | 150 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Western Lake Road Esplanade Reserve (South Wairarapa District Council) Lake Wairarapa Wetland Conservation Area (DOC) |
| Existing rankings | Ecol Site 52, 55, 131 WERI: 2, SSWI: Moderate |
| Ecological district | Wairarapa Plains |
| Estuarine classification | Category C |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Tall fescue grassland Raupō reedland Gorse shrubland Subtidal |

25.7 Pounui Lagoon conservation values

25.7.1 Ecological

The lagoon is a regionally significant ecosystem, as it is the one place in the Wairarapa that combines estuarine conditions with extensive wetland. The tidal limit does not reach the northern end of the lagoon, and the area around the inlet of Pounui Stream is essentially freshwater.

The entire lagoon is surrounded in a mosaic of rushland oioi, sea rush and shrubland (mainly saltmarsh ribbonwood and gorse, interspersed with areas of raupō at the limits of saline influence) (Figs 25.8, 25.9). Silbery & Enright (1998) listed 48 native species occurring in these wetlands, including native musk, shore primrose, remuremu, toetoe, mānuka, cabbage tree, giant umbrella sedge, knobby clubrush, and three-square. Mud pondweed is abundant in the bed of the lagoon.

Together with Lakes Ōnoke and Wairarapa, Pounui Lagoon is part of a nationally significant wetland habitat for waterfowl and wading birds. Grey teal particularly favour the combination of estuarine and freshwater wetlands. Australasian shovelers, black shags, and royal spoonbills also use this site. A DOC survey in 2009 confirmed the presence of Australian bittern (T. Silbery, DOC 2010, pers. comm.) in the raupō and rushes.

Twelve migratory freshwater fish have been recorded in the lagoon, including eight species listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, giant kōkopu, inanga, kōaro, redfin bully, torrentfish and lamprey; Allibone et al. 2010). In addition, the brown mudfish (also 'At Risk: Declining'), normally found only in freshwater environments, was recorded here by Robertson & Stevens (2007b). Taylor & Kelly (2003) suggested that the lower part of the lagoon offered good habitat for inanga spawning, but that the presence of the floodgates inhibits shoal movement and confuses spawning cues. Taylor & Marshall (2016) recorded possible inanga spawning vegetation in the lagoon but found no eggs, and speculated that salinity may be too high. The same authors confirmed inanga spawning in Pounui Stream.

25.7.2 Recreational

The lagoon is widely regarded as one of the best sites for duck shooting in the Wairarapa.

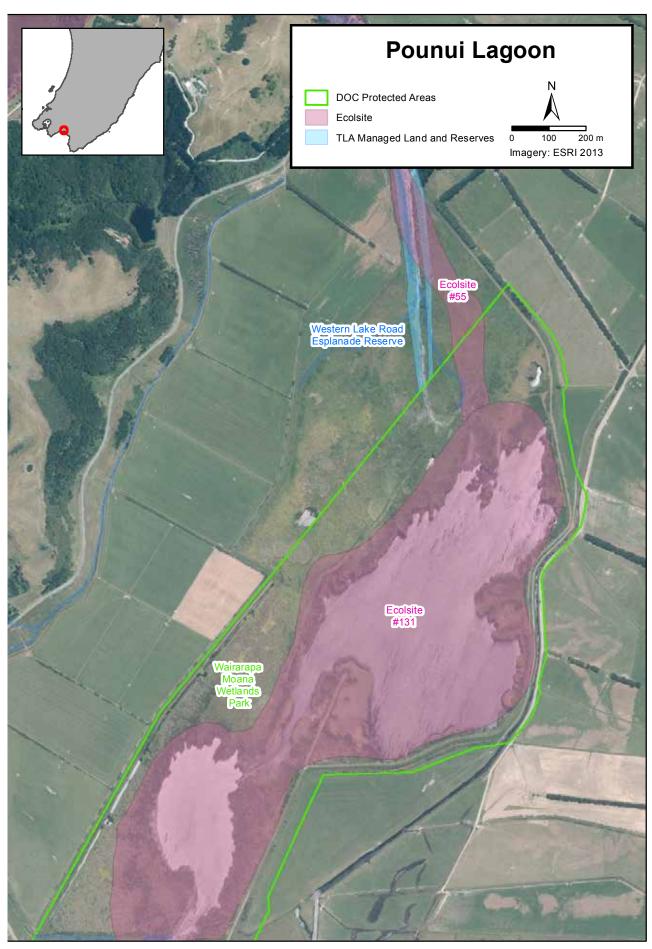


Figure 25.6. Pounui Lagoon estuarine site showing areas and places mentioned in the text.



Figure 25.7. Connectivity is maintained between Pounui Lagoon and Lake Ōnoke by culverts. *Photo: Matt Todd.*



Figure 25.8. The wetland associated with the upper pond in Pounui Lagoon. Saltmarsh ribbonwood shrubland with harekeke is dominant with raupō reedland at rear. *Photo: Matt Todd.*



Figure 25.9. Expanses of relatively intact wetland border the western margins of Pounui Lagoon. *Photo: Helen Kettles*.

25.8 Pounui Lagoon catchment properties

The lagoon is fed by Pounui Stream and Battery Stream that together drain a catchment of approximately 1700 ha on the eastern slopes of the Rimutaka Range. Overall, the catchment is largely forested, with less than 25% of the area in pasture. Battery Stream runs through farmland and a few wetlands.

Pounui Stream directly drains the high value Lake Pounui, one of the most natural lakes in the region (de Winton et al. 2011), with an almost completely forested catchment.

25.9 Pounui Lagoon threats

Since the installation of the flapgates and stopbanks, gravel from the Battery Stream catchment has accumulated in the lagoon, causing accelerated aggradation and eutrophication (Mitchell 1996). Mitchell estimated that, at the current rate of aggradation, the lagoon will dry up within a century.

As the lagoon is directly linked to Lake Ōnoke, the flapgates remain closed during times when the lake outlet is blocked, causing a rising water level within the lake. This inhibits tidal flushing of Pounui Lagoon and creates a slow rise in water levels due to the upstream discharge into the lagoon. Correspondingly, the water quality drops, and the risk of algal bloom increases (Robertson & Stevens 2007b). This risk is augmented during southerly conditions by debris blockage of the culverts, often for extended periods (Mitchell 1996). The flapgates close on the incoming tide and fish passage through them is not effective (Mitchell 1996).

The presence of exotic fish species in the lake and river is a threat to native fish populations. Perch, in particular, are of concern, as they are present in very high numbers and are voracious predators of other fish. In Lake Wairarapa, perch prey mainly on native common bullies and smelt (McEwan 2009, 2010). Other exotic species in the system include brown trout, rudd and goldfish, all of which will be having negative impacts on native fish species.

Gorse and tall fescue are present on the drier margins to the north, but for the most part don't threaten the integrity of the wetland system itself. They are strong competitors and in the absence of overgrowth to shade these species, they will maintain and gradually increase their presence in the vicinity. Robertson & Stevens (2007b) mention that the aquatic plant composition is unknown.

A range of mammalian predators will be present but their impacts have not been assessed at this site.

25.10 Pounui Lagoon conservation management

25.10.1 Current

The lagoon and the surrounding wetlands are managed by DOC as part of the Lake Wairarapa Wetland Conservation Area, and the area is fenced to exclude wandering stock. Access to the lagoon is across private farmland (permission is required) or along the stopbank separating the lagoon from Lake Ōnoke. Current management includes ecological weed control (especially willow) by GWRC and DOC.

Numbers of duck hunters are limited for the first weekend of the duck hunting season, but restrictions are removed after that.

The flapgates in the culverts separating the lagoon from Lake Ōnoke are operated by GWRC as part of the Lower Wairarapa Development Scheme. The gates work automatically, opening during ebb and low tides, closing during flow and high tides. A slot has been cut into the gates which was to allow the restricted passage of water and fish when closed (Mitchell 1996), but has proven to be an ineffective fish pass (T. Silbery, DOC 2015, pers. comm.).

25.10.2 Potential

The lagoon and saltmarsh possess high conservation values. The grassland to the north within the conservation area could be planted in native plants or allowed to regenerate once an improved water regime is established. With projected sealevel rises lowlying marginal farmland to the west (Fig. 25.10) will become even more impacted by saltwater. Planning for a process to transition some of this land to restore naturally to coastal wetlands is worthy of investigation. Locating, documenting, and restoring potential inanga spawning sites would be valuable



Figure 25.10. Saltwater intrusion to low-lying marginal farmland to the west of Pounui Lagoon is managed with stopbanks. Photo: Helen Kettles.

Ecological weed species are present on the margins, but few are in the wetland itself. A control/eradication plan for these species would further augment the value of the wetland and enhance the habitat for many of the wetland birds. The whole area would benefit from greater pest control to protect nesting birds and to allow greater natural regeneration, and ecological weed control.

The gravel aggradation in the lagoon is a problem that could be mitigated by an alternative management of the flapgates and lagoon and river system, and there are ongoing discussions about how to manage the gravel at that site. Currently, the gates close during every tidal cycle. If the gates were to close only at times of high rainfall, or when the levels of Lake Ōnoke rose beyond critical levels, then the lagoon could be more effectively flushed of gravel and sediments during normal high tides. These changes would not affect surrounding farmland, as the lagoon is lined with stopbanks. This would also improve water quality and allow more natural passage of fish into the lagoon, including the return of benthic feeders such as black flounder and stargazers. Restoration of fish passage into and through the lagoon would also allow habitat in both Battery Stream and Lake Pounui to be available. Care must be taken, however, as this would also allow passage of unwanted exotic fish species. Removal of gravel from the Battery Stream channel could also be considered. Increases in seasonal spawning fish may also benefit feeding birds.

The continuation of research and instigation of trials regarding the control of exotic fish species in the Wairarapa Lakes would be of value to the native freshwater fish populations in the Pounui Lagoon.

KIRIWAI LAGOON

25.11 Kiriwai Lagoon site description

Kiriwai Lagoon (Table 25A.3; Figs 25.11, 25.12) is a small (10 ha) dune lake/wetland connected to Lake Ōnoke by a short channel and is regularly flushed by the high tide (Fig.25.13). The lagoon is surrounded by saltmarsh with a high biodiversity value and ranking, providing habitat for a variety of waterfowl. The saltmarsh is contiguous with Ōnoke Spit, and many of the species found there are also known in and around the lagoon.

Table 25A.3. Kiriwai Lagoon site information (see also Fig. 25.11).

| SITE NAME | POUNUI LAGOON |
|--------------------------|--|
| Location | Western end of Lake Ōnoke |
| NZTM (coordinates) | 1775774 5416684 |
| NZ Topo50 | BQ32 758 167 |
| Area | 10 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private Lake Wairarapa Wetland Conservation Area (DOC) |
| Existing rankings | Ecol Sites 1519, 627 Ramsar Candidate Site RAP 17 WONI Type 2 |
| Ecological district | Wairarapa Plains |
| Estuarine classification | Category C |
| Dominant habitat | Restiad rushland Raupō reedland Tall fescue grassland Buck's horn plantain herbfield Mudflats Subtidal |

A vehicle track fords the channel that connects the lagoon to Lake Ōnoke, and then skirts the saltmarsh on the southern (coastal) side, but it is largely unused.

25.12 Kiriwai Lagoon conservation values

25.12.1 Ecological

The saltmarsh is characterised by an extensive area of rushland, mainly consisting of sea rush and oioi (Fig. 25.14). This extends almost entirely around the lagoon, except for the western extremity, where the tidal influence is low. Here, raupō dominates. At the eastern end of the lagoon, near the outlet to Lake Ōnoke, there is a fringe of three-square around the rushes. Saltmarsh ribbonwood, giant umbrella sedge, wīwī and cutty grass occasionally overtop the sea rush and oioi. Several other species of sedge are also present. Herbfields of shore primrose, remuremu and the uncommon native musk occur amongst the rushes. There are thick beds of horse's mane in the open water of the lagoon, the most intact example of this species through the entire Wairarapa Moana system.

An erosion gully that feeds into the lagoon from the north contains a mosaic of wetland and scrub species, including flax, kānuka, toetoe, giant umbrella sedge, cutty grass, and raupō.

Pygmy clubrush (Townsend 1997) recorded in the wetland forms one of only a few known populations in the Wellington Hawke's Bay Conservancy (Beadel et al. 2000). This species has not been seen in recent years, however, and may have been overwhelmed by buck's horn plantain.

Kiriwai Lagoon attracts a range of waterfowl and waders. Black swans are frequently seen on the open water, and nest here (Fig. 25.12). Kingfishers, white-faced herons, and black shags all frequently stalk prey or roost in the wetland. Royal spoonbills are less common visitors. Shorebirds also visit occasionally to feed in the mudflats.

As the lagoon does not have a significant freshwater catchment, the presence of many of the migratory freshwater fish species that are listed for Lake Ōnoke is unlikely. However, inanga, common smelt, common bullies, and yellow-eyed mullet are in the lagoon (A. McEwan 2010 pers. obs.).



Figure 25.11. Kiriwai Lagoon estuarine site showing areas and places mentioned in the text.



Figure 25.12. Swans and other waterfowl feed in the open water at Kiriwai Lagoon. *Photo: Matt Todd.*



Figure 25.13. Outlet connecting Kiriwai Lagoon to Lake Ōnoke. Photo: Helen Kettles.

As the southern and eastern shores of the lagoon are contiguous with the dunes of Ōnoke Spit, it is likely that a similar assemblage of skink and gecko will be present. The spit is a known habitat for katipō spiders (Patrick 2002), and it is likely that these may also be found in the driftwood in the dunes immediately adjacent to the lagoon.



Figure 25.14. Intact sea rush rushland occupies the margins of Kiriwai Lagoon. Photo: Helen Kettles.

25.12.2 Recreational

The lagoon is used by duck shooters and the stream that connects it to Lake Ōnoke has a high level of use by whitebaiters. The eastern end of the lagoon is used as the access point for Ōnoke Spit and Ocean Beach.

25.13 Kiriwai Lagoon catchment properties

The lagoon is fed by two small ephemeral streams, both of which drain a small (less than 200 ha) area of aggradation plain via erosion gullies. The catchment is entirely given over to pasture. Beadel et al. (2000) reported that the eastern-most of the streams had been dammed at the foot of the gully; it is unknown if the dam persists.

The northern shore and western end of the lagoon lie within the boundaries of the Lake Ōnoke/Kiriwai Lagoon Recommended Area for Protection (No. 17) (Beadel et al. 2000); this extends up the eastern gully onto the plateau and takes in the area of native bush.

25.14 Kiriwai Lagoon threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. They present a threat to bird populations in the lagoon wetland and the dunes, especially during the nesting season. Cattle and sheep may also be grazed occasionally at the western end of the lake, causing trampling damage to terrestrial vegetation. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

Ecological weed species such as gorse and tall fescue are present on the margins. Once established, these species clog the spaces between the rushes, making the habitat unsuitable for wildlife including birds. In wetlands, these species will not be inhibited by shading overgrowth and must be controlled artificially. Mats of allseed and buck's horn plantain are forming around the fringes of the wetland, particularly along the vehicle track, where the environment is already disturbed.

25.15 Kiriwai Lagoon conservation management

25.15.1 Current

The southern and eastern shores of the lagoon, and the corresponding areas of open water, lie within the boundary of the Wairarapa Moana Wetlands Park, managed according to the principles outlined in the Lake Wairarapa Wetlands Action Plan (Airey et al. 2000). Many of the management strategies outlined for Lake Ōnoke (see above) are applied in and around the lagoon, including predator and ecological weed control, and constraints around vehicle access.

The greatest conservation value at Kiriwai Lagoon is the extent and composition of the saltmarsh and the presence of pygmy clubrush and native musk. The saltmarsh is an extension of the habitat fringing Pounui Lagoon and the western limb of Lake Ōnoke, and many of the species found around the lake may also be present at this site. Pygmy clubrush is a species rare in the conservancy, while native musk is uncommon in the Wairarapa. Both require protection and monitoring. These values are already protected within the bounds of the Wairarapa Moana Wetlands Park.

The remainder of the lagoon and wetlands are privately owned, and fall within the Lake Ōnoke/Kiriwai Lagoon Recommended Area for Protection (see above); this part of the Recommended Area for Protection also covers an extension of the Ōnoke Spit dunes. The top of the coastal bluffs are fenced to exclude stock from the upper pastures.

25.15.2 Potential

Fencing around the western end of the saltmarsh and raupō would help demarcate the vehicle track and prevent wandering stock from entering the wetland, therefore improving water quality and providing some measure of protection to the population of pygmy clubrush and raupō habitat important to bittern. These are measures that would require the cooperation of the landowner.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

25.16 References

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Taylor, M.; Marshall, W. 2016: Inanga spawning habitats and their remediation and management in the Greater Wellington Region. Draft report prepared for Greater Wellington Regional Council, AEL Report No. 138.

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26. Whāngaimoana Stream

26.1 Site description

As it flows out of the coastal hills, the Whāngaimoana Stream (Table 26A; Fig. 26.1) is constrained between sand dunes and a low gravel bank on the coastal side and a high bluff on the inland side (Fig. 26.2), and runs parallel to the beach for a distance of over a kilometre, forming an elongated tidal pool. The estuarine system is narrow, no more than 5 m wide at any point, but saltmarsh vegetation is well developed, particularly along the foot of the bluff and at the western (upper) end. The outlet is dynamic and appears to be frequently blocked; Taylor & Kelly (2003) speculated that breaching could take place at various different points along the sand barrier. Vegetation on the gravel bank is sparse, particularly at the eastern end, and is dominated by exotic species.

The settlement of Whāngaimoana is adjacent to the stream just inland from the beach, and the access road runs alongside the stream from the main Cape Palliser road.

26.2 Conservation values

26.2.1 Ecological

The substrates on either side of the site are quite different; the coastal side is a coarse gravel/sand matrix, while the other, at the foot of the bluffs, is a mature soil. The vegetation on either side is correspondingly different, with the bluffs supporting patches of indigenous shrubs and flax.

Rushland dominates the inland (northern) bank; a mosaic of oioi, wīwī (Fig. 26.3), knobby clubrush and raupō. In the upper part of the estuarine site, the reedland almost takes over the entire stream, and mainly consists of raupō. Patches of flax, clubrush, and giant umbrella sedge may also be seen. Bachelor's button is present as an emergent.

Table 26A.1. Whāngaimoana Stream site information (see also Fig. 26.1).

| SITE NAME | WHĀNGAIMOANA STREAM |
|--|---|
| Location | Whāngaimoana, Palliser Bay |
| NZTM (coordinates) | 1781973 5413383 |
| NZ Topo50 | BQ33 820 134 |
| Area | Approx. 2 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private—Prickett, Rolleston |
| Existing rankings | Ecol Site 1387 QEII Covenant 5/07/631 Key Native Ecosystem (GWRC) |
| Ecological district | Wairarapa Plains |
| Estuarine classification | Category B |
| Threatened species (number) | 2 |
| At Risk species (number) | 2 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1–5) | 2 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 4 |
| Dominant habitat | Restiad rushland Raupō reedland Tall fescue grassland Mercer grass grassland Subtidal |

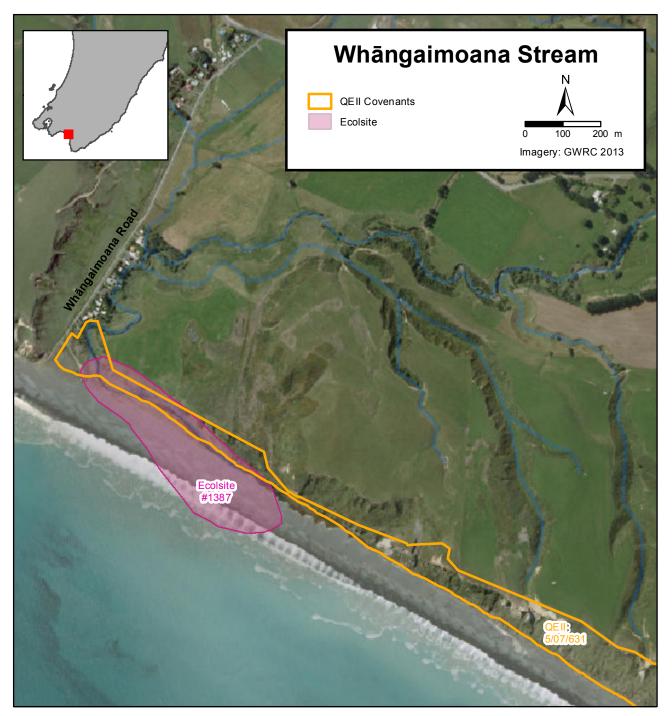


Figure 26.1. Whāngaimoana Stream estuarine site showing areas and places mentioned in the text.

There appeared to be little bird-life, despite the proximity of the roosting and feeding habitat at Lake Ōnoke. It is expected that a large variety of shorebirds and waders would find their way here at various times, although not in the numbers seen at Lake Ōnoke Spit. Banded dotterels nest in the area (A. Stead, Whāngaimoana Dune Restoration Group 2009, pers. comm.) (Fig. 26.4).

Taylor & Kelly (2003) surveyed the stream for inanga, recording the presence of several shoals. They also remarked on the occurrence of spawning on Mercer grass in the stream, but not other suitable vegetation. Later surveys by Taylor & Marshall (2016) again recorded numerous sites containing suitable inanga spawning habitat, although no spawning sites were confirmed. Banded kōkopu is the only other migratory freshwater fish species that has been recorded in the catchment.

Table 26B lists native species present in, or utilising, the Whāngaimoana Stream estuarine system.



Figure 26.2. Contrasting vegetation types are seen on either side of the Whāngaimoana Stream, with native species (wīwī and flax shown) on the northern margin, and ecological weeds (e.g. Mercer grass) on the coastal side. *Photo: Matt Todd.*



Figure 26.3. Saltmarsh vegetation in the Whāngaimoana Stream consisting of wīwī rushland (right), raupō reedland (centrerear), and Mercer grass (centre). *Photo: Matt Todd.*



Figure 26.4. Banded dotterels nest in the area adjacent to the Whāngaimoana estuarine site. Photo: Helen Kettles.

Table 26B. Native species present in, or utilising, the Whāngaimoana Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Banded dotterel+ |
| | Pied stilt |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| Fish | Banded kōkopu |
| | Inanga* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

26.2.2 Recreational

The beach receives moderate use by surfers, surfcasters, and some picnickers.

26.3 Catchment properties

The stream has a modest catchment on the western flanks of the Aorangi Range, of some 2012 ha. Of this, 70% is given over to pasture, 10% to native forest, and the remainder scrub (MacDonald & Joy 2009). Whāngaimoana Bush Recommended Area for Protection (No. 19) is some 3 km upstream from the mouth. This area is part of a mosaic of indigenous habitat fragments found within the lower Wairarapa Plains and plays an important role in linking larger areas of indigenous habitat (Beadel et al. 2000).

26.4 Threats

Given the proximity of the Whāngaimoana settlement, it is likely that there will be some incursions by domestic predators. A range of other mammalian predators and browsers will be present but their impacts have not been assessed at this site.

The abundance of ecological weed species on the coastal side of the stream is of concern. The dynamic nature of the gravel bank promotes opportunities for ecological weed establishment. There is also evidence of dumping of garden waste in the vicinity of the baches in the settlement; even occasional dumping will maintain a population of garden weeds in the site and adjacent dunes. Mercer grass and water cress in particular are invading the waterway (Figs 26.2, 26.3), and if left uncontrolled, have the potential to inundate the wetland, especially where the water is shallow.

There is no data available regarding water quality in the catchment, but it would seem likely that there would be significant fertiliser runoff into the stream from farmland. There may also be some leakage from septic tanks in the settlement. Nutrient pollution such as this degrades water quality and causes excessive aquatic plant growth, which in turn can alter fish habitat and food webs as well as deoxygenate the water to a degree that can kill or displace aquatic animals. There is a thick growth of submerged *Cerato* sp. algae (periphyton).

The beach shows signs of the use of 4WDs and motorbikes. This not only disturbs animals and their habitat, but also directly contributes to the spread of ecological weed species through introduction of fresh material and disturbance of the substrate.

26.5 Conservation management

26.5.1 Current

The north bank and the bluffs, are covered by a QEII covenant. The area has been recently referced in order to exclude stock. Indigenous vegetation is regenerating (Fig. 26.5).

The Whāngaimoana Dune Restoration Group, with the assistance of GWRC and South Wairarapa District Council, has been active in restoring the dune systems that adjoin the tidal pool margins. They have planted several thousand kōwhangatara and pīngao, demarcated the restoration site with a rope barrier, and initiated predator/ecological weed control and monitoring schedules (GWRC 2012). This will assist in enhancing the habitat buffering the wetland, and also reducing erosion and sand drift.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for Whāngaimoana is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

26.5.2 Potential

The estuarine system would benefit from regular ecological weed control. For some of the ecological weed species present, such as horned poppy and tall fescue, control will occur as they are overshaded by shrubs. For others, such as marram and Mercer grass, a specific regime of control will be required.

The Whāngaimoana Dune Restoration Group is initiating operations in the wetland around the upper tidal limit. Native species that are already present, such as flax, oioi, wīwī, and giant umbrella sedge, could be protected from damage and augmented with further planting. Saltmarsh ribbonwood is also found locally; this could be propagated and planted along the toe of the bluffs.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.



Figure 26.5. The QEII covenant, which encompasses part of the estuarine site, came about through the generosity of the landowner Hugh Prickett. *Photo: Helen Kettles.*

26.6 References

Beadel, S.; Perfect, A.; Rebergen, A.; Sawyer J. 2000: Wairarapa Plains Ecological District: survey report for the Protected Natural Areas Programme. Department of Conservation, Wellington Conservancy, Wellington.

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Taylor, M.; Marshall, W. 2016: Inanga spawning habitats and their remediation and management in the Greater Wellington Region. Draft report prepared for Greater Wellington Regional Council, AEL Report No. 138.

27. Cape Palliser streams (Mākotukutuku, Pararaki and Ōtakaha)

27.1 Site description

These three streams—the Mākotukutuku (Washpool), the Pararaki, and the Ōtakaha—all discharge into Palliser Bay, on the western coast of Cape Palliser, at intervals of 2–3 km (Table 27A; Fig. 27.1). All share similar characteristics whereby gravel from the Aorangi Range accumulates at the mouth often blocking it and causing the formation of a shallow tidal pool (Fig. 27.2). When the mouth is breached by the tide, the pool is flushed out. This type of system is highly dynamic, as new material is constantly being deposited as the course of the stream moves back and forth across the bed.

27.2 Conservation values

27.2.1 Ecological

All three streams are largely devoid of vegetation in the riverbed as the ecosystem is simply too unstable to allow the establishment of more than a handful of pioneer species (including creeping cudweed) and patches of grass (Fig. 27.3). The margins are dominated by rushes and shrubs, backed by pastureland. Knobby clubrush is plentiful, along with patches of toetoe, flax, and sea rush, although the latter is scarce at Ōtakaha Stream. The banks of Mākotukutuku Stream are steeper and rockier than the other two, and giant umbrella sedge and flax is found here in riparian areas (Fig. 27.4).

Table 27A. Cape Palliser streams (Mākotukutuku, Pararaki and Ōtakaha) site information (see also Fig. 27.1).

| SITE NAME | CAPE PALLISER STREAMS (MĀKOTUKUTUKU, PARARAKI AND ŌTAKAHA) |
|--|---|
| Location | Cape Palliser |
| NZTM (coordinates) | 1784471 5403882 1784270 5399783 1785269 5397582 |
| NZ Topo50 | BR33 845 039 BR33 843 998 BR33 853 976 |
| Area | 1–3 ha each |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private Cape Palliser Road Esplanade Reserve—Pararaki Stream, Otakaha Stream (South Wairarapa District Council) |
| Existing rankings | Ecol Site 325 (Ōtakaha Stream) |
| Ecological district | Aorangi |
| Estuarine classification | Category B |
| Threatened species (number) | 4 |
| At Risk species (number) | 8 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1-5) | 4 |
| Restoration potential (score 1–5) | 2 |
| Pressures (score 1–5) NB: 1 = high pressures | 4 |
| Dominant habitat | Knobby clubrush rushland Riparian shrubland Gravelfield |



Figure 27.1. Cape Palliser streams estuarine site showing areas and places mentioned in the text.



Figure 27.2. The Pararaki Stream displays the gravel basin and tidal pool typical of all three streams. Photo: Matt Todd.



Figure 27.3. Vegetation on the tidal margins typically consists of rushes (e.g. knobby clubrush, seen here at the Pararaki Stream). *Photo: Matt Todd*.

At the Pararaki Stream outlet, a significant dune system buffering the estuarine margin is dominated by kōwhangatara. No other rare or threatened plant species are known to be present at any of the streams.

A small range of shore birds were noted at all three streams, with Southern black-backed gulls, red-billed gulls, variable oystercatchers, and pied stilts the most common. Black shags and spurwinged plovers were also noted. New Zealand pipits, paradise shelducks, and white faced herons were seen in the gravel beds of Pararaki and Mākotukutuku Streams.



Figure 27.4. Harakeke may be found adjacent to the road bridge at the Mākotukutuku Stream. Photo: Matt Todd.

Eight migratory freshwater fish have been found in the catchments, six of which are listed as 'At Risk: Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro and redfin bully; Allibone et al. 2010). The gravelly beds are not suitable habitat for inanga spawning, and this species has not been recorded in the catchment.

Table 27B lists native species present in, or utilising, the Cape Palliser Streams (Mākotukutuku, Pararaki and Ōtakaha) estuarine system.

27.2.2 Recreational

The streams are privately owned, and the mouths see little recreational use other than as access to the beach for a few surfers and surfcasters. The Mākotukutuku (Washpool) Valley is an access point to the Aorangi Forest Park, used mainly by hunters.

Table 27B. ative species present in, or utilising, the Cape Palliser Streams (Mākotukutuku, Pararaki and Ōtakaha) estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Caspian tern+ |
| | Little shag |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spotted shag |
| | Spur-winged plover |

| SPECIES |
|-------------------------|
| Variable oystercatcher* |
| Welcome swallow |
| Banded kōkopu |
| Common bully |
| Giant kōkopu* |
| Kōaro* |
| Longfin eel* |
| Redfin bully* |
| Shortfin eel |
| Shortjaw kōkopu+ |
| |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

27.3 Catchment properties

The Pararaki and Ōtakaha catchments are roughly the same size, around 3450 ha each; the Mākotukutuku catchment is slightly smaller at 2146 ha (MacDonald & Joy 2009). All have their headwaters in the steep Aorangi Ranges, and gravel from the scree slopes is constantly being carried down the streams and deposited at the mouth. Roughly 55–60% of all three catchments are clad in forest with the rest being a mixture of scrub and pasture for sheep.

27.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Rabbits and hares appear common in the open pasture, and have potential to do considerable damage to native plant species. Sheep are allowed full access to the stream beds and will be grazing on vegetation and posing a trampling threat to nesting birds. Trampling by stock such as this causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

Very few ecological weeds have established in the dry parts of the stream bed, although tree lupin is present in patches along the margins of all three tidal pools. Pasture species are also infringing along the banks. Crack willow and silver poplar occur on the banks near the upper limit of the Mākotukutuku Lagoon.

27.5 Conservation management

27.5.1 Current

Both Pararaki and Ōtakaha Stream mouths fall within coastal esplanade reserves, administered by South Wairarapa District Council, but there is little active management. The surrounding land is privately owned and farmed. Pest and weed control is undertaken by the landowner as required.

DOC maintains the Pinnacles Track up the Mākotukutuku Stream, which has its access point at the road bridge over the tidal pool.

27.5.2 Potential

The estuarine site has low value, even though the catchment has very high freshwater fish value. In such a dynamic environment, native wetlands were unlikely to have persisted naturally. However, the margins could be restored if stock were excluded by fencing, and ecological weed species were controlled. Fencing out stock and planting riparian areas would also contribute to reducing any nutrient pollution and sedimentation issues. Plantings of flax and toetoe would be particularly suitable here, as these species are already present.

27.6 References

Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.

MacDonald, A.; Joy, M. 2009: Freshwater biodiversity in the Wellington region. Department of Conservation, Wellington Conservancy, Wellington (unpublished).

28. Ōpouawe River

28.1 Site description

The Ōpouawe River is a medium-sized braided river system constrained at the mouth by a large sand bank and limestone rock outcrops (Table 28A; Figs 28.1, 28.2). The system is dynamic, and the actual position of the outlet changes according to conditions. The outlet is likely to be frequently closed on a seasonal basis with a large brackish lake formed by the river. Tidal influence at such times is probably intermittent, occurring only at highest tides (Robertson & Stevens 2007). Little vegetation is found on the gravel flats behind the sandbar and grazed pasture extends to the banks (Fig. 28.3). In recent times, a low terrace to the west of the mouth has formed that is likely to have been part of the river bed.

| SITE NAME | ŌPOUAWE RIVER |
|--|---|
| Location | 2 km east of White Rock, Cape Palliser |
| NZTM (coordinates) | 1802268 5395478 |
| NZ Topo50 | BR33 023 955 |
| Area | 5 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private—White Rock Station Ngāpōtiki Road Esplanade Reserve (South Wairarapa District Council) |
| Existing rankings | Ecol Sites 96 & 605 |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 4 |
| At Risk species (number) | 9 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Tall fescue grassland Gravelfield |

28.2 Conservation values

28.2.1 Ecological

Due to the dynamic nature of the gravel riverbed, knobby clubrush is the only native species present in the tidal zone.

There are no threatened plant species in the estuarine ecosystem, although pīngao (Partridge 1992) and matagouri (Hay 1948), have been recorded in the adjacent dunes. Buchanan's sedge was also recorded (Zotov 1947), but is no longer present. De Lange & Crowcroft (1993) surveyed White Rock, a short distance along the coast, and found several significant species including matagouri, Cook Strait bristle grass and Cook Strait tussock.

There is good habitat for shore and wading birds although the diversity is apparently low. Banded dotterels are known to nest in the area (C. Miskelly, DOC 2009, pers. comm.). The estuarine site was included in the OSNZ (2007) river mouth bird survey.

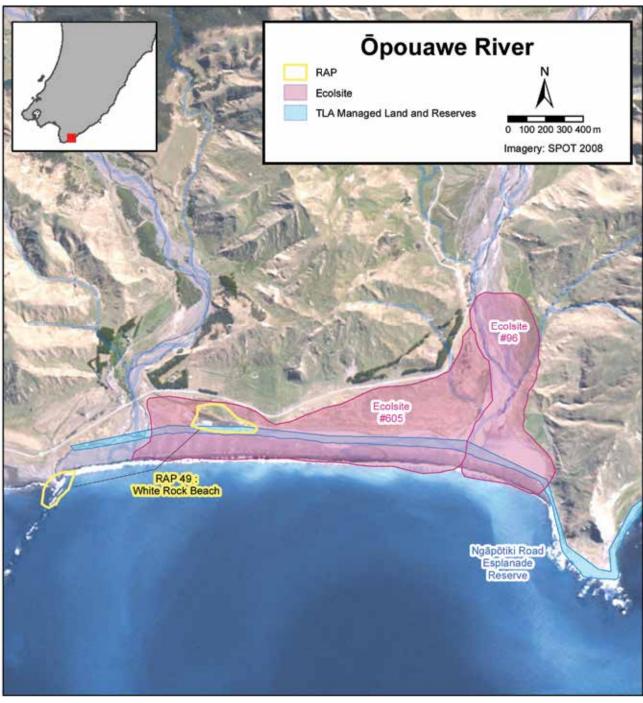


Figure 28.1. Ōpouawe River estuarine site showing areas and places mentioned in the text.

Four migratory freshwater fish species have been found in the catchment, all of which are listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, kōaro and redfin bully; Allibone et al. 2010). It appears that there is little spawning habitat for inanga, and this species has not been recorded in the catchment. Due to the frequency of blockage at the mouth, the presence of smaller coastal marine species is likely to be sporadic, while larger species are unlikely to enter the mouth at all.

There are records of spotted skink, which is significant if it is still present (Anon. 1970).

Table 28B lists native species present in, or utilising, the Ōpouawe River estuarine system.

28.2.2 Recreational

The area is part of White Rock Station. There is a small public carpark that allows access to the beach, but recreational use is low, mainly consisting of surfers, surfcasters, and a few picnickers.



Figure 28.2. An overview of the Ōpouawe River mouth. Photo: Wriggle Coastal Management, © Greater Wellington Regional Council.



Figure 28.3. Sand and gravel flats form the Ōpouawe River mouth basin. Photo: Matt Todd.

28.3 Catchment properties

The Ōpouawe is a medium-sized river with a hilly catchment of 10 500 ha. The western part of the catchment drains the steep, bush-clad slopes of the Aorangi Range, while the coastal Ewe Ridge (Tora) is to the east. Less than a third of the catchment is pastoral; the remainder is scrub and regenerating native forest (MacDonald & Joy, 2009). The headwaters of the Ōpouawe western tributaries all lie within the boundaries of the Aorangi Forest Park.

While the river is prone to flooding, the broad, braided bed means that floodwaters dissipate quickly and sediment is deposited before it reaches the estuarine system. Water quality is thought to generally be good, although when the outlet is blocked, standing water in the waterway is frequently subject to algal bloom (Robertson & Stevens 2007).

Table 28B. Native species present in, or utilising, the Opouawe River estuarine system.

| GROUP | SPECIES |
|-------|------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Black swan |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Kingfisher |
| | Paradise shelduck |
| | Pied stilt* |
| | New Zealand pipit* |
| | Red-billed gull+ |
| | |

| GROUP | SPECIES |
|-----------------|----------------------------|
| Birds continued | Royal spoonbill* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-fronted tern* |
| Fish | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortjaw kōkopu+ |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the upper and middle parts of the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

GWRC manages flood control in the river under the Āwhea-Ōpouawe Catchment Scheme. This focuses on afforestation of erosion-prone land rather than physical alteration of the river bed.

28.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. There is no specific fencing of the river margin (Figure 28.3), and stock (mainly sheep) have unfettered access to the river bed. As well as damaging terrestrial vegetation, trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

There are no invasive weeds of real concern, although marram, tree lupin, and tall fescue are all established in abundance in the margins and immediate vicinity. These species are stiff competitors, and tend to overwhelm native species and prevent them from re-establishing.

Vehicle access to the beach is limited, and there was no evidence of vehicle tracks near the river mouth. Because visitation is low, human disturbance is assumed to be low.

28.5 Conservation management

28.5.1 Current

The river mouth, apart from the Ngāpōtiki Road Esplanade Reserve, is entirely within the boundaries of White Rock Station, and pasture extends to the margin of the river bed. Sheep are allowed to wander freely in the river bed and graze on the tall fescue on the bank. There is no evidence of riparian planting for some distance upstream. A paper road connects the small carpark area to the White Rock Road and is maintained by South Wairarapa District Council for public access to the beach and is fully fenced. An undefined footpath leads from here to the beach. There appears to have been little control of tree lupin.

GWRC has undertaken habitat mapping of the Ōpouawe River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

28.5.2 Potential

Given the physical geology and hydrology of the river mouth, it would seem unlikely that saltmarsh has ever occurred here. The greatest potential for habitat restoration lies with the dunes and terraces on the true right of the mouth. These habitats buffer the river margins and restoration would enhance vegetation sequences and reduce disturbance to the estuarine system. Currently vegetated with marram and tree lupin scrub, these species could be controlled and the area replanted with pīngao in the dunes and matagouri shrubland on the terrace. A number of regionally significant coastal plant species (e.g. prickly couch) are found in the vicinity, and there is the potential for these to be reintroduced to this site. These species are hardy and would be likely to survive most flooding events and recover quickly.

Fencing of this area to exclude wandering stock would not only protect native vegetation, water quality and aquatic habitats, but also alleviate the risk of damage to banded dotterel nesting sites. White Rock Station has already fenced along the rear of the terrace, but access is open from the river bed.

The track from the carpark to the beach could be redefined, and rope barriers put in place to encourage users to keep off the potential restoration site. Information panels regarding the significance of the ecosystem could be erected at the carpark.

There is currently no legal protection of this estuarine site, although it is partly covered by the esplanade reserve (managed by South Wairarapa District Council). To provide further protection, the site status could be upgraded by South Wairarapa District Council or included in the nearby DOC reserve at White Rock which adjoins the current esplanade reserve approximately 2 km west of the estuarine site mouth. It may also be possible to negotiate with the owners of White Rock Station to place a QEII covenant upon their portion of the terrace.

28.6 References

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29. Āwheaiti Stream

29.1 Site description

The mouth of this small stream (Table 29A; Fig. 29.1) cuts through a coastal terrace (Fig. 29.2), where a small pool is formed before discharging across Tora Beach (Fig. 29.3). The banks of the pool are steep and crumbly. The area has been grazed for over 120 years, and pasture species dominate the stream margins. The homestead and farm buildings of Tora Station are immediately adjacent to the stream at the rear of the terrace. The coastal road bridge crosses the stream above the tidal zone.

Table 29A. Āwheaiti Stream site information (see also Fig. 29.1).

| SITE NAME | ĀWHEAITI STREAM |
|--|---|
| Location | Tora |
| NZTM (coordinates) | 1809270 5401276 |
| NZ Topo50 | BR34 093 013 |
| Area | Approx. 1 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private — Tora Station South Tora Recreation Reserve (South Wairarapa District Council) Āwheaiti Marginal Strip (DOC) |
| Existing rankings | None |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 2 |
| At Risk species (number) | 3 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1–5) | 2 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Browntop grassland Sandflats |

29.2 Conservation values

29.2.1 Ecological

The terrace has been grazed as part of Tora Station's 'home' paddocks for many years, and there is little native vegetation remaining on the stream margins (Fig. 29.3). Patches of knobby clubrush and giant umbrella sedge are present at the base of the banks, and small-leaved pōhuehue may be found. There are no threatened plants in the stream vicinity.

Shorebirds appear to visit the beach in low numbers, with only a few southern black-backed gulls and red-billed gulls seen on the beach. Other species visiting include variable oystercatchers, banded dotterels and pied stilts. White-faced herons and kingfishers are seen at the stream mouth only occasionally.

Only one migratory freshwater fish species has been recorded in the catchment, the common bully.

Table 29B lists native species present in, or utilising, the Āwheaiti Stream estuarine system.

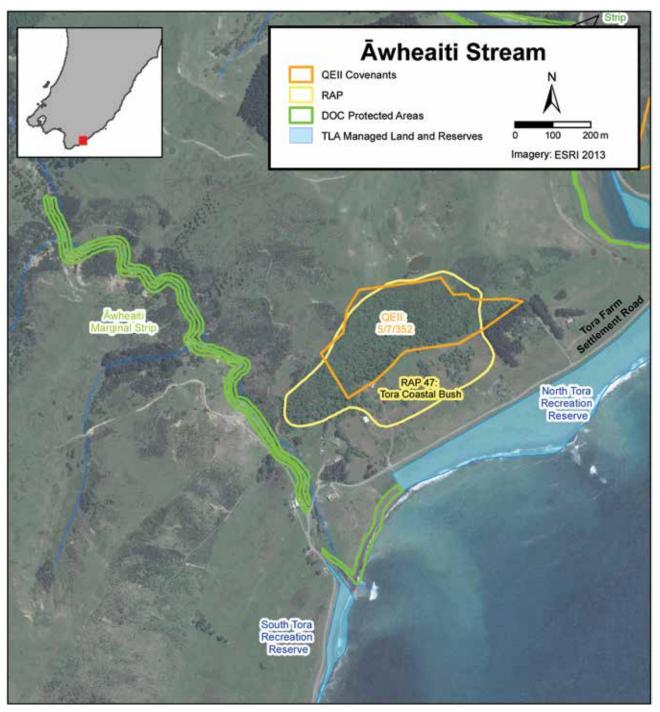


Figure 29.1. $\bar{\text{A}}$ wheaiti Stream estuarine site showing areas and places mentioned in the text.

29.2.2 Recreational

The beach front is part of the South Tora Recreation Reserve and receives a moderate number of holiday-makers during the summer months. The Tora homestead is to the north, while a farm cottage, now run as a guest house, is immediately adjacent to the east.

29.3 Catchment properties

The stream drains around 8100 ha of the coastal hills (MacDonald & Joy 2009). Sixty-five percent of the catchment is grazed as part of Tora Station, while the remainder is either scrub or native bush. There is no record of water quality monitoring.



Figure 29.2. The tidal area of the Āwheaiti Stream is adjacent to Tora Station. *Photo: Matt Todd.*



Figure 29.3. The Āwheaiti Stream outlet crosses the sandflats of Tora Beach. Photo: Matt Todd.

The headwaters of the stream lie in the Tora Bush Scenic Reserve, while the lower part of the river is part of the Āwheaiti Marginal Strip, managed by DOC. The Tora Coastal Bush Recommended Area for Protection (No. 47) and the corresponding QEII Covenant (5/07/352) are adjacent to the river, only a few hundred metres upstream from the stream mouth (Beadle et al. 2004).

29.4 Threats

Sheep and cattle have full access to the stream margins. As well as causing damage to terrestrial vegetation, trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals.

Table 29B. Native species present in, or utilising, the Awheaiti Stream estuarine system.

| GROUP | SPECIES |
|-------|--------------------|
| Birds | Banded dotterel+ |
| | Kingfisher |
| | Little shag |
| | New Zealand pipit* |
| | Paradise shelduck |
| | Pied stilt* |

| GROUP | SPECIES |
|-----------------|----------------------------|
| Birds continued | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | White-faced heron |
| Fish | Common bully |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

Sedimentation also exacerbates the effects of flooding. Pasture runs nearly to the water's edge, and the area is dominated by exotic grasses. Along the steep banks of the stream, briar is the species of most concern, as this shrub is an aggressive competitor in disturbed conditions and will overwhelm native vegetation, particularly where grazing occurs.

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. During the summer months, domestic pets (particularly dogs) may also be present in the company of holiday-makers. Rabbits and hares are likely to be in the vicinity, presenting a threat to new growth of native plant species.

29.4 Conservation management

29.4.1 Current

The southern bank of the stream mouth, and the beach to the north, is part of the South Tora Recreation Reserve managed by South Wairarapa District Council. The northern stream mouth is administered by DOC as part of the Āwheaiti Marginal Strip, which covers both sides of the river for about a 1.5 km upstream (Fig. 29.1). Part of the camping and parking area on the south terrace is mowed, while the remainder is occasionally grazed. South Wairarapa District Council camping bylaws have restriction in relation to pollution, vehicle use and dogs. The only fencing near the stream mouth encloses the adjacent guest-house.

Pest control of possums, and possibly ferrets, is carried out by Tora Station as part of farm management as they are vectors of tuberculosis. GWRC also controls these species in the bush areas.

29.4.2 Potential

There is only a thin strip of habitat suitable for restoration of saltmarsh vegetation along the water's edge. Other species to plant here could include three-square, pūrua grass, wīwī and sea rush, as these species are common in saltmarsh wetlands along this coast. A buffer zone of native shrubs could be planted along the steep banks to inhibit further ecological weed invasion. If the area were to be fenced to exclude stock, the briar would soon lose its competitive advantage, and be controlled through overshading, although it could require other control measures in order to eliminate the species completely. Fencing out stock and planting riparian areas would also contribute to reducing any nutrient pollution and sedimentation issues.

While these measures could be carried out on public land, it would be advantageous to work in partnership with the Tora Station management in order to improve the condition of this estuarine system.

29.5 References

MacDonald, A.; Joy, M. 2009: Freshwater biodiversity in the Wellington region. Department of Conservation, Wellington Conservancy, Wellington (unpublished).

30. Āwhea River

30.1 Site description

The Āwhea River is a medium-sized river that has a 2 ha area of wetland near the mouth. The mouth features a large sand bar (Table 30A; Figs 30.1, 30.2). The mouth is frequently blocked, as it was in 2009, causing a brackish lake to back up the river. At such times, tidal influence is negligible. A wetland occupies the true left (north-eastern) bank (Figs 30.3, 30.4), while dune vegetation occupies the narrow spit that separates the lake from the beach. A road bridge and causeway crosses the estuarine system, splitting the wetland in half.

30.2 Conservation values

30.2.1 Ecological

The edges of the estuarine site have been greatly modified by farming and grazing. In the wetland, ruatahi (cutty grass) forms dense swards (Fig. 30.4). Sea rush, wīwī and three-square are present in the mid-tidal area. Flax, giant umbrella sedge, and clubrush are also abundant in the wetland, while slender clubrush and slender spike sedge grow in the spaces amongst the cutty grass. Kōwhangatara grows amongst the vegetation at the rear of the adjoining beach.

There are no threatened plant species recorded in the estuarine site.

The beach adjacent to the mouth is frequented by a range of birds, including gulls, banded dotterels, variable oystercatchers, and pied stilts. Waders and waterfowl visit the lake to feed. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Table 30A. Āwhea River site information (see also Figs 30.1).

| SITE NAME | ĀWHEA RIVER |
|--|---|
| Location | Tora |
| NZTM (coordinates) | 1810470 5402075 |
| NZ Topo50 | BR34 105 021 |
| Area | 7 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private North Tora Road Recreation Reserve (South Wairarapa District Council) Te Awaiti Marginal Strip (DOC) Äwhea Marginal Strip (DOC) |
| Existing rankings | Ecol Site 3 |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 5 |
| At Risk species (number) | 10 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1–5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Cutty grass sedgeland Tall fescue grassland Sandflats Subtidal |

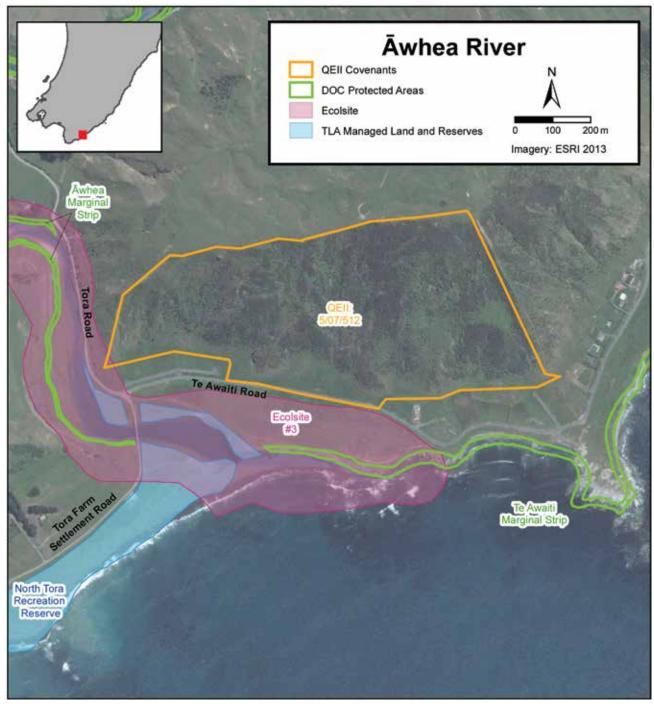


Figure 30.1. \bar{A} whea River estuarine site showing areas and places mentioned in the text.

Six migratory native fish species have been found in the catchment, including three species listed as 'At Risk: Declining' (longfin eel, inanga and redfin bully; Allibone et al. 2010). On the occasions that the mouth is open, the tall fescue on the banks is likely to provide suitable spawning habitat for inanga. Small coastal marine species are also likely to enter the lake when mouth is open, followed occasionally by kahawai and stingrays.

Table 30B lists native species present in, or utilising, the Āwhea River estuarine system.



Figure 30.2. The mouth of the Āwhea River which can be completely blocked, causing the formation of a lake. *Photo: Helen Kettles.*



Figure 30.3. Looking across the Awhea River to the area of intact saltmarsh, adjacent to the road bridge. Photo: Matt Todd.

30.2.2 Recreational

The North Tora Recreation Reserves, managed by South Wairarapa District Council, is adjacent to the lake on either side. The parking and camping sites provided make it a popular area for holiday-makers and recreational users (e.g. surfers and divers) who visit the beach during the summer months. The three day Tora Coastal Walk through private farmland also passes by this estuarine site.

30.3 Catchment properties

The Āwhea River has a hilly catchment of 15 160 ha, consisting mostly of pasture and scrub (MacDonald & Joy 2009). The catchment penetrates a considerable distance inland in the direction of Martinborough and contains the small rural settlement of Tūturumuri. The main Āwhea River is lined on both sides by the DOC-administered Āwhea Marginal Strip, following the river to the Little Tora settlement. To the west, the river's tributaries drain the Tora Bush Scenic Reserve. A QEII Covenant (5/07/512) is adjacent to the river and lake along the northeastern bank.

GWRC manages flood control in the river under the \bar{A} whea- \bar{O} pouwe Catchment Scheme. This focuses on afforestation of erosion-prone areas.



Figure 30.4. The saltmarsh at the mouth of the Āwhea River consists largely of giant umbrella sedge sedgeland. *Photo: Matt Todd.*

Table 30B. Native species present in, or utilising, the Āwhea River estuarine system.

| GROUP | SPECIES |
|-------|------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Black swan |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | Paradise shelduck |
| | New Zealand pipit* |
| | Pied shag+ |
| | Pied stilt* |
| | Pūkeko |
| | Red-billed gull+ |
| | Reef heron+ |
| | Royal spoonbill* |

| GROUP | SPECIES |
|-----------------|----------------------------|
| Birds continued | Southern black-backed gull |
| | Spotted shag |
| | Spur-winged plover |
| | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Common bully |
| | Common smelt |
| | Inanga* |
| | Kahawai |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

30.4 Threats

Robertson & Stevens (2007) identify soil erosion and sedimentation as the main water quality issues in the estuarine system, although they note that nutrient enrichment and algal buildup are likely to become significant when the mouth is closed for extended periods. This is supported by the findings of the GWRC water quality monitoring station at the Tora Road bridge (GWRC site RS53), which consistently rates the river water as 'fair' to "good" (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015). An extremely high

level of periphyton was measured in a one-off sample during late summer (Perrie 2008), although it was not found during this survey at the same time a year later. Nuisance periphyton growth at the monitoring site is exacerbated by frequent low flows.

A range of mammalian predators and browsers will be present but mostly their impacts have not been assessed at this site. Sheep commonly have access to the wetland and north-eastern margins of the lake, and there was evidence of a stock trampling in the shelter of a rock-outcrop adjacent to the water. As well as causing damage to terrestrial vegetation, trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding. During the summer months, domestic pets (particularly dogs) may also be present in the company of holiday-makers.

Tall fescue is abundant in the tidal margins and throughout the saltmarsh. If it is allowed to become rank this pasture would also pose a major fire risk. Around the steeper slopes associated with the causeway, there is an assortment of exotic shrubs. Of these, briar is the most invasive species in disturbed sites, but it is unlikely that this will spread into the wetland.

30.5 Conservation management

30.5.1 Current

Both banks of the lake are administered by South Wairarapa District Council as the North Tora Road Recreation Reserve, but only the south-western terrace is actively managed as a parking and camping site. South Wairarapa District Council camping bylaws have restrictions in relation to pollution, vehicle use and dogs. The northern bank, including the saltmarsh, is grazed by sheep, although the recreation reserve in this area is fenced from the road. Also along the northeastern bank towards the river mouth is Te Awaiti Marginal Strip, administered by DOC.

GWRC has undertaken habitat mapping of the Āwhea River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). The estuarine system is part of GWRC's long-term estuarine state of the environment monitoring programme.

30.5.2 Potential

The estuarine site has good potential for restoration because of the diversity of native species present, which would help parts of the lake margins to revert to healthy estuarine wetland relatively quickly, particularly if the saltmarsh were fenced to exclude sheep. Fencing out stock would also contribute to reducing erosion and sedimentation. Control of the tall fescue may be necessary, although this would require careful management in the estuarine environment. Improvement to water quality in this estuarine site could be achieved through improved land use management in the catchment.

It would be desirable to carry out supplementary planting of riparian shrubs at the rear of the wetland, to inhibit ecological weed invasion of the wetland. Saltmarsh ribbonwood, toetoe, taupata, and flax are all common in wetlands along the Wairarapa coast and would be appropriate.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

Information panels at the recreational camping area would help raise public awareness of the significance of estuarine wetlands and encourage dog control.

It will be important to work with local landowners and the developer of the new subdivision on the far side of the road to get their support for habitat restoration efforts and ecological weed control.

30.6 References

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31. Ōterei River

31.1 Site description

This medium-sized river is constrained at the mouth by a steep-sided coastal gully and a semi-permanent sandbar (Table 31A; Figs 31.1, 31.2). Due to these constraints, a brackish lake can sometimes form, and it is likely that tidal flushing is then intermittent at best.

A road bridge crosses the upstream end of the lake, providing access to Te Awaiti Station on the eastern terrace (Fig. 31.3). There is also a small settlement on the western side of the estuarine site, with Te Awaiti Road Recreation Reserve occupying the water's edge adjacent to the mouth. A rough vehicle track runs along the western margins of the lake.

31.2 Conservation values

31.2.1 Ecological

The banks on the east of the lake are too steep for the formation of intertidal saltmarsh. Patches of flax, toetoe, and tauhinu are present along the high tide level. Knobby clubrush is throughout the flatter areas of the marginal grassland.

On the western margin of the lake, adjacent to the reserve, there is about a hectare of saltmarsh (Figs 31.3, 31.4), consisting of a mosaic of knobby clubrush, sea rush, wīwī, and three-square. Shore primrose and native musk both grow in the spaces below the rushes, while giant umbrella sedge grows at the rear of the wetland. A smaller area of rushland, composed of a similar suite of species, is on the true left bank, upstream of the bridge.

Table 31A. Ōterei River site information (see also Fig. 31.1).

| | _ |
|--|--|
| SITE NAME | ÖTEREI RIVER |
| Location | Te Awaiti |
| NZTM (coordinates) | 1815171 5404374 |
| NZ Topo50 | BR34 152 044 |
| Area | 4 ha |
| DOC Office | Whakaoriori/Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private—Te Awaiti Station Te Awaiti Road Recreation Reserve (South Wairarapa District Council) Ōterei No. 1 Marginal Strip (DOC) |
| Existing rankings | Ecol Site 99 |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 5 |
| At Risk species (number) | 10 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Restiad rushland Three-square sedgeland Browntop grassland Sandflats Subtidal |

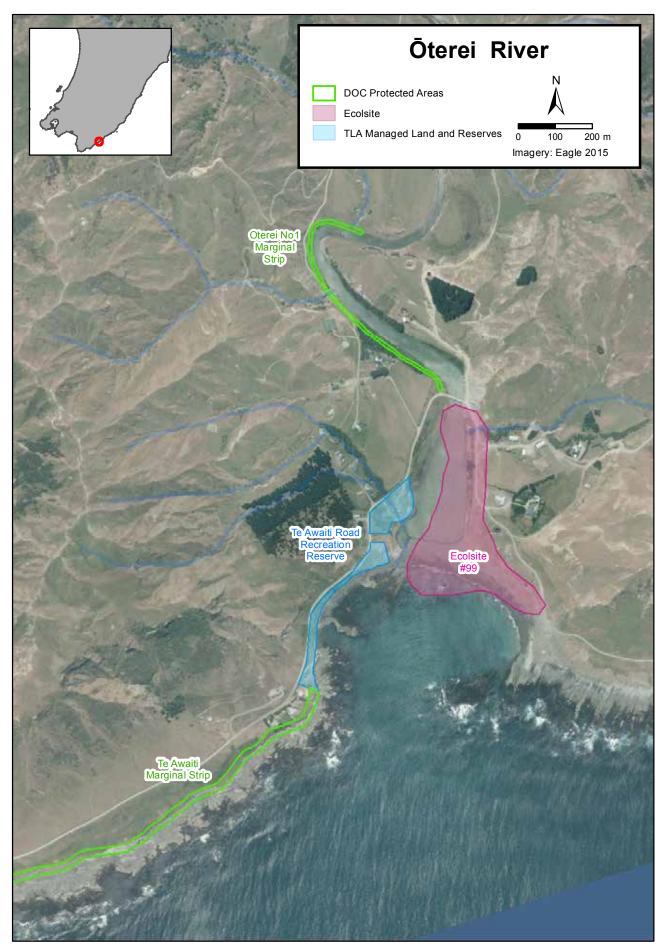


Figure 31.1. Ōterei River estuarine site showing areas and places mentioned in the text.



Figure 31.2. The mouth of the Ōterei River which is sometimes completely blocked by a sandbar, which then causes the formation of a lake. *Photo: Helen Kettles*.



Figure 31.3. Overview of the lake at the mouth of the Ōterei River. An area of intact saltmarsh habitat is seen on the left. Photo: Matt Todd.

Kōwhangatara is present in the dunes at the mouth. Shrubby tororaro was recorded here by de Lange (1993) but is no longer present.

Several bird species were seen roosting on the sandbar, including southern black-backed gulls, variable oystercatchers, banded dotterels, and pied stilts. Elsewhere around the lake, black shags, New Zealand pipits, and white-faced herons were noted. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Nine migratory native freshwater fish, including all the migratory galaxiids present in New Zealand, have been found in the catchment, and the estuarine system provides excellent spawning habitat for inanga (Taylor & Kelly 2003). Six of these species are listed as 'At Risk:



Figure 31.4. On the western margin of the estuarine site there is a large area of saltmarsh. Photo: Helen Kettles.

Declining' (longfin eel, giant kōkopu, shortjaw kōkopu, kōaro, inanga and redfin bully; Allibone et al. 2010).

No lizards have been recorded at this site.

Table 31B lists native species present in, or utilising, the Ōterei River. estuarine system.

31.2.2 Recreational

The beach and lake receives moderate numbers of recreational users including fishers and swimmers during the summer. The three day Tora Coastal Walk through private farmland also passes by this estuarine site.

Table 31B. Native species present in, or utilising, the Ōterei River. estuarine system.

| SPECIES |
|----------------------------|
| Native musk* |
| Shrubby tororaro+ |
| Banded dotterel+ |
| Black shag* |
| Black-fronted dotterel |
| Caspian tern+ |
| Little black shag* |
| Little shag |
| Paradise shelduck |
| Pied stilt* |
| Red-billed gull+ |
| Southern black-backed gull |
| Spur-winged plover |
| |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birsd continued | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| Fish | Banded kōkopu |
| | Common bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Shortjaw kōkopu+ |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

31.3 Catchment properties

The catchment is around 6500 ha of coastal hills, covered in pasture and scrub (MacDonald & Joy 2009). Robertson & Stevens (2007) highlight sedimentation and nutrient enrichment as potential issues, particularly when the mouth is blocked, and this is supported by the elevated levels of brown algae (periphyton) noted in the estuarine system.

There are two marginal strips along the riverbank managed by DOC (Ōterei Nos. 1 & 2) (Fig. 31.1). Ōterei No. 1 strip follows the true right bank from the inland side of the bridge for nearly a kilometre and the Ōterei No. 2 strips begin about 3 km upstream from the lake on both sides of the Ōterei River and continues upstream for approximately 2.4 km.

31.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. During the summer months, domestic predators may also be present in the company of holiday-makers.

Mats of buck's horn plantain are forming around the fringes of the wetland, particularly along the vehicle track where the environment is already disturbed. These mats inundate new growth of wetland species and can dramatically alter the habitat. The vehicle track through the saltmarsh (Fig. 31.5) also poses a threat to the habitat in three ways: (a) doing direct damage to the wetland plants, aquatic habitats and native fish; (b) compacting the muddy substrate, modifying it in a way that makes it difficult for native plant species to re-establish; and (c) facilitating the invasion of mat-forming weeds such as buck's horn plantain.

31.5 Conservation management

31.5.1 Current

A marginal strip (Ōterei No. 1) near the upper tidal limit is administered by DOC, but it would appear that active management is carried out only by the adjacent landowners. The waterway itself, including the wetland, is managed by GWRC. The remainder of the estuarine margin is privately owned.

The terrace adjacent to the western bank of the lake is maintained as Te Awaiti Road Recreation Reserve by South Wairarapa District Council and is regularly mown and weed controlled. South Wairarapa District Council camping bylaws have restrictions in relation to pollution, vehicle use and dogs at the adjacent camping area. The recreation reserve is contiguous with the coastal Te Awaiti Marginal Strip, managed by DOC, with access to the beach via the dunes in this area. The lake is largely unfenced, although there is no stock access to the margins. Pest control of possums and possibly ferrets, in relation to tuberculosis, is carried out by Te Awaiti Station as part of farm management.

A proposed subdivision near the recreation reserve has a restrictive covenant requiring water quality and vegetation planting measures.

GWRC has undertaken habitat mapping of the Ōterei River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). The site is part of GWRC's long-term estuarine state of the environment monitoring programme.

31.5.2 Potential

The wetland on the lake margin contains several species that are rare along this coastline (e.g. native musk is found elsewhere only at Honeycomb Rock and around Lake Ōnoke). This is an ecosystem that has the potential to revert to a valuable estuarine habitat with careful management.

The wetland values would be enhanced if it was physically protected as soon as possible, preferably by fencing. Optimally, vehicles would be excluded from the estuarine margins and saltmarsh in order to reduce further degradation of the habitat. It would be prudent to liaise with the local residents over this issue, in order to gain their cooperation in implementing this measure.

The buck's horn plantain population should be controlled, and preferably eradicated in the wetland. A monitoring schedule to keep check upon ecological weed incursion into the saltmarsh would also be desirable. Other measures that could be taken to facilitate restoration of the habitat could include supplementary planting of sea rush, wīwī, and giant umbrella sedge, and the establishment of riparian planting along the rear of the saltmarsh to act as a buffer zone. As flax, toetoe, and tauhinu are already present, these species would be the logical choice to plant, although taupata and saltmarsh ribbonwood are also known to occur along this coastline and could be legitimately included as part of the natural habitat. It would also be valuable to erect an information panel at a strategic point within the recreation reserve to raise public awareness of restoration efforts, highlighting wetland conservation value.

Improvements to water quality could be achieved through fencing off and planting streams throughout the catchment and by lowering stocking rates and fertiliser inputs on agricultural land if necessary.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

Currently, as noted above, the western terrace is managed by South Wairarapa District Council as a recreation reserve. Options to change the status of this area in order to protect the wetland habitat could be explored.

31.6 References

- Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.
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- Taylor, M.J; Kelly, G.R. 2003: Inanga spawning habitats in the Greater Wellington Region: Part 2 Wairarapa. NIWA Client Report CHC01/67. National Institute of Water and Atmospheric Research, Christchurch.

32. Rerewhakaaitu River

32.1 Site description

The Rerewhakaaitu River discharges to the sea via a steep-sided, rocky valley (Table 32A; Fig. 32.1). The mouth is usually blocked by a substantial sandbar. Because of this sandbar, a broad brackish lake (5 ha) takes up the valley floor (Fig. 32.2), breaching the bar only at as a result of river flooding. The river is flanked by farmland, and the surrounding area is regularly grazed (Fig. 32.3). A small strip of saltmarsh is present along the gentler margins.

32.2 Conservation values

32.2.1 Ecological

At the time of visiting, the lake was significantly higher than normal. Knobby clubrush and sea rush grow in patches along the margin, particularly further upstream where the slope is gentle and the water is shallow. Saltmarsh ribbonwood, flax, tauhinu, and giant umbrella sedge are also present along the margins.

Elsewhere, the slopes are so steep and rocky that little vegetation grows along the high tide mark at all; only a few flax plants and small-leaved pōhuehue were seen in these areas. No threatened species have been recorded at this site.

Several bird species were seen roosting on the sandbar, including southern black-backed gulls, variable oystercatchers, banded dotterels, and pied stilts. Elsewhere around the lake, black shags, New Zealand pipits, and white-faced herons were noted.

There are no formal records of migratory freshwater fish species available for the catchment. The river has not been surveyed for inanga spawning, but it would appear to be too rocky for the most

Table 32A. Rerewhakaaitu River site information (see also Fig. 32.1).

| SITE NAME | REREWHAKAAITU RIVER |
|--|--|
| Location | 2 km south-west of Pāhāoa |
| NZTM (coordinates) | 1823474 5411872 |
| NZ Topo50 | BQ34 235 119 |
| Area | 5 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private—Pāhāoa Station, Te Awaiti Station Pāhāoa Road Esplanade Reserve (South Wairarapa District Council) |
| Existing rankings | None |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 1 |
| At Risk species (number) | 4 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 2 |
| Pressures (score 1–5) NB: 1 = high pressures | 5 |
| Dominant habitat | Browntop grassland Sea rush rushland Sandflats Subtidal |

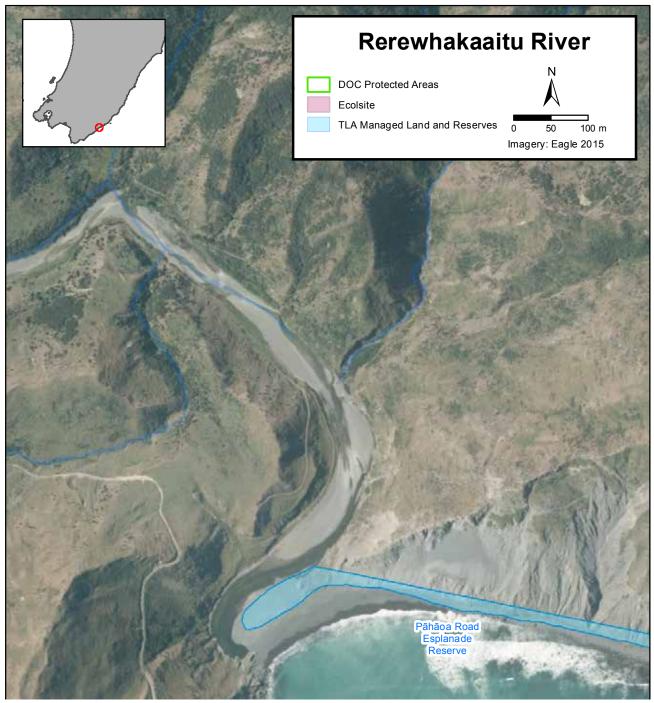


Figure 32.1. Rerewhakaaitu River estuarine site showing areas and places mentioned in the text.

part to sustain a large population. Small coastal marine species, such as yellow-eyed mullet and smelt, are only likely to enter the lake occasionally, at those times that the mouth is open.

A single specimen of raukawa gecko was seen in the cracks in the rock face adjacent to the mouth (M. Todd 2009, pers. obs.).

Table 32B lists native species present in, or utilising, the Rerewhakaaitu River estuarine system.

32.2.2 Recreational

With 4WD access only from Te Awaiti Station, this estuarine site is likely to receive few visitors other than farm workers and the occasional hunter or fisherman.



Figure 32.2. Overview of the brackish lake formed at the mouth of the Rerewhakaaitu River. *Photo: Matt Todd.*



Figure 32.3. Pasture dominates the margins of the Rerewhakaaitu River. Photo: Matt Todd.

32.3 Catchment properties

The catchment is of moderate size, around 4660 ha (MacDonald & Joy 2009), and consists mainly of steep, scrub-covered hills. Less than a third of the catchment is in pasture. Water quality for the majority of the river is likely to be good, although turbidity and algal growth are an issue in the lake at times of blockage (frequently during summer: Robertson & Stevens 2007).

Table 32B. Native species present in, or utilising, the Rerewhakaaitu River estuarine system.

| GROUP | SPECIES |
|--------------|----------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Pied stilt* |
| | New Zealand pipit* |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| | White-faced heron |
| Herpetofauna | Raukawa gecko |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

32.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Grazed pasture continues right to the high tide mark in most places, and pasture grasses dominate the margins (Figs 32.2 and 32.3). While the area is partially fenced on the south side of the mouth, stock have full access to the stream on the north bank. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding. The gravest concern around the lake is the presence of buck's horn plantain forming thick mats in the margins. This aggressive competitor is capable of quickly eliminating low-growing native species and may even eventually break down taller non-woody plants.

During summer, the lake outlet is usually blocked, thus the estuarine system is not properly flushed by the tide. Toxic algal blooms are, therefore, likely to be common during these times (Robertson & Stevens 2007) (see above). Elevated levels of algae and phytoplankton quickly deplete oxygen in the sediments, leading to anoxia and eutrophication.

32.5 Conservation management

32.5.1 Current

The river forms the boundary between Pāhāoa (north) and Te Awaiti (south) Stations. Although the waterway is officially the responsibility of GWRC, and the coastal Pāhāoa Road Esplanade Reserve is administered by South Wairarapa District Council, it would appear that only the adjacent landowners carry out active management by undertaking control of some pasture weeds such as thistles.

GWRC has undertaken habitat mapping of the Rerewhakaaitu River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

32.5.2 Potential

Given the physical geology and hydrology of the river mouth, it would seem unlikely that significant saltmarsh has ever occurred here. It may be possible, however, to improve the tidal margins by encouraging landowners to exclude stock from the riparian areas on their properties and by planting more of the native shrubs and grasses already found here, such as tauhinu, saltmarsh ribbonwood, small-leaved pōhuehue, and flax. Other than this, the banks are simply too steep and rocky to support wetland vegetation in most places.

Although land use in the catchment is currently of low intensity and the catchment consequently experiences low inputs of nutrient and sediment pollution, water quality issues do arise in the estuarine system when the mouth is blocked during summer. Fencing out stock and planting riparian areas would contribute to reducing these issues. It would also be prudent to monitor land use changes in the catchment, as they could have marked impacts on the environment.

32.6 References

MacDonald, A.; Joy, M. 2009: Freshwater biodiversity in the Wellington region. Department of Conservation, Wellington Conservancy, Wellington (unpublished).

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33. Pāhāoa River

33.1 Site description

The Pāhāoa River site is classified as a large Category B estuarine system characterised by a sandspit at its outlet (Table 33A; Fig. 33.1). Limestone outcrops constrain the mouth (Fig. 33.2). The river is tidal for 3 km upstream. The estuarine sediments form an important feeding ground for birds that use the spit. There is very little in the way of estuarine riparian vegetation, as the edges of the river are in pasture and the river margins are generally steep, offering little opportunity for the development of saltmarsh (Fig. 33.3).

33.2 Conservation values

33.2.1 Ecological

The edges of the estuarine system have been greatly modified by farming (Figure 141). Native species present around the tidal area include tauhinu, toetoe, and flax, although none of these species grow within the tidal margin. The only sign of saltmarsh vegetation is a small fringe of three-square in the tidal margins, backed by giant umbrella sedge and knobby clubrush. Patches of horse's mane may be seen in the subtidal zone.

A small population of New Zealand spinach is known to be present in the log piles at the strand line near the rock outcrops at the mouth (Silbery & Enright 1998). The adjacent dunes contain pīngao, kōwhangatara, and mat daisy (Beadel et al. 2004) and are covered by a Recommended Area for Protection (45). Shrubby tororaro is known to have occurred here as recently as 1992 (de Lange), but is no longer present. Although nearby, the dunes are quite disjunct from the tidal margins of the river mouth.

Table 33A. Pāhāoa River site information (see also Fig. 33.1).

| SITE NAME | PĀHĀOA RIVER |
|--|--|
| Location | Pāhāoa |
| NZTM (coordinates) | 1827674 5413771 |
| NZ Topo50 | BQ34 277 138 |
| Area | 60 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | South Wairarapa District Council, GWRC |
| Land status (tenure) | Private — Pāhāoa Station, Glendhu Station |
| Existing rankings | Ecol Sites 599 & 2055 RAP 45 (Ecol Site 2055) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 4 |
| At Risk species (number) | 8 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 2 |
| Dominant habitat | Exotic pastureland Sandflats Subtidal |

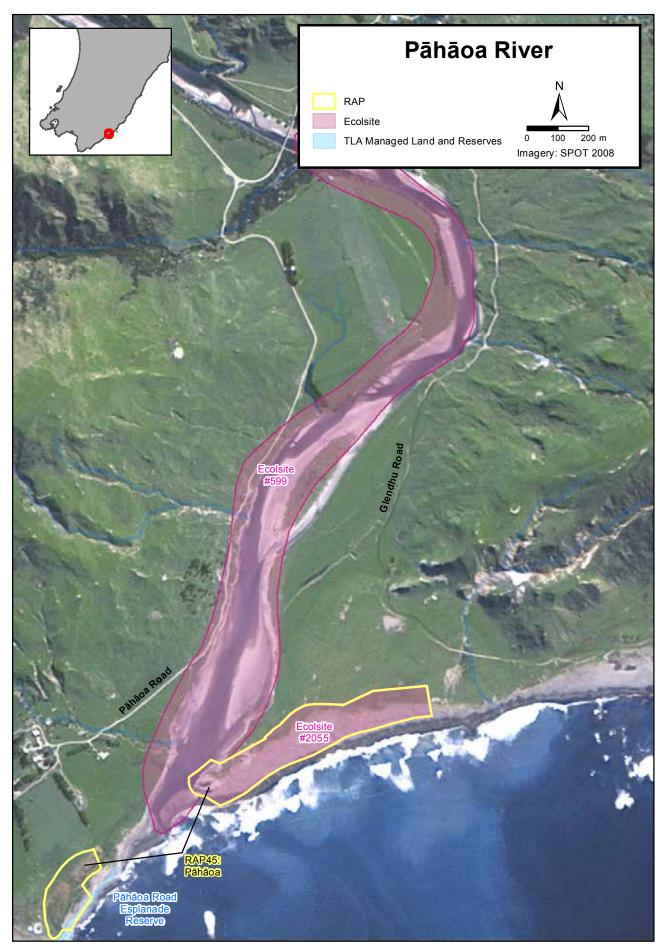


Figure 33.1. Pāhāoa River estuarine site showing areas and places mentioned in the text.



Figure 33.2. Overview of the mouth of the Pāhāoa River. Note the limestone outcrops at centre, adjacent to the mouth. Photo: Wriggle Coastal Management, © Greater Wellington Regional Council.



Figure 33.3. Pāhāoa River tidal margins are dominated by pasture. Horse's mane is in the lagoon. *Photo: Matt Todd.*

The sandspit and estuarine site are popular with shorebirds as a roosting and feeding habitat. It is likely that banded dotterels nest in the dunes, but there appears to be little nesting habitat for waterfowl. The estuarine system was included in the OSNZ (2007) river mouth bird survey.

Six migratory native freshwater fish have been found in the catchment, three of which are listed as 'At Risk: Declining' (longfin eel, inanga and kōaro; Allibone et al. 2010). Yellow-eyed mullet were observed at the site (M. Todd 2009, pers. obs.).

There is a population of raukawa gecko in the limestone outcrops, and probably also in the adjacent dunes. The number of shells on the sandy margins of the river mouth suggests that both cockles and pipi occur in the vicinity, possibly in the sediments of the tidal reach.

Table 33B lists native species present in, or utilising, the Pāhāoa River estuarine system.

Table 33B. Native species present in, or utilising, the Pāhāoa River estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | New Zealand spinach* |
| Birds | Banded dotterel+ |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Little shag |
| | Paradise shelduck |
| | New Zealand pipit* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Common bully |
| | Common smelt |
| | Inanga* |
| | Kahawai |
| | Kōaro* |
| | Leatherjacket |
| | Longfin eel* |
| | Shortfin eel |
| Herpetofauna | Raukawa gecko |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

33.2.2 Recreational

The river mouth is a well known fishing and surfing spot. The estuarine site itself is a safe and popular swimming site for local residents, and whitebaiting takes place along the river during the season.

33.3 Catchment properties

The Pāhāoa/Waioronu River catchments drain an area of approximately 64750 ha (MacDonald & Joy 2009) of the hill country between Martinborough and the coast. The Mt. Adams-Pāhāoa River Bush Recommended Area for Protection covers a large area of the catchment within the Pāhāoa Gorge. Most of the catchment is in sheep and cattle farm, with a significant portion (13%) in exotic forestry. There is very little indigenous forest remaining. The catchment is steep, and prone to erosion.

33.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. The area of saltmarsh habitat is minimal, although stock access has had a tendency to pug and break down banks. The native vegetation in the dune hollows of the Recommended Area for Protection may sustain some damage from rabbits and hares.

Grazed pasture continues right to the high tide mark in most places, and pasture grasses dominate the margins almost exclusively (Fig. 33.3). Gorse and lupin have a presence along the banks, but are well controlled. Marram is present in patches amongst the kōwhangatara in the dunes at the mouth of the river. This is the main ecological weed present.

Sedimentation and flooding are issues that present a concern in the lower river (Wairarapa Engineering Lifelines Association 2004, GWRC 2007). Robertson & Stevens (2007) also highlight nutrient enrichment and eutrophication. Sedimentation can reduce water quality, inhibit fish migration and smother habitat for aquatic animals, while nutrient pollution leads to elevated levels of algal growth and anoxic sediments in the estuarine bed, particularly when the river flow is low. Local residents have reported that this has only begun to occur since the use of fertilisers in the upper catchment was introduced (Robertson & Stevens 2007).

33.5 Conservation management

33.5.1 Current

The estuarine system forms the boundary between two coastal sheep stations, Pāhāoa to the south and Glendhu to the north, and the margins have been continually grazed for over 120 years. The banks are partially fenced, but stock have not been excluded and access the river where the sides are not steep. Possum control is carried out as part of farm management.

GWRC has undertaken habitat mapping of the Pāhāoa River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). They have also recently undertaken a year-long investigation, measuring a range of water quality variables, to enable them to report on health of the catchment.

33.5.2 Potential

Protection and restoration of the entire 3 km tidal zone would require retirement of much pasture and a willingness to do so from the landowners. Instead, it may be possible to improve sections of the tidal margins by encouraging landowners to exclude stock from the riparian areas on their properties and plant wetland vegetation, particularly if the pasture value is already poor. Support could be provided in the form of advice and resources. This would not only enhance the river margins, but provide habitat for waterfowl and native fish, and improve water quality by helping to absorb sediments and fertiliser runoff. Similarly, water quality could be further improved through fencing and planting riparian stream margins throughout the catchment, and encouraging best farming practices.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

33.6 References

- Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.
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34. Kaiwhata River

34.1 Site description

A brackish lake constrained by a sandbar at the mouth (Table 34A; Figs 34.1, 34.2) characterises the Kaiwhata as a Category A estuarine system. The mouth is frequently blocked during summer, although the sandbar has disappeared completely during periods of high rainfall (C. Tatham, Homewood Station 2009, pers. comm.; OSNZ 2007a). The northern riverbank has been stabilised and grazed since the late 1800s and very little native vegetation remains. The southern bank consists of steep, erosion-prone cliffs. The only remaining trace of wetland is a small area on the northern bank of the mouth.

The fossilised remains of tree stumps may be seen in the water off the beach adjacent to the river mouth. Tectonic activity has caused their re-emergence from the coastal sediments.

34.2 Conservation values

34.2.1 Ecological

The only remaining patch of wetland habitat consists largely of knobby clubrush and giant umbrella sedge in an area near the river mouth (Fig. 34.3). The vegetation in the dunes on the north side of the mouth largely contains a significant amount of kōwhangatara. There are no known threatened plant species here.

A range of waterfowl visit the lake to feed, particularly black swans, and paradise shelducks. Waders, such as pied stilts and white-faced herons, are also frequent visitors. The beach provides a roosting spot for shorebirds. The estuarine site was included in the OSNZ (2007b) river mouth bird survey.

Table 34A. Kaiwhata River site information (see also Fig. 34.1).

| SITE NAME | KAIWHATA RIVER |
|--|---|
| Location | 4 km north-east of Flat Point |
| NZTM (coordinates) | 1850784 5435067 |
| NZ Topo50 | BQ35 508 351 |
| Area | 10 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Homewood Station |
| Existing rankings | Ecol Site 35 Area of Important Conservation Value (GWRC) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 2 |
| At Risk species (number) | 6 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 4 |
| Restoration potential (score 1–5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Knobby clubrush rushland Tall fescue grassland Sandflats Subtidal |

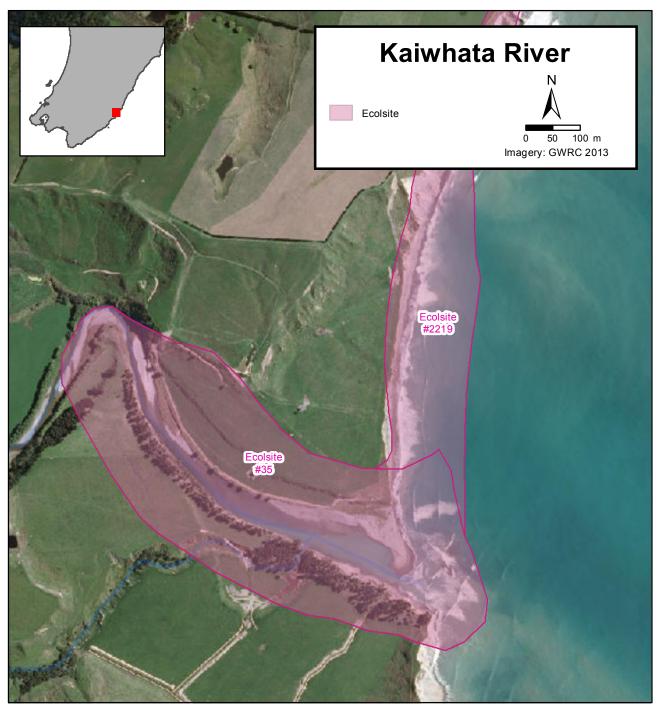


Figure 34.1. Kaiwhata River estuarine site showing areas and places mentioned in the text.

Five migratory native freshwater fish species have been found in the catchment, including three species that are listed as 'At Risk: Declining' (longfin eel, inanga and redfin bully; Allibone et al. 2010). When the mouth is open, the tall fescue on the banks is likely to provide suitable spawning habitat for inanga.

There is little invertebrate and no reptile data available, although the dunes would provide habitat for northern grass skinks (Jewell 1968) and katipō spiders (Patrick 2002), both of which are known to occur at Flat Point, just a few kilometres along the coast. Beadel et al. (2004) noted the presence of false katipō spider here.

Table 34B lists native species present in, or utilising, the Kaiwhata River estuarine system.



Figure 34.2. The mouth of the Kaiwhata River is completely blocked by a sandbar, causing the formation of a lake. *Photo: Matt Todd.*



Figure 34.3. Wetland vegetation at the blocked mouth of the Kaiwhata River. The vehicle track passes through the wetland. *Photo: Matt Todd.*

34.2.2 Recreational

Access to the river mouth is only by boat, or across Homewood Station, so the estuarine site receives little or no recreational use except by local residents. The Petrified Forest is well known to geologists and a lot of people visit this feature. Some fishing, whitebaiting, and duck shooting does take place in the site.

Table 34B. Native species present in, or utilising, the Kaiwhata River estuarine system.

| | · · |
|-------|----------------------------|
| GROUP | SPECIES |
| Birds | Black shag* |
| | Black swan |
| | Black-fronted dotterel |
| | Caspian tern+ |
| | Little shag |
| | Paradise shelduck |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| Fish | Common bully |
| | Inanga* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

34.3 Catchment properties

The river drains an inland basin of some 10 200 ha before penetrating the coastal hills (MacDonald & Joy 2009). Around two thirds of this area is part of the Ngāumu Forest, and is a mixture of exotic pine forest and native bush. The remainder is grazed farmland. The landscape is steep and prone to erosion in the lower catchment, leading to high levels of sedimentation. Robertson & Stevens (2007) highlight this as an issue, although comment that contamination from agricultural runoff is low.

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the middle part of the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

34.4 Threats

The estuarine system is exposed to high levels of sedimentation from the catchment (see above). Fine sediment can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding and inhibits the growth of aquatic vegetation. Eventually, it can significantly alter the character of a small estuarine system.

The 4WD track that provides access to the beach passes through the middle of the wetland area at the mouth of the river (Fig. 34.3), although there was no evidence of vehicles on the beach at the time of visiting. Vehicles in wetlands damage the ecosystem by (a) doing direct damage to the wetland plants, aquatic habitats and native fish; (b) compacting the muddy substrate, modifying it in a way that makes it difficult for native plant species to re-establish; and (c) facilitating the invasion of mat-forming weeds such as buck's horn plantain.

Cattle are frequently grazed on the northern terrace but have been excluded from the banks of the lake. Consequently, a variety of common weeds have thrived in the absence of grazing pressure along the lake's edge, although there do not appear to be any serious pest species amongst them. A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

34.5 Conservation management

34.5.1 Current

The river is part of the Homewood coastal sheep and cattle station, and the river margins have been drained and grazed continuously for at least 120 years, leaving little in the way of terrestrial native biodiversity.

The accessible northern margin of the lake has been fenced off to exclude stock, and willows have been planted at regular intervals to stabilise the banks. Similarly, the steep south face has been planted with Douglas firs and poplars. Pest and weed control is carried out by the landowner as part of preventing tuberculosis but the conservation benefits are unknown.

The river was part of the GWRC 'Streams Alive' initiative (Forsyth & Sevicke-Jones 2005), whereby landowners on properties adjacent to the river are provided with funding and resources over a 2-year period to initiate and maintain riparian planting, in order to further enhance the conservation value of the river as a whole.

The Petrified Forest adjacent to the river mouth has been listed as an Area of Important Conservation Value by GWRC in their Regional Coastal Plan. Ngāti Kahungunu retains a strong cultural and historic interest in the management of the forest, and of the site in general.

GWRC has assessed risks to the Kaiwhata estuarine ecosystem integrity (Robertson & Stevens 2007).

34.5.2 Potential

There is a small area of remaining wetland at the river mouth that, if fenced, could be allowed to revert to the original saltmarsh, providing an enhanced habitat for waders and waterfowl in the environment. In this instance, it would be desirable to reroute the 4WD track around the fringe of the wetland, as passage by vehicles disturbs and compacts the soil, inhibiting the growth of wetland species and creating disturbance and promoting incursion by ecological weeds. Restoration of this habitat could be further augmented with plantings of saltmarsh ribbonwood and sea rush, fringed along the low water mark with pūrua grass and three-square. All of these species are found in estuarine systems within 10 km up and down the coast.

It would also be an appealing option to make use of the funding and resources offered by GWRC in order to revegetate the riparian margin with native shrubs as the area has already had stock excluded to allow the planting of willows. Planting species such as flax, toetoe, koromiko, cabbage tree, and taupata would not only augment the native biodiversity, but would overgrow ecological weed species, and shade the water to provide added shelter for fish in the estuarine site.

Although it is not deemed currently necessary to implement a water monitoring regime, it would be prudent to watch land use in the catchment, as a sudden change could have a marked impact on the environment.

34.6 References

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35. Waikaraka Stream

35.1 Site description

The Waikaraka Stream is frequently blocked by the sandbar at the mouth, and a small tidal pool has formed behind it (Table 35A; Figs 35.1, 35.2). The tide has been known to flood nearly 2 km upstream when the mouth is open (G. Tatham, Matariki Station 2009, pers. comm.). Saltmarsh containing significant diversity is present on both margins of the waterway.

35.2 Conservation values

35.2.1 Ecological

The saltmarsh in the pool is largely composed of pūrua grass beds (Fig. 35.1) along with patches of three-square, oioi, wīwī and sea rush. Saltmarsh ribbonwood is found growing over the rushes at the high tide mark. Other significant species in the saltmarsh include toetoe, giant umbrella sedge, and a patch of raupō. Horse's mane grows in the pool. There are no threatened plant species known at this site.

The sandflats appear to be a popular feeding site for shore birds, with a small flock of pied stilts, spur-winged plovers, variable oystercatchers, and a mixed gang of red-billed and southern black-backed gulls observed. Exotic waterfowl find habitat for feeding and nesting in the saltmarsh.

There are no formal records for migratory native freshwater fish species available in the catchment.

There are no known records of reptiles or invertebrates in the saltmarsh, although Jewell (1968) recorded both northern grass skinks and raukawa geckos along this coast in the past.

Table 35A. Waikaraka Stream site information (see also Fig. 35.1).

| | · |
|--|---|
| SITE NAME | WAIKARAKA STREAM |
| Location | 5 km south-east of Urutī Point |
| NZTM (coordinates) | 1853286 5439067 |
| NZ Topo50 | BQ36 533 391 |
| Area | 2 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Matariki Station |
| Existing rankings | Key Native Ecosystem (GWRC) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 2 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Pūrua grass reedland Saltmarsh ribbonwood shrubland Restiad rushland Raupō reedland Sandflats Subtidal |



Figure 35.1. Waikaraka Stream estuarine site showing areas and places mentioned in the text.

Table 35B. list native species present in, or utilising, the Waikaraka Stream estuarine system.

35.2.2 Recreational

Access to the stream mouth is only by boat, or across Matariki Station, and so it receives little or no recreational use except by residents of the Station. Some whitebaiting and duck shooting may occur.



Figure 35.2. A small tidal pool is formed at the mouth of the Waikaraka Stream. Pūrua grass reedland lines both banks. Photo: Matt Todd.

Table 35B. Native species present in, or utilising, the Waikaraka Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

35.3 Catchment properties

The Waikaraka Stream drains 1615 ha of coastal plain and hills (MacDonald & Joy 2009), mostly occupied by Matariki Station. The headwaters lie in the fringes of the exotic plantations of Ngāumu State Forest, but the majority of the catchment is used for cattle and sheep pasture.

There is no information regarding water quality, but sedimentation, nutrient enrichment, and elevated levels of algal bloom have been identified as issues in other streams along this section of coast (e.g. Robertson & Stevens 2007).

The mature windbreaks of macrocarpa lining the banks on either side have a stabilising effect upon the margins, facilitating the influx of ecological weeds such as pampas grass and tree lupin. Crack willow is also present along the stream. Marram and tall fescue are the dominant species on the beach, around the mouth of the stream.

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

35.4 Conservation management

35.4.1 Current

The estuarine site is entirely within Matariki Station. The area is well fenced and stock are excluded from the stream margins. Some ecological weed and pest control are conducted by the landowner but there appears to be little conservation management of the stream mouth.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these values. A draft KNE Plan for the Homewood Coast is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

35.4.2 Potential

Ecological weed control would appear to be the most pressing priority in this site. The elimination of tall fescue, pampas, and tree lupin in the saltmarsh would greatly enhance the conservation value and improve the habitat for the use of nest sites by wading birds and waterfowl. It would be desirable to plant the banks behind the saltmarsh with native shrubs, such as taupata, tarata, flax, and cabbage tree. Upon reaching maturity, these species would shade out the pasture weeds on the saltmarsh fringes and act as a buffer zone to impede reinvasion. Similarly, it would be of value to control the marram around the stream mouth by planting pīngao, kōwhangatara, and sand tussock in its place, thereby buffering the pool with native vegetation on the beach as well. Sand tussock is not commonly found on the Wairarapa coast, but is known to occur at Flat Point (Milne & Sawyer 2002 and references therein).

Improvements to water quality could be achieved through fencing off and planting the riparian margins of streams throughout the catchment and by encouraging best farming practices on agricultural land.

It would be prudent to monitor land use in the catchment, as a sudden change could have a marked impact on the environment.

As the site is surrounded on all sides by private land, these measures can only be achieved with the support of the landowners. However, additional support could be provided by the regional and district councils in the form of advice and resources.

35.5 References

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36. Patanui Stream

36.1 Site description

This stream runs through open farmland before forming a tidal pool behind a sandspit at the mouth (Table 36A; Fig. 36.1). The tide travels nearly 3 km upstream (G. Tatham, Matariki Station 2009, pers. comm.). A significant area of saltmarsh has formed in the pool (Fig. 36.2), and several small gully wetlands that radiate from the stream bed also show evidence of saline influence. A small dune ecosystem flanks the mouth on the northern side. It is likely that the mouth is frequently blocked, particularly following southerly storms.

36.2 Conservation values

36.2.1 Ecological

This is one of the largest areas of estuarine sedge vegetation on the eastern Wairarapa coast. The saltmarsh in the pool is largely composed of pūrua grass beds, along with patches of three-square, oioi, and sea rush (Fig. 36.2). At the tidal margin on the coastal (north) bank there runs a band of saltmarsh ribbonwood shrubland, mixed with small-leaved pōhuehue and toetoe. On the landward (south) side, a swale runs behind a steep-sided bank, dominated by pūkio and giant umbrella sedge. Knobby clubrush may be found throughout the margin. Several small gullies run off the main stream and these too contain swamp sedge, giant umbrella sedge, and knobby clubrush. There are no threatened plant species known to occur here, although this species of pūrua grass is uncommon in the district (Beadel et al. 2004).

Table 36A. Patanui Stream site information (see Fig. 36.1).

| SITE NAME | PATANUI STREAM |
|--|---|
| Location | 4 km south-east of Urutī Point |
| NZTM (coordinates) | 1853686 5439667 |
| NZ Topo50 | BQ36 537 397 |
| Area | 5 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Matariki Station |
| Existing rankings | Ecol Sites 107 & 771 WERI: 2, SSWI: Potential (Ecol Site 107) RAP 26 (Ecol Sites 107 & 771) Key Native Ecosystem (GWRC) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 2 |
| Ecosystem value (score 1-5) | 4 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 5 |
| Pressures (score 1–5) NB: 1 = high pressures | 5 |
| Dominant habitat | Pūrua grass reedland Saltmarsh ribbonwood shrubland Tall fescue grassland Sandflats Subtidal |

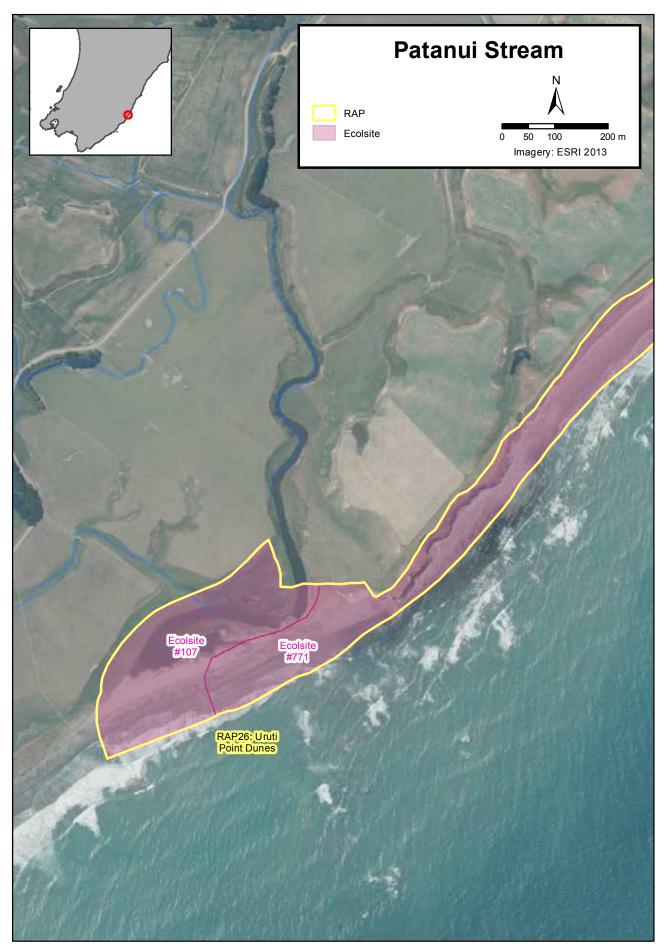


Figure 36.1. Patanui Stream estuarine site showing areas and places mentioned in the text.



Figure 36.2. Intact pūrua grass beds line the margins of the tidal area of the Patanui Stream. Photo: Matt Todd.

A number of species of birds frequent the tidal area. These are mainly exotic species but white-faced herons and paradise shelducks are also known visitors. Australasian shovelers, grey teal, and royal spoonbills are occasionally seen along the coast. Red-billed and southern black-backed gulls, variable oystercatchers, and spur-winged plovers are regular visitors to the beach and dunes.

There are no formal records for migratory native freshwater fish species available in the catchment. Small coastal marine species are only likely to enter the pool when unblocked.

There is no reptile data available, although the dunes would provide good habitat for common and spotted skinks, which are known to occur at Flat Point, just a few kilometres along the coast.

Katipō spiders have been recorded in the dunes around the pool (Beadel et al. 2004).

The estuarine system forms the southern limit of the Urutī Point coastal dune ecosystem, one of the largest in the Wairarapa. The duneland is regarded as one of the best relatively intact plant communities of its type in the region, in terms of natural character and species diversity (Beadel et al. 2004).

Table 36B list native species present in, or utilising, the Patanui Stream estuarine system.

Table 36B. Native species present in, or utilising, the Patanui Stream estuarine system.

| GROUP | SPECIES |
|-------|-----------------------|
| Birds | Australasian shoveler |
| | Black swan |
| | Grey teal |
| | Paradise shelduck |
| | Red-billed gull+ |

| GROUP | SPECIES |
|-----------------|----------------------------|
| Birds continued | Royal spoonbill* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | White-faced heron |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

36.2.2 Recreational

Access to the stream mouth is only by boat, or across Matariki Station, and so it receives little or no recreational use except by residents of the Station. Some whitebaiting and duck shooting may occur during their respective seasons.

36.3 Catchment properties

The stream has a catchment of around 3500 ha (MacDonald & Joy 2009), consisting of coastal hills and pasture. The headwaters of the stream lie within the Ngāumu State Forest; exotic forest and scrub takes up around 40% of the catchment.

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the middle part of the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

There is no information regarding water quality, but sedimentation, nutrient enrichment, and elevated levels of algal bloom have been identified as issues in other streams along this section of coast (e.g. Robertson & Stevens 2007).

36.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Hares and rabbits may also cause significant damage to the native plants in the dunes.

The saltmarsh has been colonised by a number of pasture weeds. Of these, Mercer grass is of most concern, as this species forms floating mats that have the potential to inundate the wetland, particularly where the water is shallow. Tall fescue and yarrow are species that can infiltrate the sedgeland, clogging interstitial spaces and degrading nesting habitat for wading bird species and waterfowl.

The natural blockage of the outlet prevents regular tidal flushing and at such times the stream is prone to rapid eutrophication, algal build-up and increased turbidity (Robertson & Stevens 2007). This contributes to the development of anoxic, sulphide-rich sediments in the bed of the estuarine site.

36.5 Conservation management

36.5.1 Current

The estuarine site is entirely within Matariki Station. The site is well fenced and all stock are entirely excluded from the margins of the stream and pool.

Pests and weeds are controlled where required as part of farm management. GWRC began ecological weed control in 2014, and set up a pest animal control network the same year that is currently serviced by the landowner.

The entire site forms the southern-most part of the Urutī Point Dunes Recommended Area for Protection (No. 26) (Beadel et al. 2004). This takes in the coastal margin as far north as Riversdale, including all of Urutī Point.

GWRC has assessed risks to the Patanui estuarine ecosystem integrity (Robertson & Stevens 2007). The site is part of GWRC's long-term estuarine state of the environment monitoring programme.

This site also falls under the GWRC draft Key Native Ecosystem (KNE) Plan for the Homewood Coast that is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

36.5.2 Potential

The highest priority for this site is ecological weed control. The elimination of tall fescue, Mercer grass, gorse, and tree lupin in the saltmarsh and dunes would greatly enhance the conservation value and improve the habitat for the use of nest sites by birds. It would be desirable to plant the banks behind the saltmarsh and the lateral gullies with native shrubs, such as taupata, tarata, flax, and cabbage tree. Upon reaching maturity, these species would overshade the pasture weeds on the saltmarsh fringes and act as a buffer zone to impede reinvasion. Similarly, it would be of value to control the marram around the stream mouth, planting pīngao and kōwhangatara, both known to occur elsewhere in the dunes system, in its place.

Improvements to water quality could be achieved through fencing off and planting the riparian margins of streams throughout the catchment and by encouraging best farming practices on agricultural land. It would be useful to monitor land use in the catchment, as a sudden change could have a marked impact on the environment.

As the estuarine site is surrounded on all sides by private land, these measures can only be achieved in partnership with the landowners, although additional support could be provided by the regional and district councils in the form of advice and resources.

The combination of ecosystems at the site, in conjunction with the Waioronu Stream mouth and Urutī Point dunes, are rare on the east Wairarapa coast (Beadel et al. 2004). If there was any initiative to upgrade the conservation status of the Urutī Point dune system it would be appropriate to encompass protection of the estuarine system given its importance and rarity.

36.6 References

Beadel, S.M.; Bibby, C.J.; Perfect, A.J.; Rebergen, A.L.; Sawyer, J.W.D. 2004: Eastern Wairarapa Ecological District: survey report for the Protected Natural Areas Programme. Department of Conservation, Wellington Conservancy, Wellington.

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37. Waioronu Stream

37.1 Site description

The dominant feature of the estuarine site is the large sandbar that blocks the mouth (Table 37A; Figs 37.1, 37.2). It is likely that the tide only fully flushes the stream following a large flood. At other times, saline influence will be by seepage alone. The water of the blocked stream mouth is brackish for around 300 m upstream, and a significant area of saltmarsh has formed on both sides of the stream in this section. The stream is constricted by a culvert near the upper limit of saline influence.

37.2 Conservation values

37.2.1 Ecological

The saltmarsh in the waterway is largely composed of dense banks of pūrua grass and sea rush, along with patches of three-square, and significant areas of knobby clubrush. On the true right (southern) bank there is a band of shrubs, dominated by saltmarsh ribbonwood and small-leaved pōhuehue (Fig. 37.3). Other significant native species in the wetland include giant umbrella sedge and cutty grass. No threatened plant species are known to occur at this site. Pūrua grass is uncommon in the district (Beadel et al. 2004).

Species such as white-faced heron and paradise shelduck may visit to feed in the site. The beach, however, is well used by birds, with several species observed at the time of visiting.

There are no records for migratory native freshwater fish species available in the catchment. When the stream mouth is open, small coastal marine species are likely to enter the waterway.

| Table 37A. | Waioronu Str | eam site | information | (see also | Fig. 37.1). |
|------------|--------------|----------|-------------|-----------|-------------|
|------------|--------------|----------|-------------|-----------|-------------|

| SITE NAME | WAIORONU STREAM |
|--|--|
| Location | Urutī Point |
| NZTM (coordinates) | 1856188 5441767 |
| NZ Topo50 | BQ36 562 418 |
| Area | 2 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private |
| Existing rankings | Ecol Site 771 RAP 26 (Ecol Site 771) Key Native Ecosystem (GWRC) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category A |
| Threatened species (number) | 3 |
| At Risk species (number) | 4 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1–5) | 2 |
| Restoration potential (score 1-5) | 5 |
| Pressures (score 1–5) NB: 1 = high pressures | 4 |
| Dominant habitat | Pūrua grass reedland Saltmarsh ribbonwood shrubland Restiad rushland Tall fescue grassland Sandflats |

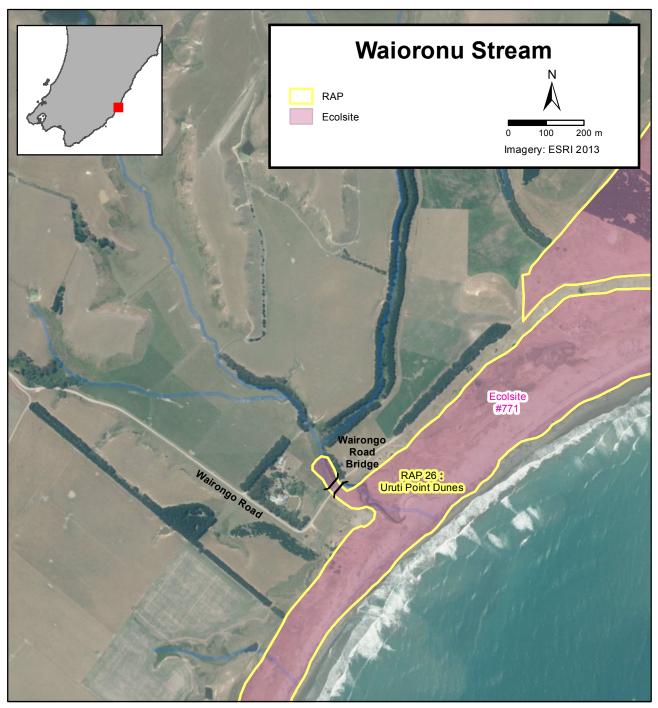


Figure 37.1. Waioronu Stream estuarine site showing areas and places mentioned in the text.

There are no records regarding reptiles or invertebrates at this site, although katipō spiders are known to occur at nearby Urutī Point (Patrick 2002) and may possibly occur throughout the dunes along this section of coast (Beadel et al. 2004).

The estuarine site lies within the Urutiī Point coastal dune ecosystem, one of the largest in the Wairarapa. The duneland is regarded as one of the best relatively intact habitats of its type in the region, in terms of natural character and species diversity (Beadel et al. 2004).

Table 37B list native species present in, or utilising, the Waioronu Stream estuarine system.

37.2.2 Recreational

The stream has little recreational use. Access is across private land from the Waiōrongo Road. Some fishing may occur on the beach.



Figure 37.2. The waterway of the Waioronu Stream is obscured (foreground) by dense pūrua reedland. Note the large sandbar blocking the outlet. *Photo: Matt Todd*.



Figure 37.3. Shrubland is present on the southern bank (centre-right) of the upper tidal reach of the Waioronu Stream. *Photo: Matt Todd.*

37.3 Catchment properties

The stream has a small catchment, no larger than 7000 ha (MacDonald & Joy 2009), consisting of the low hills that separate Homewood Station from Riversdale Station. The catchment consists almost entirely of pasture and is likely to be prone to a degree of nutrient pollution from agricultural runoff. In addition to this, algae levels are likely to be persistently high, as the stream mouth is usually blocked and seldom flushed.

Table 37B. Native species present in, or utilising, the Waioronu Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Banded dotterel+ |
| | Caspian tern+ |
| | Paradise shelduck |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |

| GROUP | SPECIES |
|--|-------------------------|
| Birds continued | Spur-winged plover |
| | Variable oystercatcher* |
| | White-faced heron |
| Threatened/At Risk terrestrial invertebrates | Katipō spider* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

37.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Stock have unrestricted access to the wetland and damage the margins through trampling, which has created opportunities for adventive pasture species to colonise the sedgeland. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

Buck's horn plantain and allseed have colonised the disturbed areas on the fringes of the wetland. These species are saline tolerant and can colonise saltmarsh habitats, forming mats and eventually displacing native species. Tall fescue also colonises saltmarsh, growing in the interstitial spaces between the sedges and rushes and compromising the habitat for use by nesting birds. Marram is the dominant grass species in the dunes. This is an aggressive competitor, which displaces native dune species such as pīngao and kōwhangatara.

37.5 Conservation management

37.5.1 Current

The site is entirely on private land, as the outlet is blocked well short of the coast. Fences provide partial protection for the ecosystem on the southern bank and also restrict access from the road, but the northern bank is unfenced.

Pest and weed control are undertaken by the landowner as part of farm management but there is no targeted conservation management, and in 2016 predator control will be set up by GWRC and serviced by the landowner.

The entire site is within the Urutī Point Dunes Recommended Area for Protection (No. 26) (Beadel et al. 2004). This takes in the coastal margin as far north as Riversdale, including all of Urutī Point and south to the Patanui estuarine system.

This site also falls under the GWRC draft Key Native Ecosystem (KNE) Plan for the Homewood Coast that is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

37.5.2 Potential

It would be essential to work with the landowners in order to preserve the values of the estuarine system. The highest priority is fencing, as there is currently only partial fencing on the southern side, and none at all on the northern side. The exclusion of stock from the wetlands would prevent direct damage by grazing and trampling and indirect damage through the facilitation of ecological weed dispersal into the estuarine margins. Fencing out stock and planting riparian areas throughout the catchment would also contribute to reducing nutrient pollution issues.

A schedule of ecological weed control would alleviate competitive pressure in the habitat and improve nesting prospects for birdlife. Planting native shrubs in the riparian strip at the rear of the wetland would provide a buffer zone to inhibit reinvasion and create additional habitat for birds. Similarly, it would be of value to control the marram around the stream mouth, planting pīngao and kōwhangatara in its place.

The combination of ecosystems at the site, in conjunction with the Waioronu Stream mouth and Urutī Point dunes, are rare on the east Wairarapa coast (Beadel et al. 2004). If there was any initiative to upgrade the conservation status of the Urutī Point dune system it would be appropriate to encompass protection of the estuarine site given its importance and rarity.

37.6 References

- Beadel, S.M.; Bibby, C.J.; Perfect, A.J.; Rebergen, A.L.; Sawyer, J.W.D. 2004: Eastern Wairarapa Ecological District: survey report for the Protected Natural Areas Programme. Department of Conservation, Wellington Conservancy, Wellington.
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38. Motuwaireka Stream

38.1 Site description

This stream at the north end of Riversdale has a small, well defined, Category B-type estuarine system (Table 38A; Figs 38.1, 38.2) which has formed behind a coastal sandspit. The outlet of the stream is often blocked, but generally shows a tendency to migrate northwards along the beach until a flood event forces the reopening of the outlet at the south end of the tidal pool (Williams 2001). The tidal influence extends only a few hundred metres upstream from the pool.

There is a coastal wetland on the inland (northeastern) bank of the pool (Fig. 38.3). The Riversdale beachfront reserve includes the southern bank adjoining the beach and dune areas.

38.2 Conservation values

38.2.1 Ecological

The relatively intact saltmarsh wetland is some 2 ha in size, and is likely to have been a historical path of the stream. Three-square lines the tidal area, along with pūrua grass, bachelor's button and small areas of remuremu. The depression area in the wetland is dominated by knobby clubrush and sea rush, with saltmarsh ribbonwood throughout. Other species here include wīwī, giant umbrella sedge, flax, toetoe and horokaka. The upper reach of the estuarine site is mainly given over to a raupō swamp, covering nearly a hectare. There is a thick bed of horse's mane in the pool itself. Matagouri is present in the contiguous dunes. This species is rare in the North Island (Te Ika-a-Māui) (Ogle 1999).

Table 38A. Motuwaireka Stream site information (see also Fig. 38.1).

| SITE NAME | MOTUWAIREKA STREAM |
|--|---|
| Location | Riversdale |
| NZTM (coordinates) | 1858690 5447368 |
| NZ Topo50 | BP36 587 474 |
| Area | 6 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Orui Station Riversdale Beachfront Esplanade Reserve (Masterton District Council) |
| Existing rankings | Ecol Site 770 Key Native Ecosystem (GWRC) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 7 |
| At Risk species (number) | 13 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 5 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Restiad rushland Raupō reedland Saltmarsh ribbonwood shrubland Tall fescue grassland Sandflats Subtidal |

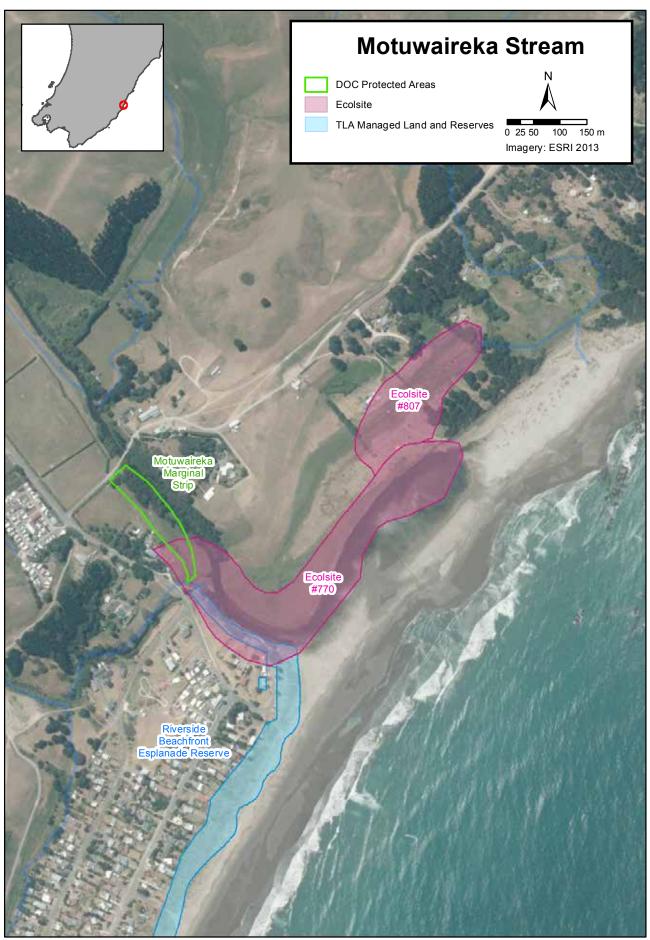


Figure 38.1. Motuwaireka Stream estuarine site showing areas and places mentioned in the text.



Figure 38.2. Sedgeland is visible along the left (inland) margin of the tidal pool at the mouth of the Motuwaireka Stream. Photo: Matt Todd.



Figure 38.3. Saltmarsh wetland adjacent to the Motuwaireka Stream. Photo: Matt Todd.

A wide range of birds frequent the pool and wetland to feed and roost, along with a number of arboreal birds. Blue penguins and banded dotterels are known to nest in the area. New Zealand dotterels nested in the vicinity of the south end of the pool for the first time in 2012 (Wairarapa Times-Age 2012). The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Eight native migratory freshwater fish have been found in the catchment, including four species that are listed as 'At Risk: Declining' (longfin eel, inanga, kōaro and redfin bully; Allibone et al. 2010). Giant kōkopu (also 'At Risk: Declining') are also reported to be present (T. Silbery, DOC 2009, pers. comm.). Taylor & Kelly (2003) stated that there was an abundance of suitable spawning habitat for inanga in the site. Small coastal fish species are likely to enter the pool frequently.

There are no significant terrestrial invertebrate records from this site, although katipō spiders are known to be found in the adjacent dunes (Patrick 2002). Raukawa gecko was recorded by Miller (1986), with no further records.

Table 38B shows native species present in, or utilising, the Motuwaireka Stream estuarine system.

Table 38B. Native species present in, or utilising, the Motuwaireka Stream estuarine system.

| GROUP | SPECIES |
|-------|-----------------------|
| Birds | Australasian shoveler |
| | Banded dotterel+ |
| | Bar-tailed godwit* |
| | Black shag* |
| | Black swan |
| | Black-billed gull+ |
| | Black-fronted tern |
| | Caspian tern+ |
| | Grey teal |
| | Kingfisher |
| | Little black shag* |
| | Little shag |
| | Little tern |
| | New Zealand dotterel+ |
| | New Zealand pipit* |
| | Pacific golden plover |
| | Paradise shelduck |
| | Pied shag+ |
| | Pied stilt* |
| | Red knot |
| | |

| GROUP | SPECIES |
|-----------------|----------------------------|
| Birds continued | Red-billed gull+ |
| | Royal spoonbill* |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Swamp harrier |
| | Turnstone |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| | Wrybill+ |
| Fish | Banded kōkopu |
| | Common bully |
| | Common smelt |
| | Giant kōkopu* |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

38.2.2 Recreational

The settlement of Riversdale Beach adjacent to the estuarine site was developed during the 1950s and is a popular summer holiday destination. Consequently, the beach and estuarine site receive heavy use, particularly during the summer months, by holiday-makers, surfers, and surfcasters. The Riversdale Surf Club facilities are adjacent immediately to the south. The stream is also a popular spot for whitebaiting. The Orui Coastal Walk, through private farmland, passes by this estuarine site.

38.3 Catchment properties

The stream drains an area covering some 3320 ha, mainly consisting of steep coastal hill country, at least 60% of which is farmed for sheep and beef cattle (MacDonald & Joy 2009). Less than 30% is in native vegetation, with the remainder in exotic forestry. Rewa Bush, a conservation area managed by DOC, and an associated Recommended Area for Protection (No. 20) are both located in the headwaters. The only settlement is that of Riversdale, adjacent to the estuarine site. The riverbanks directly to the north of the pool are managed as the Motuwaireka Marginal Strip by DOC.

The estuarine system is frequently subject to nutrient pollution, particularly when the mouth of the stream is blocked (Robertson & Stevens 2007). Recreational water quality in Riversdale Lagoon was graded 'poor' during 2014-15 (Keenan et al. 2015).

38.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Adjacent to both a holiday settlement and a rural farming community, the estuarine site is likely to be part of the territory of domestic predators. There is trampling on the northern boundary with Orui Station, suggesting that stock occasionally graze in the wetland, despite the delineating fence.

Common ecological weeds, such as gorse, lupin, and wattle, are present in low numbers. These are currently of little concern, although they will require control if they become further established in the wetland.

Water quality has deteriorated since the mid-1990s (Stansfield 2000; Williams 2001; Robertson & Stevens 2007), with a rise in bacteriological levels (E. coli is of particular concern). Stansfield (2000) suggested that this could be due to changing land use in the catchment and inefficiencies in local waste disposal combining to reach a critical point. There is no sign, however, of any of the aquatic weeds that thrive in such conditions. GWRC recorded unacceptable levels of enterococci at their nearby recreational water quality monitoring site (Riversdale Beach at lagoon mouth) during the 2009/2010 summer bathing season although this was preceded by heavy rainfall and follow-up sampling showed enterococci to be at an acceptable level (Ryan & Warr 2010). Samples during the 2010/2011 bathing season also found enterococci to be at acceptable levels (Morar & Warr 2011). In the 2014/15 summer season Keenan et al. (2015) also recorded acceptable levels of enterococci, but guidelines for *E. coli* were exceeded in January 2015. There is a permanent warning sign located on the beach culvert advising against contact recreation.

38.5 Conservation management

38.5.1 Current

The estuarine system and a large part of the associated saltmarsh are part of the Riversdale beachfront reserve, managed by Masterton District Council. Orui Station owns the land immediately behind the north side of the estuarine site, including nearly a hectare of the wetland. The Station management have fenced the rear of the area, however, and taken care that stock are generally excluded, although there is evidence that some grazing does occasionally take place.

The saltmarsh wetland area is isolated from the residential area of Riversdale by the pool and dense vegetation at the northern end. Public access to the saltmarsh vegetation is effectively cut off by private land and the pool, although the area may be viewed from a vantage point adjacent to the surf club. Predator control is undertaken by GWRC and Forest & Bird volunteers to protect rare shorebirds, and fencing has been erected to prevent access by vehicles and dogs.

A local community organisation, the Riversdale Beach Care Group, are working with GWRC on a dune restoration programme along the residential part of the beach. This is contiguous with the south bank of the estuarine system, where the Riversdale beachfront reserve is managed as a garden-like park area. Well-formed paths and signs make this a very inclusive place for the public to visit.

At the upper end of the estuarine site a marginal strip, administered by DOC, extends as far as the Ōrui Bridge.

GWRC has undertaken habitat mapping of the Motuwaireka Stream estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). GWRC also monitors microbiological water quality in the tidal pool and adjacent coastal waters.

GWRC has identified this area as a site with high biodiversity values. Under the Key Native Ecosystem (KNE) programme, GWRC staff actively manage the site to protect and restore these

values. A draft KNE Plan for the Riversdale-Orui Coast is in development (GWRC in press) and provides detailed information about the site's values, the threats to those values, and the actions that will be carried out to protect and restore the site.

38.5.2 Potential

Water quality in the pool should improve as the entire settlement is going on a reticulated sewage system. Fencing out stock and planting riparian areas throughout the catchment would also contribute to reducing nutrient pollution issues.

The wetland area has fragile habitat. To ensure its long-term integrity it would be worth exploring further fencing and legal protection options.

Locating, documenting, and restoring potential inanga spawning sites would also be valuable.

38.6 References

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39. Whareama River

39.1 Site description

The Whareama River (Table 39A; Fig. 39.1) is a large, high volume river that, unusually for this coast, has no sandbar at the mouth and is always open to the sea (Fig. 39.2). For this reason it is classed as a Category B estuarine system, and the tidal influence can be observed up to 17 km upstream at times (Robertson & Stevens 2007). Its banks are steep, and the bed is given over to soft muddy sediments of a type not seen elsewhere in the Wairarapa; saltmarsh vegetation is negligible. The hills and terraces on either side of the river have been cleared and farmed for over 100 years. There is a sizeable pine plantation on the true left, around a kilometre upstream.

39.2 Conservation values

39.2.1 Ecological

The edges of the estuarine system have been greatly modified by farming. There is very little native vegetation remaining in the intertidal zone. The only sign of saltmarsh vegetation is a narrow strip of sea rush and wīwī (Fig. 39.3), some distance upstream (Robertson & Stevens 2007). An ephemeral wetland is present adjacent to the mouth of the river. Common species here include three-square, knobby clubrush, and giant umbrella sedge. Sand coprosma is also present. There are no threatened plant species in the estuarine site. A very small amount of seagrass has been noted near the entrance to the sea (Leigh Stevens, Wriggle Coastal Management 2012, pers. comm.)

Table 39A. Whareama River site information (see also Fig. 39.1).

| SITE NAME | WHAREAMA RIVER |
|--|--|
| Location | 6 km north of Riversdale |
| NZTM (coordinates) | 1860993 5455270 |
| NZ Topo50 | BP36 610 553 |
| Area | Approx. 120 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private Whareama Marginal Strip (DOC) |
| Existing rankings | Ecol Sites 168 & 2169 RAP 21 (Ecol Site 2169) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 5 |
| At Risk species (number) | 9 |
| Ecosystem value (score 1-5) | 4 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Gorse shrubland Browntop grassland Radiata pine forest Mudflats Subtidal |

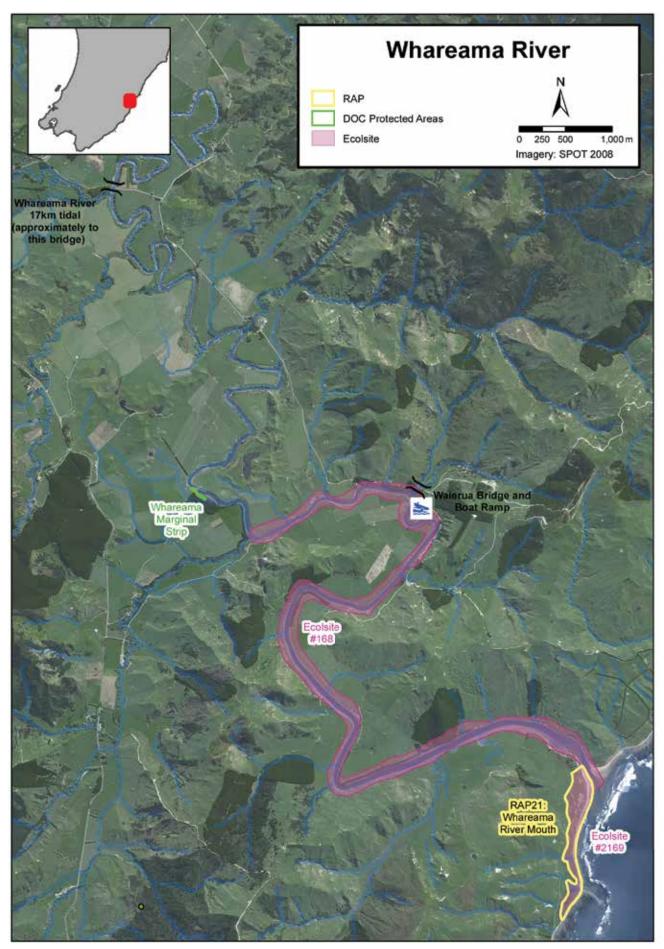


Figure 39.1. Whareama River estuarine site showing areas and places mentioned in the text.



Figure 39.2. The mouth of the Whareama River, with flanking dunes. Photo: Matt Todd.



Figure 39.3. Saltmarsh vegetation is present (left) along the bank of the upper tidal reaches of the Whareama River. *Photo: Helen Kettles*.

The mudflats of the river (Fig. 39.4) are known to attract a number of birds to feed. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Six species of migratory freshwater fish have been found in the catchment, including four species listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga and lamprey; Allibone et al. 2010). Taylor & Kelly (2003) identified suitable spawning habitat for inanga several kilometres upstream.

The soft muddy sediments are home to a range of invertebrate animals, including mud crabs, mudflat snails, cockles, and a range of polychaete species (Stevens & Robertson 2013). Compared



Figure 39.4. The soft sediment mudflats of the Whareama River are a rare ecosystem in the Wairarapa. Photo: Matt Todd.

with other New Zealand estuarine systems the community diversity is relatively impoverished and dominated by species that prefer moderate mud, less oxygenation, strong salinity fluctuations and moderate organic enrichment levels.

There are no records of lizards in the vicinity.

Table 39B lists native species present in, or utilising, the Whareama River estuarine system.

Table 39B. Native species present in, or utilising, the Whareama River estuarine system.

| GROUP | SPECIES |
|---------------------------|----------------------------|
| Threatened/At Risk plants | Seagrass* |
| Birds | Banded dotterel+ |
| | Black shag* |
| | Caspian tern+ |
| | Gannet |
| | Kingfisher |
| | Little shag |
| | New Zealand pipit* |
| | Pied stilt* |
| | Red-billed gull+ |
| | Reef heron+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| | |

| GROUP | SPECIES |
|--------------------|--------------------------|
| Fish | Common bully |
| | Giant kōkopu* |
| | Inanga* |
| | Kahawai |
| | Lamprey+ |
| | Longfin eel* |
| | Shortfin eel |
| Aquatic | Cockle |
| macroinvertebrates | Large wedge shell |
| | Mudflat snail |
| | Mudflat whelk |
| | Oval trough shell |
| | Pillbox crab (H. whitei) |
| | Pipi |
| | Stalk-eyed mud crab |
| | Tunnelling mud crab |
| | |

Note: Little detailed survey work for animals has been carried out in many esturine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

39.2.2 Recreational

The river mouth is only accessible by boat, or over several kilometres of private property. The mouth is a favoured fishing spot for recreational fishers and boat users from Riversdale, and there is a moderate amount of water traffic on the river from the boat club and ramp near Waierua, some 8 km upstream. The Whareama is one of the most popular 'whitebait rivers' in the Wairarapa. There are a few small cottages and baches on both sides of the mouth. Both the Whareama and Orui Coastal Walks, through private farmland, pass by this estuarine site.

39.3 Catchment properties

The catchment of the Whareama River comprises some 53 100 ha (MacDonald & Joy 2009) of hill country and valleys. There are four settlements adjacent to the river, the largest of which is Tinui. Other features of the catchment include a section of the Ngāumu Forest, and a number of sheep and cattle stations.

The underlying geology of the region is that of sedimentary rock, making erosion and flooding an issue (Wairarapa Engineering Lifelines Association 2004). The Whareama Catchment Scheme seeks to address this through planting of erosion-prone slopes and dredging of the river bed in places (GWRC 2007).

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the upper and middle parts of the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

GWRC monitors water quality in the river (GWRC site RS42) which is rated as 'fair' to 'good' (Perrie 2007, 2008, 2009; Perrie & Cockeram 2010, Perrie et al. 2012, Morar & Perrie 2013; Keenan & Morar 2015). There are issues with water turbidity and sewage discharge from Tinui (MacDonald & Joy 2009). Sedimentation rates have been monitored for around seven years and the annual average sedimentation rate for this estuarine site is deemed very high at 10.5 mm/yr (Stevens and Robertson 2015).

39.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. The native vegetation in the dune hollows of the coastal Recommended Area for Protection (No. 21) may sustain some damage from rabbits and hares.

Pasture weed species are abundant on both banks of the river but seldom colonise the mudflats. Scrub species such as gorse, briar, and tree lupin line the steeper faces. Crack willow is known to be present further upstream (Townsend 1996).

Stevens & Robertson (2013) warn that the mudflats are poorly oxygenated. This leaves the estuarine system exposed to the risk of nutrient enrichment and algal bloom, particularly during times of low water flow. The sedimentation rate is high resulting in elevated mud content. This has affected the benthic invertebrate communities which currently only consist of species which are tolerant of organic enrichment.

39.5 Conservation management

39.5.1 Current

The banks of the river are almost entirely privately owned and managed as farmland. There is a small marginal strip managed by DOC on the true right bank, upstream of the boat ramp, but within the tidal flush of the estuarine system.

The banks of the lower part of the estuarine site (the last 2 km) are steep, and mostly fenced for the safety of stock. Further upstream, fencing is sporadic as the banks are lower. Weed and pest control are carried out as part of farm management but there is no targeted conservation management. The planting of erosion-prone slopes in the catchment by GWRC will contribute to reducing sedimentation issues in the river and the estuarine system.

The area of duneland immediately to the south of the river mouth is included in the Whareama River Mouth Recommended Area for Protection, although this area is only partially fenced, and stock (mainly sheep) have full access (Beadel et al. 2004).

GWRC has undertaken habitat mapping of the Whareama River estuarine site and margins, fine-scale intertidal sediment and sediment biota monitoring (Robertson & Stevens 2008, 2009, 2010, Stevens & Robertson 2012, 2013, 2014), and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007). Sediment plates have been installed to monitor rates of sedimentation (Stevens & Robertson 2015).

The site is part of GWRC's long-term estuarine state of the environment monitoring programme. Annual ecological surveys of the intertidal flats (sediment quality and benthic plants and animals) have been undertaken since 2007/08. Sedimentation plates have also been deployed in the site.

39.5.2 Potential

The mudflats of the site (Fig. 39.4) are an ecosystem unique in the ecological district; no other river on the Wairarapa coast has such an expanse, and the only other similar area in the Wellington region is Te Awa Kairangi/Hutt River estuarine system. Given its value as an uncommon environment and as a feeding site for birdlife, this part of the river requires at least reassessment of its legal status and could warrant protection as a Wildlife or Scenic Reserve.

GWRC has identified the estuarine system as a priority site for sediment monitoring, and management of nutrient and fine sediment sources entering the ecosystem has been recommended (Stevens & Robertson 2009).

The site would benefit from replanting of native shrubs and trees on the riparian margins. As well as generating habitat, erosion would be kept in check, ecological weeds such as gorse would eventually be overtopped, and a buffer zone would form between the pasture and the riverbank. Given the physical geology and hydrology of the river mouth, it is unlikely that significant areas of mature saltmarsh have ever occurred here.

Further work to locate, document, and restore potential inanga spawning sites would be valuable.

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40. Otahome Stream

40.1 Site description

Much of the wetland at the rear of this small stream mouth has been drained and converted to pasture. The main stream and a smaller tributary have been straightened and constrained by steep banks. However, an area of relatively intact saltmarsh with medium-high biodiversity value still surrounds the small tidal pool (Table 40A; Figs 40.1, 40.2) at the rear of the beach. The outlet is frequently blocked, and at such times the tide enters the pool only occasionally.

40.2 Conservation values

40.2.1 Ecological

The wetland is dominated by banks of sea rush and knobby clubrush, with a broad band of saltmarsh ribbonwood at the upper tidal limit. Along the margins of the pool there are herbfields of shore primrose and halfstar, fringed with three-square and slender clubrush. Other significant species in the saltmarsh include giant umbrella sedge, toetoe, small-leaved pōhuehue, flax, and wīwī. Horse's mane grows in thick clumps in the pool.

Kōwhangatara and knobby clubrush are also well represented in the dunes on either side of the pool. In the upper reaches of the estuarine system, the stream has been channelised and the wetlands drained, but saltmarsh ribbonwood and sea rush are thick along the banks for around 100 m. There are no threatened plant species known at the site.

The pool is a popular feeding site for a range of birds. Variable oystercatchers, spur-winged plovers, New Zealand pipits, pied stilts, southern black-backed gulls and red-billed gulls were all observed at the time of visiting.

| Table 40A. | Otahome | Stream si | te information | (see | also | Fig. | 40.1). |
|------------|---------|-----------|----------------|------|------|------|--------|
|------------|---------|-----------|----------------|------|------|------|--------|

| SITE NAME | OTAHOME STREAM |
|--|---|
| Location | Otahome |
| NZTM (coordinates) | 1865696 5462271 |
| NZ Topo50 | BP36 657 623 |
| Area | 2 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Castlepoint Station |
| Existing rankings | Ecol Site 814 |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 3 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1–5) | 2 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 2 |
| Dominant habitat | Saltmarsh ribbonwood shrubland Restiad rushland Marram grassland Tall fescue grassland Sandflats Subtidal |

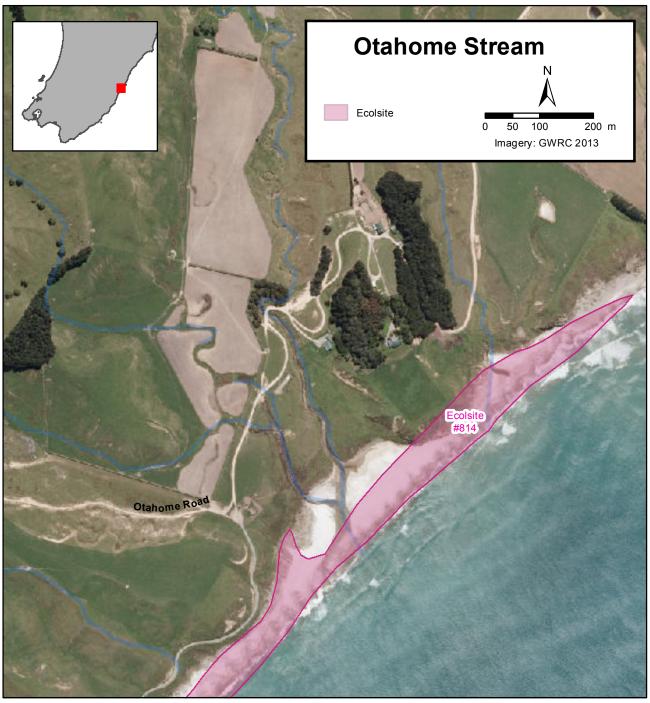


Figure 40.1. Otahome Stream estuarine site showing areas and places mentioned in the text.

There are no formal records available for migratory native freshwater fish species in the catchment. Small coastal marine species are likely to enter the pool only when the mouth is open.

The dunes have a population of northern grass skink and spotted skinks have been recorded in the area (T. Silbery, DOC 2015, pers. comm.).

Table 40B lists native species present in, or utilising, the Otahome Stream estuarine system.

40.2.2 Recreational

The beach and pool receive only low levels of recreational use, with access only over private land (Castlepoint Station from the Otahome Road end). Duck shooting and whitebaiting may both occur. The Whareama Coastal Walk, through private farmland, passes by this estuarine site.



Figure 40.2. A tidal pool has formed at the mouth of the Otahome Stream. Saltmarsh ribbonwood shrubland can be seen at upper right. *Photo: Wriggle Coastal Management*, © *Greater Wellington Regional Council*.



Figure 40.3. Saltmarsh ribbonwood shrubland lines the banks of Otahome Stream. Photo: Matt Todd.

40.3 Catchment properties

The stream drains a modest catchment of 5680 ha in the coastal hills (MacDonald & Joy 2009). Much of this is grazed (61%), and the headwaters lie in the Ngāumu Forest.

Table 40B. Native species present in, or utilising, the Otahome Stream estuarine system

| GROUP | SPECIES |
|--------------|----------------------------|
| Birds | New Zealand pipit* |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Spur-winged plover |
| | Variable oystercatcher* |
| | White-faced heron |
| Herpetofauna | Northern grass skink |
| | Spotted skink |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

40.4 Threats

There is no regular monitoring of water quality, but Robertson & Stevens (2007) identify sedimentation and nutrient pollution as potential issues in the stream. Water quality can deteriorate due to algal build-up, particularly when the pool outlet is blocked. This is exacerbated by the presence of deposits of anoxic, sulphide-rich sediments (Robertson & Stevens 2007). The stream is therefore rated as being in a eutrophication balance and is susceptible to land use changes.

A range of mammalian predators and browsers will be present but mostly their impacts have not been assessed at this site. Rooks nest in adjacent trees, causing a disturbance amongst populations of shore-birds. Cattle have access to the stream margins in the pasture areas and can cause damage by trampling seedlings and disturbing the soil, allowing ecological weeds to colonise. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

Tall fescue is present throughout the wetland, along with other pasture weeds such as dock, allseed, and hare's foot trefoil. Pampas grass grows adjacent to the stream near the upper limits of the tidal zone.

40.5 Conservation management

40.5.1 Current

The wetland and pool is entirely on Castlepoint Station. The landowner has fenced the wetland, largely excluding stock from the margins of the pool, although the stream itself is still accessible.

Rooks in a tree adjacent to the old Otahome homestead are being eradicated by GWRC contractors. Possum control is carried out by the landowner and would have some conservation benefits in the long-term.

GWRC has undertaken habitat mapping of the Otahome Stream estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

40.5.2 Potential

Although greatly modified and reduced in size, the wetlands associated with the pool still contain medium-high biodiversity value in the association of saltmarsh ribbonwood, sea rush, and herbfields (Figure 162). However, restoration of the wetland to its former extent would require

significant effort. The area would benefit most by the continued exclusion of stock from the wetland and fencing of the tidal area of the stream to physically protect the riparian vegetation. Fencing out stock and planting riparian areas throughout the catchment would also contribute to reducing any nutrient pollution and sedimentation issues.

An ecological weed control programme in the wetland is not currently necessary, although this situation may change. While pasture species are present, they are controlled through overtopping in time in the absence of disturbance. Tall fescue, however, generally persists and has the capacity to clog the spaces within the native vegetation, preventing new growth of native species. If this stage is reached, initiation of an ecological weed control programme may be required.

There are currently no formal records of fish species in the catchment. There is potential for a methodical fish survey to establish baseline knowledge of marine and migratory freshwater fish species that are utilising the habitat for feeding, spawning, or simply passing through.

If there are significant changes in land use in the catchment, which could result in elevated nutrient levels, it would be prudent to initiate water quality monitoring. Should the water quality fall, it may be necessary to investigate catchment mitigation measures (e.g. identifying potential point sources of effluent contamination) or managing the outlet artificially.

Because the estuarine system is surrounded on all sides by private land, these measures can only be achieved with the cooperation of the landowners; however, additional support could be provided by the regional and district councils in the form of advice and resources.

40.5 References

MacDonald, A.; Joy, M. 2009: Freshwater biodiversity in the Wellington region. Department of Conservation, Wellington Conservancy, Wellington (unpublished).

Robertson, B.; Stevens, L. 2007: Wairarapa coastal habitats: mapping, risk assessment, and monitoring. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.

41. 'Humpy' Stream

41.1 Site description

This stream has a small Category B estuarine system; a rudimentary tidal pool constrained behind a sandbar (Table 41A; Fig. 41.1). The outlet is often blocked, and at such times saline influence is by seepage or wave splash. The banks of the tidal area of the stream cut through the coastal terrace, and there are narrow strips of saltmarsh vegetation on either side. The banks have been the subject of riparian planting since the 1990s (A. Crofoot, Castlepoint Station 2009, pers. comm.), and shrubs are beginning to dominate (Fig. 41.2).

41.2 Conservation values

41.2.1 Ecological

The stream margins are lined with narrow strips of saltmarsh, consisting of three-square in front of a dense bank of sea rush and wīwī. Knobby clubrush and slender clubrush also have significant presences. The saltmarsh is backed with riparian shrubland. An assortment of native species, including taupata, tarata, flax, and cabbage tree, have been planted on the banks by the landowner. These plants are now maturing and will soon shade the water. Other native species present in the ecosystem include giant umbrella sedge and toetoe on the banks, kōwhangatara on the sandflats, and horse's mane in the pool. There are no threatened plant species present.

Only one pair of pied stilts was observed when field surveys were conducted. Red-billed gulls, southern black-backed gulls and variable oystercatchers are known to be resident in the vicinity.

| Table 41A. | 'Humpy' | Stream | site | information | (see | also | Fig | . 41.1 | 1). |
|-------------|---------|---------|------|-------------|------|------|------|--------|-----|
| Table + IA. | riumpy | Oticani | 3110 | minormation | (300 | aiso | 1 19 | | ٠, |

| SITE NAME | 'HUMPY' STREAM |
|--|--|
| Location | 4 km south of Castlepoint |
| NZTM (coordinates) | 1867497 5463771 |
| NZ Topo50 | BP36 675 638 |
| Area | Approx. 1 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private—Castlepoint Station Castlepoint Coastline Esplanade Reserve (Masterton District Council) |
| Existing rankings | None |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 2 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Three-square sedgeland Restiad rushland Tall fescue grassland Riparian shrubland Sandflats |

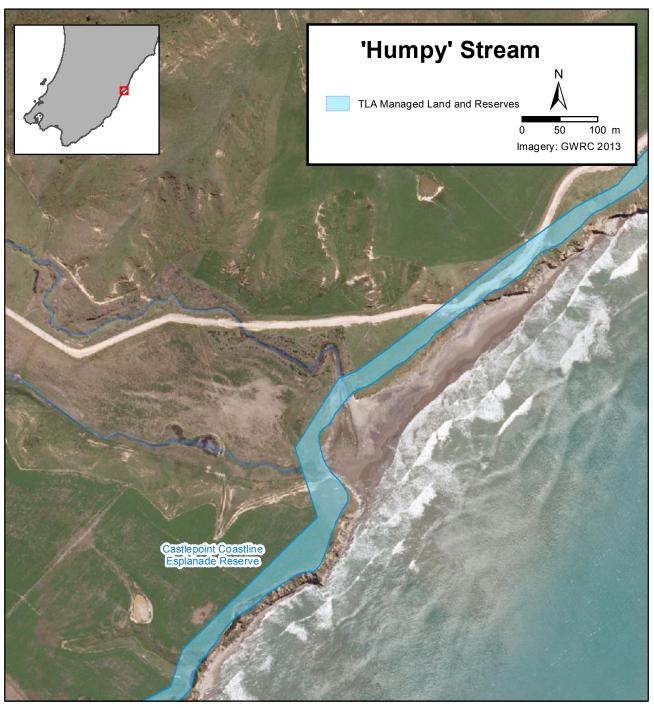


Figure 41.1. 'Humpy' Stream estuarine site showing areas and places mentioned in the text.

There are no formal records for migratory native freshwater fish species available in the catchment nor invertebrates or lizards in the area. Smaller marine species may enter the pool occasionally.

Table 41B lists native species present in, or utilising, the 'Humpy' Stream estuarine system.

41.2.2 Recreational

Access to the stream mouth is only by boat, or across Castlepoint Station, and so the estuarine site receives little or no recreational use except by residents of the Station.



Figure 41.2. The mouth of the 'Humpy' Stream forms a tidal pool, with rushland and riparian shrubs visible on the banks of the waterway. *Photo: Matt Todd.*

Table 41B. Native species present in, or utilising, the 'Humpy' Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Variable oystercatcher* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

41.3 Catchment properties

The catchment is a small area of the coastal hills, no more than 4000 ha (Robertson & Stevens 2007) and consists of grazed pasture within the boundaries of Castlepoint Station. The stream is subject to a degree of sedimentation as a result of soil erosion. There is no regular monitoring of water quality, but Robertson & Stevens (2007) identify nutrient enrichment and algal bloom as potential issues in the stream, particularly when the mouth is blocked for extended periods.

41.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site.

Pasture weeds, particularly tall fescue, are prevalent along the margins of the stream, while marram dominates in the adjacent dunes.

Natural blockage of the outlet prevents regular tidal flushing, and at such times, the stream is prone to algal build-up and increased turbidity. This contributes to the development of anoxic, sulphide-rich sediments in the bed of the estuarine system.

41.5 Conservation management

41.5.1 Current

The stream mouth and pool are almost entirely within the boundaries of Castlepoint Station, with only the narrow outlet crossing the Castlepoint coastline reserve, managed by Masterton District Council. The stream is managed by the landowner as a native ecosystem in the process of restoration; the riparian area has been fenced to exclude stock and exotic trees have been felled and replaced by a selection of native shrubs and grasses (Fig. 41.2).

The exclusion of stock has resulted in a substantial increase in the growth of pasture grasses and ecological weeds in the riparian area. These are not actively controlled, as shading by overgrowing shrubs will eventually cause dieback.

Control of feral pests is carried out by the landowner.

GWRC has undertaken habitat mapping of the 'Humpy' Stream estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

41.5.2 Potential

The continued exclusion of stock, combined with ongoing control of pests, will allow this habitat to continue to regenerate and assist with the reduction of nutrient pollution and sedimentation issues. The shrubs in the riparian area are flourishing and will eventually form a dense band of vegetation on either bank, providing shade for the stream. Saltmarsh species will provide a fringe to the pool and lower part of the stream; this could possibly be augmented by the planting of saltmarsh ribbonwood amongst the rushes. This is a good example of private conservation.

There are currently no formal records of fish species in the catchment. There is potential for a methodical fish survey to establish baseline knowledge of marine and migratory freshwater fish species that are utilising the habitat for feeding, spawning, or simply passing through.

41.6 References

Robertson, B.; Stevens, L. 2007: Wairarapa coastal habitats: mapping, risk assessment, and monitoring. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.

42. Ngākauau Stream

42.1 Site description

This estuarine site is actually the mouth of two streams: the Ngākauau and a smaller un-named stream, both flowing into the same tidal pool (Table 42Å; Figs 42.1, 42.2), constrained by a dynamic sandbar. These features are characteristic of a Category B estuarine system. The upper part of the estuarine system has been historically drained, and the associated wetland converted to pasture. Despite this, there is still a narrow fringe of saltmarsh at the rear of the pool and up both banks of the main Ngākauau Stream (Fig. 42.3). The outlet of the stream is frequently blocked, although it is likely that saline influence is maintained by seepage at such times.

42.2 Conservation values

42.2.1 Ecological

Sea rush and three-square are the dominant species in the wetland; three-square fringes the entire rear of the pool, while sea rush lines the banks of Ngākauau Stream. Wīwī, knobby clubrush, pūrua grass, and giant umbrella sedge may also be found along the stream margins. Horse's mane grows throughout the pool. There are no threatened plant species in this estuarine ecosystem.

The extensive sandflats associated with the pool are visited by a range of birds. A small flock of variable oystercatchers and pied stilts were noted feeding in the pool margin, while southern black-backed and red-billed gulls gathered on the beach. Black swans were on the water, and one pair of black shags was spotted roosting in the macrocarpas.

Table 42A. Ngākauau Stream site information (see also Fig. 42.1).

| SITE NAME | NGĀKAUAU STREAM |
|--|--|
| Location | 3 km south-east of Castlepoint |
| NZTM (coordinates) | 1868397 5464471 |
| NZ Topo50 | BP36 684 645 |
| Area | 5 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private — Castlepoint Station Castlepoint Coastline Esplanade Reserve (Masterton District Council) |
| Existing rankings | None |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 1 |
| At Risk species (number) | 5 |
| Ecosystem value (score 1–5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1–5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Tall fescue grassland Restiad rushland Three-square sedgeland Pampas grassland Macrocarpa tree land Sandflats Subtidal |

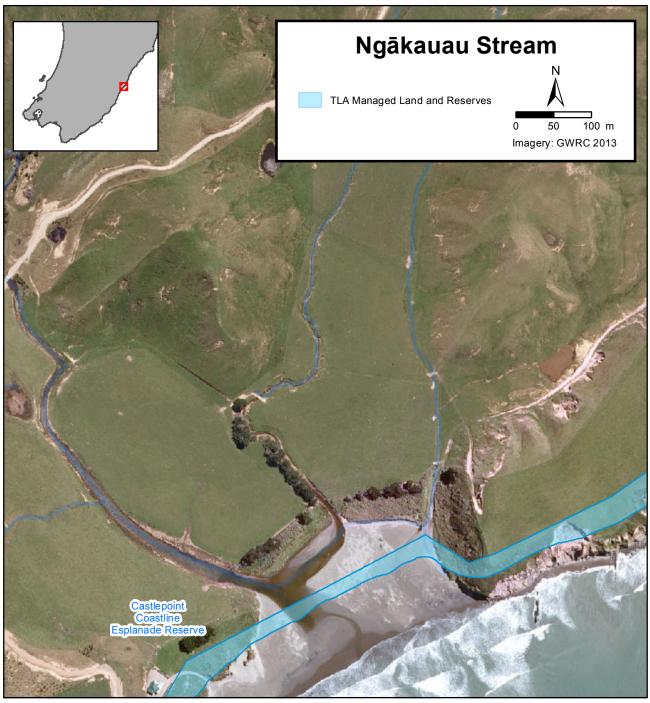


Figure 42.1. Ngākauau Stream estuarine site showing areas and places mentioned in the text.

MacDonald & Joy (2009) list four migratory freshwater fish species as present in the catchment, two of which are listed as 'At Risk: Declining' (longfin eels and inanga; Allibone et al. 2010). Small coastal fish species, such as common smelt, may enter the pool occasionally. There are no records of lizards in the estuarine site.

Table 42B lists native species present in, or utilising, the Ngākauau Stream estuarine system.

42.2.2 Recreational

Access to the stream mouth is only by boat or across Castlepoint Station. A cottage adjacent to the dunes has been converted into a guest-house by the landowner, with virtually exclusive use of the beach and pool for the guests as part of the accommodation. Some private whitebaiting and duck shooting may take place.



Figure 42.2. The tidal pool at the mouth of Ngākauau Stream. The main stream mouth is at the far left (obscured) while the smaller stream is visible at centre. *Photo: Matt Todd*.



Figure 42.3. The tidal waterway of Ngākauau Stream is lined with narrow strips of searush rushland on both banks. The stream is utilised by waterfowl. *Photo: Matt Todd*.

42.3 Catchment properties

The stream drains a catchment of 15 760 ha in the coastal hills (MacDonald & Joy 2009). Nearly half of this area (45%) is in the Ngaumu Forest under exotic pine plantations, while most of the remainder is pasture. There is no regular monitoring of water quality, but Robertson & Stevens (2007) identify sedimentation and algal bloom as potential issues in the stream.

Table 42B. Native species present in, or utilising, the Ngākauau Stream estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Black shag* |
| | Black swan |
| | Pied stilt* |
| | Red-billed gull+ |
| | Southern black-backed gull |
| | Variable oystercatcher* |
| Fish | Common bully |
| | Inanga* |
| | Longfin eel* |
| | Shortfin eel |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

42.4 Threats

A range of mammalian predators and browsers will be present but mostly their impacts have not been assessed at this site. There is evidence of rabbits and hares around the pool that could do significant damage to regenerating native seedlings. Stock are able to access the stream margins, and cattle and horses have done particular damage to the margins by trampling native vegetation and trampling the soil. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

Pasture grasses, particularly tall fescue, are invading the wetland margins throughout the area, while marram is prevalent in the dunes. There is an established hedge of pampas grass around the north-west shore of the pool. The original structure of the planting has long since broken down, and the whole area (around half a hectare) is a dense mass of pampas. As mentioned above, this is possibly acting as a seed source for solitary plants elsewhere around the pool. On the sandflats, allseed is invading the rushland. This species form mats that clog the spaces between taller plants, eventually displacing them.

The stream has a history of chemical contamination; the waste from sheep drenching was directly discharged into the waterway for many years (A. Crofoot, Castlepoint Station 2009, pers. comm.). The practice was discontinued at some time during the 1980s, but the contamination persists in the sediments of the stream and pool. Persistent blockage of the outlet prevents regular tidal flushing, and at such times the stream is prone to algal build-up and turbidity (Robertson & Stevens 2007). This contributes to the development of anoxic, sulphide-rich sediments in the bed of the estuarine system.

42.5 Conservation management

42.5.1 Current

The mouths of the streams and the pool fall almost entirely within the boundaries of Castlepoint Station, with only the narrow outlet crossing the coastline reserve, managed by Masterton District Council. The pool has been fenced to exclude stock from the margins of the beach, although there is a gate adjacent to the northern stream. Further upstream, near the tidal limit, the stream banks are fenced and riparian vegetation strips planted with a range of native shrubs and grasses. The remainder of the estuarine wetland is unfenced.

Weed and pest control takes place as required by the landowner and this would help to reduce seed production. The pampas infestation is regularly sprayed (A. Crofoot, Castlepoint Station 2009, pers. comm.), but this appears to be having little effect on the population as a whole.

GWRC has undertaken habitat mapping of the Ngākauau Stream estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

42.5.2 Potential

Although there is a significant association of saltmarsh ribbonwood and rushland in the wetland margins of the pool and streams, the wetlands as a whole are too greatly modified to easily restore. The area would benefit most by the continued exclusion of stock from the wetland, and fencing of the tidal area of the stream to physically protect the riparian vegetation. Fencing out stock and planting riparian areas throughout the catchment would also contribute to reducing any nutrient pollution and sedimentation issues.

Locating, documenting, and restoring potential inanga spawning sites would be valuable.

To remove the pampas infestation would require a rigorous control programme but would enable the surrounding vegetation to be replaced with shady native shrubs. The tall fescue along the steep banks of the pool could also probably be best controlled by the planting of shrubs.

It could be of benefit to conduct an analysis of the sediments in the pool in order to accurately assess the residual chemical contamination and the risk to the environment that this poses. Regular monitoring of water quality may be useful considering there are significant land use changes in the catchment.

42.6 References

Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.

MacDonald, A.; Joy, M. 2009: Freshwater biodiversity in the Wellington region. Department of Conservation, Wellington Conservancy, Wellington (unpublished).

Robertson, B.; Stevens, L. 2007: Wairarapa coastal habitats: mapping, risk assessment, and monitoring. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.

43. Whakataki River

43.1 Site description

The mouth of the Whakataki River is characterised by a large sandspit and when it is occasionally blocked it is backed by a tidal pool which is only flushed intermittently (Fig 43.1, 43.2). This is typical of a Category B estuarine system. At the rear of the pool is a low dune and terrace, incised with an oxbow wetland, where there is a high level of plant biodiversity. The river is tidal for 600 m upstream. Mechnical opening of the river mouth last occurred in 2015 (Fig. 43.3) altering the position of the river mouth and side of the tidal pool (Fig 43.4). A small creek, entering the southern end of the beach, ensures some water still flows through the wetland.

The northern bank of the tidal area is constrained by the access road to the small coastal settlement of Whakataki. The main road to Castlepoint crosses the river in the upper reach of the estuarine site and skirts the western part of the oxbow.

43.2 Conservation values

43.2.1 Ecological

While the sandspit on the coastal side of the old tidal pool has little vegetation, the oxbow terrace on the inland side has an intact saltmarsh vegetation sequence from margin through to terrestrial tussockland. Near the top of the old tidal pool, the margin is dominated by a band of pūrua grass and sea rush, growing over a herbfield of halfstar and three-square. This gives way to a bank of dune vegetation, where knobby clubrush is present, before the saltmarsh vegetation

Table 43A. Whakataki River site information (see also Fig. 43.1).

| SITE NAME | NGĀKAUAU STREAM |
|--|---|
| Location | Whakataki |
| NZTM (coordinates) | 1871900 5470572 |
| NZ Topo50 | BP36 719 706 |
| Area | 9 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private Mātaikona Road Esplanade Reserve (Masterton District Council) |
| Existing rankings | Ecol Site 805 RAP 15 (Ecol Site 805) |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 3 |
| At Risk species (number) | 11 |
| Ecosystem value (score 1–5) | 3 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 4 |
| Pressures (score 1–5) NB: 1 = high pressures | 4 |
| Dominant habitat | Gorse shrubland Saltmarsh ribbonwood shrubland Tall fescue grassland Restiad rushland Raupō reedland Sandflats Subtidal |

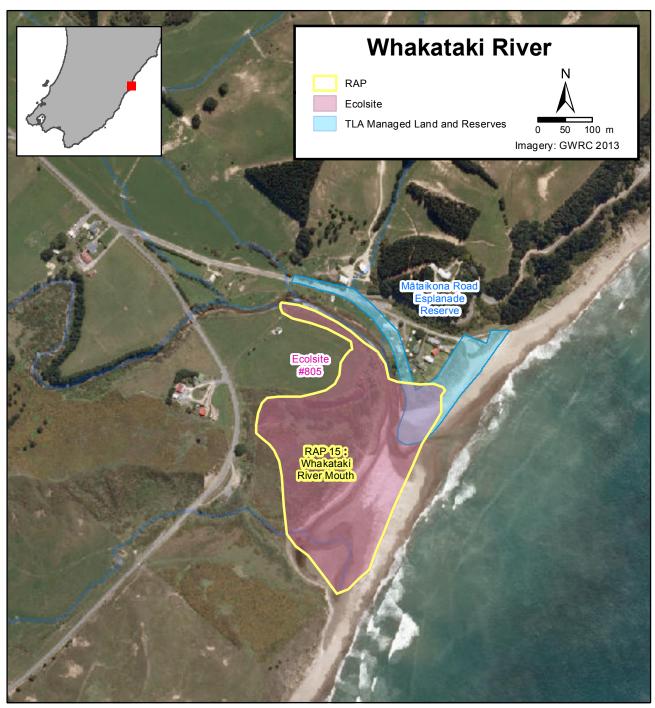


Figure 43.1. Whakataki River estuarine site showing areas and places mentioned in the text.

re-establishes in the oxbow wetland. This largely consists of pūrua grass, sea rush, saltmarsh ribbonwood, giant umbrella sedge, toetoe, and cutty grass. Patches of raupō occur at the rear of the site. Horse's mane grows in thick clumps in the pool. The north bank of the pool, adjacent to the settlement, is steep and lined with patches of cutty grass. There are no threatened estuarine plant species present. Sand pimelea was recorded in the area by Mercer (1995). Slender clubrush and New Zealand celery are also both present here; these species are of limited distribution in the region (Beadel et al. 2004)

The pool and wetland areas are well used by birds as roosting and feeding grounds. Banded dotterels and variable oystercatchers are known to breed on the spit, and a range of other birds visit to feed and roost, including gannets, white-fronted terns and Caspian terns. Royal spoonbills occasionally visit the site. The estuarine site was included in the OSNZ (2007) river mouth bird survey.



Figure 43.2. An overview of the mouth of the Whakataki River taken in 2009 when the outlet was blocked. The oxbow wetland can be seen occupying the terrace to the right of the large tidal pool. *Photo: Wriggle Coastal Management,* © *Greater Wellington Regional Council.*



Figure 43.3. Mechnical opening of the river mouth was undertaken in 2015 to prevent flooding to neighbouring houses. Photo: Helen Kettles.

Eight migratory native freshwater fish species have been found in the catchment, including five that are listed as 'At Risk: Declining' (longfin eel, inanga, kōaro, redfin bully and torrentfish; Allibone et al. 2010). Taylor & Kelly (2003) rated the riparian vegetation just below the Castlepoint Bridge as good spawning habitat for inanga.

Invertebrate and herpetological records are limited, but katipō spiders have been found nearby at Castlepoint (Patrick 2002), so it is possible that they may also be present here.

Table 43B lists native species present in, or utilising, the Whakataki River estuarine system.



Figure 43.4 The new opening to the sea created in 2015 has diverted water flow from the owbow and tidal pool areas of the estuarine site. *Photo: Helen Kettles*.

Table 43B. Native species present in, or utilising, the Whakataki River estuarine system.

| GROUP | SPECIES |
|-------|----------------------------|
| Birds | Banded dotterel+ |
| | Black shag* |
| | Black swan |
| | Caspian tern+ |
| | Gannet |
| | Paradise shelduck |
| | Pied stilt* |
| | New Zealand pipit* |
| | Red-billed gull+ |
| | Royal spoonbill* |
| | Southern black-backed gull |
| | Swamp harrier |
| | |

| SPECIES |
|-------------------------|
| Variable oystercatcher* |
| White-faced heron |
| White-fronted tern* |
| Black flounder |
| Common bully |
| Inanga* |
| Kōaro* |
| Longfin eel* |
| Redfin bully* |
| Shortfin eel |
| Torrentfish* |
| |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

43.2.2 Recreational

While not as popular as nearby Castlepoint, Whakataki is a small holiday location. The beach receives moderate numbers of recreational users, and fishing and swimming are frequent activities during the summer. The upper estuarine area is easily accessible and popular with whitebaiters.

43.3 Catchment properties

The river catchment is 2330 ha of farmed hill country with a lot of forest cover both pines and native. The river comes under the Mātaikona-Whakataki Catchment Scheme, which focuses on alleviation of flood risk through the planting of erosion-prone slopes (GWRC 2007).

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present throughout the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

43.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Rabbits and hares in the dunes and wetland will impair the regrowth of native vegetation, allowing competing ecological weeds to flourish. Sheep and cattle are occasionally allowed to graze in the oxbow, trampling the native species and disturbing the soil—

conditions that facilitate further invasion and establishment by pasture weed species. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

In the oxbow wetland, gorse and tall fescue are the major ecological weed species (Fig. 43.5). In places, the gorse is so dense that all other plants are excluded. Tall fescue is abundant throughout the wetland. White clover is forming mats on the wetland flats of the oxbow, excluding native herbs.

A track, likely used as access to maintain the power pylons, dissects the oxbow wetland (Fig 43.6). Vehicles using this could also introduce ecological weed species to the area.

43.5 Conservation management

43.5.1 Current

The beach, dunes and pool fall within the Whakataki River Mouth Recommended Area for Protection (No. 15), which is contiguous with the Mātaikona Road Esplanade Reserve on the western side of the pool. The oxbow wetland, which takes up the bulk of the Recommended



Figure 43.5. Gorse is very thick on the river banks and in the oxbow area of the site. Photo: Helen Kettles.



Figure 43.6. A track used to service powerlines dissects the oxbow wetland area. Photo: Helen Kettles.

Area for Protection, is privately owned, and managed as occasional grazing land. The area is not fenced, although it is bound by roads on the inland side.

Ngāti Papauma and Ngāti Hāmua retain a strong interest in the management of the site.

GWRC has undertaken habitat mapping of the Whakataki River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

43.5.2 Potential

Given the conservation value of the intact saltmarsh vegetation sequence in the oxbow, physical protection and ecological weed control are priorities. It is recommended to work with the landowner to retire the site from grazing, and fence the boundaries to exclude stock. An ecological weed control programme, aimed particularly at the removal and continued control of gorse and tall fescue, could be initiated in order to allow the re-establishment of native wetland species. Where gorse has formed a monoculture, some restoration planting of larger species such as saltmarsh ribbonwood, toetoe, and flax would be appropriate. Once removed, continued vigilance against gorse will be necessary as there will be a substantial seed bank in the soil, as well as extensive populations in the adjacent hills.

Further work to locate, document, and restore potential inanga spawning sites would be valuable.

The population of banded dotterel and variable oystercatcher nesting in the area would benefit from increased awareness of human disturbance (including vehicles), as well as the need for controlling dogs. This could be done through information panels in strategic sites, environmental education, and community projects.

Legal protection, e.g. using a QEII or DOC covenant, of the oxbow may be a prudent long-term option. This would need to be in discussion with the landowner. A conversation with the people responsible for the power poles could explore the potential for rerouting these around the wetland when they are scheduled for replacement.

It would be good to review monitoring water quality in the river, as GWRC has no monitoring sites in the catchment. It would be desirable to establish at least one monitoring point in order to gather data on nutrient levels and turbidity in the water.

Climate change-induced sealevel rise will also affect the dynamics of this river mouth. Future options for the natural meandering of the river mouth and management through mechnical opening warrants exploring.

43.6 References

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44. Ōkau Stream

44.1 Site description

When the outlet is blocked (which occurs frequently), the narrow estuarine system of the Ōkau Stream sweeps across the shrubby coastal flat before forming a small tidal pool at the rear of the beach (Figs 44.1, 44.2). At times, the tide flushes over the bar and upstream. It is therefore a dynamic system. The coastal road skirts the estuarine site, constraining its southern end (Fig. 44.3). There are areas of saltmarsh vegetation along the fringes of the site, and an area of associated coastal wetland on the flat, marking a historical oxbow.

44.1 Conservation values

44.1.1 Ecological

Three-square was the dominant species along the margin of the tidal area in 2009 (Figs 44.2 & 44.4), although tall fescue grew thickly along the bank further upstream. The tidal flats were converted into pasture and are now dominated by shrubland. Toetoe, giant umbrella sedge, tauhinu, and tarata were all present in 2009. Horse's mane grows in patches in the stream while knobby clubrush forms thick patches in the open pasture. There are no threatened plant species currently known to be present in the estuarine system, although sand pimelea was recorded in the adjacent dunes by Zotov (1945).

White-faced herons and paradise shelducks may visit to feed in the narrow tidal area. The beach is well used by birds, with several species observed at the time of visiting.

Five species of migratory native freshwater fish have been recorded in the catchment, including three species that are listed as 'At Risk: Declining' (longfin eel, inanga and redfin bully; Allibone et al. 2010). Smaller marine species may enter the pool occasionally.

Table 44A. Ōkau Stream site information (see also Fig. 44.1).

| | , |
|--|---|
| SITE NAME | ŌKAU STREAM |
| Location | 2 km north of Whakataki |
| NZTM (coordinates) | 1873501 5473273 |
| NZ Topo50 | BP36 735 733 |
| Area | Approx. 1 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Masterton District Council, GWRC |
| Land status (tenure) | Private-Ōkau Station |
| Existing rankings | Ecol Site 803 |
| Ecological district | Eastern Wairarapa |
| Estuarine classification | Category B |
| Threatened species (number) | 3 |
| At Risk species (number) | 5 |
| Ecosystem value (score 1-5) | 3 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Gorse shrubland Tall fescue grassland Three-square sedgeland Knobby clubrush rushland Sandflats |

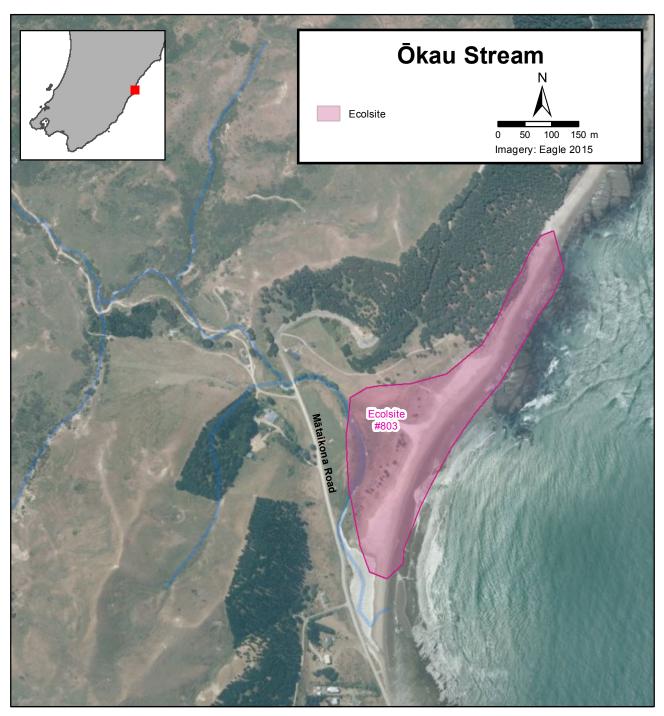


Figure 44.1. $\bar{\text{O}}$ kau Stream estuarine site showing areas and places mentioned in the text.

Table 44B lists native species present in, or utilising, the Ōkau Stream estuarine system.

44.1.2 Recreational

There is a small holiday settlement on the point adjacent to the stream mouth, there is occasional whitebaiting activity, and the beach receives a moderate amount of use by recreational fishers and holiday-makers.

44.2 Catchment properties

The stream drains a narrow valley of approximately 1200 ha (MacDonald & Joy 2009), consisting mainly of indigenous forest and scrub. Although the catchment is almost entirely within Ōkau Station, only 20% of the area is in pasture. Water quality is generally 'good', and Robertson &



Figure 44.2. An overview of the tidal pool and associated wetland at the mouth of the Ōkau Stream, 2009. Photo: Matt Todd.



Figure 44.3. The stream mouth is at the southern end of the of the estuarine site and is constrained by the road and rock armouring. *Photo: Helen Kettles.*

Stevens (2007) list algal bloom as an issue only when the mouth is closed for prolonged periods. They also suggest that nutrient enrichment is likely to be negligible.

The Mt Percy Recommended Area for Protection covers more than 50% of the upper catchment.



Figure 44.4. Three-square sedgeland lined the margins of the waterway in 2009. Gorse and other ecological weed species can be seen in the wetland further upstream. *Photo: Matt Todd.*

Table 44B. Native species present in, or utilising, the Ōkau Stream estuarine system.

| GROUP | SPECIES | | GROUP | SPECIES |
|-------|----------------------------|--|-----------------|-------------------------|
| Birds | Banded dotterel+ | | Birds continued | Variable oystercatcher* |
| | Black shag | | | Welcome swallow |
| | Caspian tern+ | | | White-faced heron |
| | Paradise shelduck | | Fish | Common bully |
| | Pied stilt* | | | Inanga* |
| | Red-billed gull+ | | | Longfin eel* |
| | Southern black-backed gull | | | Redfin bully* |
| | Spur-winged plover | | | Shortfin eel |
| | | | | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

44.3 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. Stock access to the waterway has damaged wetland vegetation at the margins (Figs 44.5 & 44.6) as pugging is likely to be exacerbated when tides penetrate into the wetland area.

The flats are dominated by ecological weed species, principally tall fescue, and gorse has been particularly dense along the southern bank. Elsewhere, scrub species such as tree lupin are abundant.

Although the beach is free of vegetation, marram grows thickly on the low dunes. Crack willow and radiata pine both line the stream at the upper tidal limit.



Figure 44.5. The Ōkau Stream now meanders through intensified farm land, 2016. Photo: Helen Kettles.



Figure 44.6. Stock access to the stream margins and waterway in recent years has caused pugging and altered the ecological values of the Ōkau Stream estuarine site. *Photo: Helen Kettles*.

44.4 Conservation management

44.4.1 Current

The landowners of Ōkau Station regard their boundary as running parallel with the beach, as this is where the fence is located, despite historical changes in the course of the stream. Ecological weed control and replanting work is being done by GWRC in the estuarine system. The adjacent wetlands appear to have little in the way of active management, although the landowners occasionally graze stock there. The fence line is ageing, overgrown, and in need of repair in places. It would seem that it has been built to prevent stock from wandering onto the beach.

Ngāti Papauma and Ngāti Hāmua retain an interest in the management of the site.

GWRC has undertaken habitat mapping of the Ōkau Stream estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

44.4.2 Potential

Despite the degraded condition of the estuarine system, there is still potential for the wetland to be restored, particularly following a sustained effort to control the ecological weed species on the flats. Many of the native species are still present, and if the area were properly fenced to exclude stock, it would rapidly revert to estuarine saltmarsh vegetation. This could be further assisted by the supplementary planting of native shade species such as toetoe, tauhinu (already present on site), and flax (also present in the vicinity) to discourage the return of gorse and lupin. This would have the effect of enhancing the habitat and providing shade and cover for both native birds and fish. Locating, documenting, and restoring any potential inanga spawning sites would be valuable. As this area is on private land, the project would need the cooperation of the landowner.

44.5 References

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45. Mātaikona River

45.1 Site description

The mouth of the Māitaikona River is a Category B estuarine system constrained by a long sandspit (Table 45A; Fig. 45.1, 45.2). The river is tidal for around 2 km upstream. The estuarine sediments form an important feeding ground for birds that use the spit (Fig. 45.3). There is very little in the way of estuarine riparian vegetation, as the river margins are generally steep and the saltmarsh probably already occupies its maximum extent. There is a fringe of saltmarsh at the rear of the pool. The river drains through a narrow, rocky outlet and may occasionally be blocked.

The small holiday settlement of Mātaikona is adjacent to the southern side of the estuarine site, while the Mātaikona Tussockland Recommended Area for Protection (No. 9) is adjacent on the northern side.

45.2 Conservation values

45.2.1 Ecological

The margins of the tidal pool are steep and crumbly, offering little scope for the development of saltmarsh. A fringe of three-square has formed along the base of the bank on the mudflats at the rear of the pool. There are patches of toetoe and giant umbrella sedge scattered along the margin, and knobby clubrush grows on the sandflats of the spit. Horse's mane grows in the subtidal area of the pool. A terrace on the northern side of the river has the remanants of a wetland (Fig. 45.4). There are no threatened plant species in the estuarine system but sand pimelea and sand coprosma have been recorded in the vicinity (Townsend 1994, cited in Milne & Sawyer 2002).

Table 45A. Mātaikonā River site information (see also Fig. 45.1).

| SITE NAME | MĀTAIKONA RIVER | | |
|--|--|--|--|
| Location | Mātaikona | | |
| NZTM (coordinates) | 1875604 5480175 | | |
| NZ Topo50 | BN36 756 802 | | |
| Area | 12 ha | | |
| DOC Office | Whakaoriori / Masterton Office | | |
| Councils | Masterton District Council, GWRC | | |
| Land status (tenure) | Private – Ōwāhanga (Aorangi) Station, Mātaikona Station | | |
| Existing rankings | Ecol Site 832 | | |
| Ecological district | Eastern Wairarapa | | |
| Estuarine classification | Category B | | |
| Threatened species (number) | 3 | | |
| At Risk species (number) | 12 | | |
| Ecosystem value (score 1-5) | 3 | | |
| Social value (score 1-5) | 3 | | |
| Restoration potential (score 1-5) | 4 | | |
| Pressures (score 1–5) NB: 1 = high pressures | 4 | | |
| Dominant habitat | Knobby clubrush rushland Gorse shrubland Exotic tree land Three-square sedgeland Sandflats Mudflats Subtidal | | |

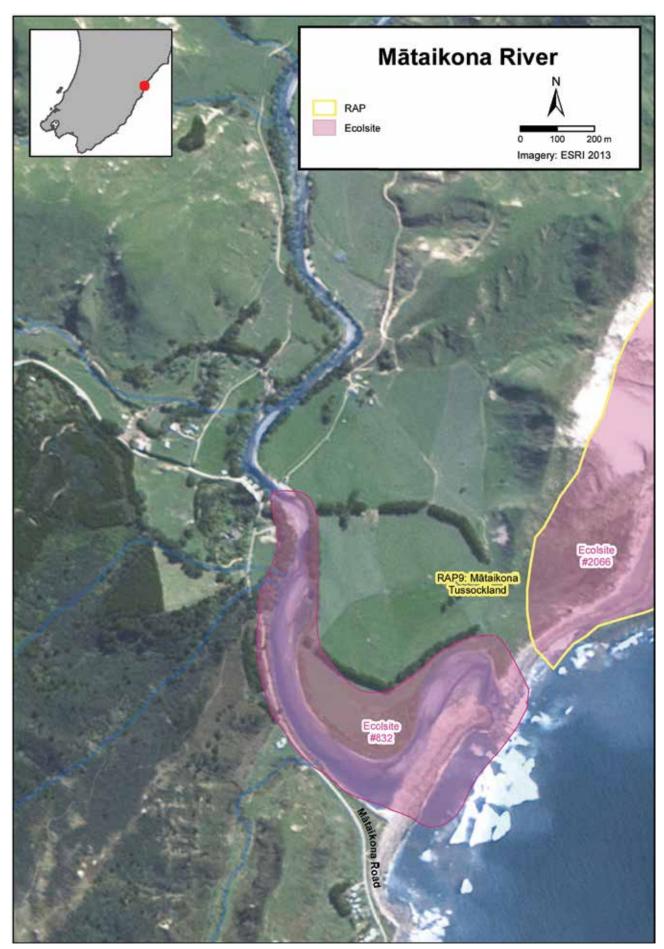


Figure 45.1. Mātaikona River estuarine site showing areas and places mentioned in the text.



Figure 45.2. The Mātaikona River mouth is dynamic with step margins. Photo: Helen Kettles.



Figure 45.3. A number of shore and wading bird species visit the Mātaikona River mouth to feed in the mudflats. Note the steep, crumbly margins of the tidal pool. *Photo: Matt Todd.*



Figure 45.4. The southern side of the Mātaikona River is steep sided but a terrace on the northern side has the remanants of a wetland. *Photo: Helen Kettles*.

Table 45B. Native species present in, or utilising, the Mātaikonā River estuarine system.

| GROUP | SPECIES | |
|-------|----------------------------------|--|
| Birds | Black shag* | |
| | Black swan | |
| | Black-fronted dotterel | |
| | Caspian tern+ | |
| | Kingfisher | |
| | Little black shag* | |
| | Little shag | |
| | Pied shag+ | |
| | Pied stilt* | |
| | Red-billed gull+ | |
| | Royal spoonbill* | |
| | South Island pied oystercatcher* | |
| | Southern black-backed gull | |
| | Spur-winged plover | |
| | | |

| GROUP | SPECIES |
|-----------------|-------------------------|
| Birds continued | Swamp harrier |
| | Variable oystercatcher* |
| | Welcome swallow |
| | White-faced heron |
| | White-fronted tern* |
| Fish | Common bully |
| | Common smelt |
| | Inanga* |
| | Kōaro* |
| | Longfin eel* |
| | Redfin bully* |
| | Shortfin eel |
| | Torrentfish* |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

Oioi, uncommon on this coast, may be seen in the dune slacks of the Mātaikona Tussockland Recommended Area for Protection (No. 9) at the northern end of the pool (Beadel et al. 2004), associated with pīngao in the dunes.

The mudflats of the shallow pool provide rich feeding grounds for a range of birds. White-faced herons, black shags, pied stilts, black swans and kingfishers are all present. Royal spoonbills (Fig. 45.3) and little shags are also sighted occasionally. On the sandspit, Caspian terns, banded dotterels, variable oystercatchers, southern black-backed gulls and red-billed gulls may be seen. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Eight migratory native freshwater fish species have been found in the catchment, including five species that are listed as 'At Risk: Declining' (longfin eel, inanga, kōaro, redfin bully and torrentfish; Allibone et al. 2010). However, Taylor & Kelly (2003) noted that the spawning habitat for inanga here was limited by the steepness of the banks. Coastal marine species may be found in the pool occasionally.

Table 45B lists native species present in, or utilising, the Mātaikonā River estuarine system.

45.2.2 Recreational

Mātaikona is a small holiday settlement. The beach receives moderate numbers of recreational users, and fishing and swimming are frequent activities during the summer. The upper estuarine system is easily accessible and popular with birdwatchers and whitebaiters.

45.3 Catchment properties

The river drains a catchment of 18 900 ha (MacDonald & Joy 2009), consisting of hill country sheep stations and exotic forestry. The underlying geology of the region is that of sedimentary rock, making erosion and flooding an issue (Wairarapa Engineering Lifelines Association 2004).

The river comes under the Mātaikona-Whakataki Catchment Scheme, which focuses on alleviation of flood risk through the planting of erosion-prone slopes (GWRC 2007).

Horsetail, a highly aggressive ecological weed capable of forming dense monocultures over large areas, is present in the middle and lower parts of the catchment. Currently there are no control measures that can be applied to any but the smallest infestations.

Robertson & Stevens (2007) identify sedimentation as an issue affecting water quality in the estuarine system. Due to the rocky nature of the outlet, the pool is seldom blocked and the risk of elevated algal levels is alleviated by regular tidal flushing.

45.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. During the summer months, domestic pets (particularly dogs) may also be present in the company of holiday-makers. Rabbits and hares are likely to be in the vicinity, presenting a threat to new growth of native plant species. A rookery is known to be in the vicinity.

Fine sediment from erosion can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding and inhibits the growth of aquatic vegetation. Eventually, it can significantly alter the character of a small estuarine system.

Pasture and shrubby ecological weeds are abundant in the vicinity of the pool, with gorse and tall fescue the dominant species.

There is evidence of regular vehicle usage on the beach. Not only does this adversely impact the vegetation and wildlife, but vehicles are frequently dispersal vectors for ecological weeds, and their passage creates a disturbance of the ecosystem that can facilitate the incursion of ecological weed species. However, their use on the sandspit and around the pool is severely restricted by the large piles of driftwood and debris observed at the time of survey.

45.5 Conservation management

45.5.1 Current

The land on either side of the river is privately owned, with two stations bordering the estuarine area: Ōwāhanga to the north and Mātaikona to the south.

The estuarine area is largely unfenced, although stock have no access from the south, and the north-western terrace has been largely ungrazed for some length of time. Only the very northern point of the pool is fenced. A small unformed carpark is on the southern terrace overlooking the estuarine site, adjacent to the road and beach. Vehicles have access to the beach from this point.

Pest and weed control on the road are carried out by Masterton District Council contractors at regular intervals. Adjoining landowners conduct control measures as part of property management. There is no targeted conservation management.

Ngāti Papauma and Ngāti Hāmua retain a strong interest in the management of the site.

GWRC has undertaken habitat mapping of the Mātaikona River estuarine site and margins, and assessed risks to the estuarine ecosystem integrity (Robertson & Stevens 2007).

45.5.2 Potential

It appears that the north-western terrace is the remains of a wetland once contiguous with the pool, possibly even a historical part of the riverbed. If the gorse were kept under control in this area, there is potential to reintroduce native wetland plant species in order to restore the habitat. These could include toetoe, giant umbrella sedge (both already present on the tidal margin), flax, saltmarsh ribbonwood, and small-leaved pōhuehue. Once these larger species were established to overshade weeds, rushes such as oioi and sea rush could also be planted. Once removed, continued vigilance against gorse would be necessary as there will be a substantial seed bank in the soil, as well as extensive populations in the adjacent hills. This initiative would require the cooperation of the landowner.

The use of vehicles on the beach is damaging the habitat, disturbing wildlife, and facilitating the spread of ecological weeds on the sandspit adjacent to the pool. The area could be protected by the demarcation of the carpark with low barriers and the blocking of access tracks onto the beach. An access point should be left for the purpose of launching boats.

45.6 References

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46. Ōwāhanga River

46.1 Site description

The Ōwāhanga River reaches the sea in broad sweeps, with the river mouth constrained by a short sandbar (Table 46A; Fig. 46.1). The river is tidal for over 3 km, but the river valley has been modified during the early 20th century by drainage of the wetlands for pasture. At low tide, mudflats are exposed in the river bed, flanked by steep banks topped with pasture (Fig. 46.2). The most natural habitats remaining are found in the saltmarsh and mudflats of the river mouth.

46.2 Conservation values

46.2.1 Ecological

Sea rush and knobby clubrush dominate the wetland areas (Fig. 46.3) on the margins of the tidal area, with wīwī, giant umbrella sedge, tauhinu, and small-leaved pōhuehue also present. Slender spike sedge is present amongst the rushes. There are no threatened plant species in the estuarine system.

The river mouth is a popular feeding site for a range of birds. Variable oystercatchers, spurwinged plovers, New Zealand pipits, pied stilts, southern black-backed gulls and red-billed gulls were all observed at the time of visiting. Waterfowl, such as paradise shelducks, are frequently seen on the river, while black shags roost at the mouth. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Table 46A. Ōwāhanga River site information (see also Fig. 46.1).

| SITE NAME | ŌWĀHANGA RIVER | |
|--|---|--|
| Location | Ōwāhanga | |
| NZTM (coordinates) | 1883009 5491579 | |
| NZ Topo50 | BN37 830 916 | |
| Area | 60 ha | |
| DOC Office | Whakaoriori / Masterton Office | |
| Councils | Tararua District Council, Horizons Regional Council | |
| Land status (tenure) | Private - Ōwāhanga Station, Moanaroa Station | |
| Existing rankings | Ecol Sites 105, 2203, 2204 WERI: 2, SSWI: Moderate (Ecol Sites 105 & 2203) | |
| Ecological district | Eastern Wairarapa | |
| Estuarine classification | Category B | |
| Threatened species (number) | 5 | |
| At Risk species (number) | 7 | |
| Ecosystem value (score 1-5) | 2 | |
| Social value (score 1-5) | 3 | |
| Restoration potential (score 1-5) | 3 | |
| Pressures (score 1–5) NB: 1 = high pressures | 3 | |
| Dominant habitat | Tall fescue grassland Restiad rushland Marram grassland Mudflats Sandflats Subtidal | |

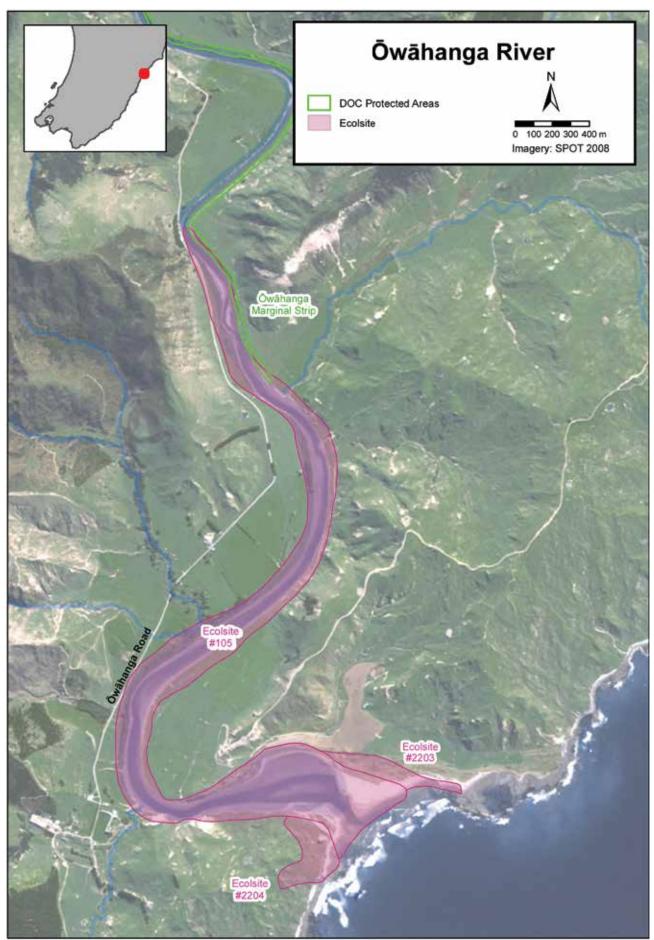


Figure 46.1. $\bar{\text{O}}\text{w}\bar{\text{a}}\text{hanga}$ River estuarine site showing areas and places mentioned in the text.



Figure 46.2. A part of the tidal reach of the Ōwāhanga River, looking towards the mouth (obscured at rear). The margins have been grazed for many years, but wading birds visit the mudflats to feed. *Photo: Matt Todd.*



Figure 46.3. Rushland near the mouth of the Ōwāhanga River. This is one of the few areas of indigenous habitat remaining around the tidal area. *Photo: Matt Todd.*

Six migratory native freshwater fish species have been found in the catchment, including four species that are listed as 'At Risk: Declining' (longfin eel, shortjaw kōkopu, inanga and redfin bully; Allibone et al. 2010). The banks are lined with tall fescue, a plant that inanga have been known to utilise for spawning. The range of coastal marine species which may be found in the estuarine system could penetrate quite some distance upstream with the tide.

Spotted skink has been recorded in the dunes at the mouth of the river (Jewell 1967) and is a significant population if it still persists.

Table 46B lists native species present in, or utilising, the Ōwāhanga River estuarine system.

Table 46B. Native species present in, or utilising, the Ōwāhanga River estuarine system.

| GROUP | SPECIES | GROUP | SPECIES |
|-------|----------------------------|-----------------|-------------------------|
| Birds | Banded dotterel+ | Birds continued | Swamp harrier |
| | Black shag* | | Variable oystercatcher* |
| | Caspian tern+ | | White-faced heron |
| | Gannet | Fish | Common bully |
| | Little shag | | Estuarine stargazer |
| | Paradise shelduck | | Inanga* |
| | Pied stilt* | | Kahawai |
| | New Zealand pipit* | | Longfin eel* |
| | Red-billed gull+ | | Redfin bully* |
| | Reef heron+ | | Shortfin eel |
| | Southern black-backed gull | | Shortjaw kōkopu+ |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists: + denotes Threatened species and * At Risk species.

46.2.2 Recreational

The river mouth can be accessed only by boat or over Ōwāhanga Station. Despite this, the beach receives use by recreational fishers and is popular with surfers. There is a moderate amount of whitebaiting in the river.

46.3 Catchment properties

The catchment (40 674 ha) mainly consists of sheep farm hill country, with over 80% of the catchment in pasture (MacDonald & Joy 2009). Only around 5% of the catchment is forested. The dominant soils in the catchment are sedimentary sandstone and mudstone, and erosion is a common occurrence which leads to water turbidity and sedimentation in the river bed. Horizons Regional Council (2013) rate the water quality as 'good' for nitrogen concentrations (meets the One Plan targets 60-80% of the time) and 'excellent' for phosphorus (meets target > 80% of the time).

The Ōwāhanga marginal strip, managed by DOC, can be found approximately 4 km upstream of the mouth along the northern side of the Ōwāhanga River, and continues for 5 km upstream.

46.4 Threats

A range of mammalian predators and browsers will be present but their impacts have mostly not been assessed at this site. Stock (including horses and cattle) access the river margins, doing damage through trampling as well as grazing on new growth. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding. Siltation in the estuarine system is an ongoing problem, due to the prevalence of soil erosion in the catchment. Rabbits are widespread in the area and will pose a threat to threatened plants in the dunes, as well as general damage to vegetation.

In a farming environment, introductions of ecological weeds have been regular events during the 19th and 20th centuries. Besides the common pasture weeds of gorse, pampas grass, tall fescue, and crack willow, other ecological weed species in the catchment include Spanish broom, vetch, and sweet pea shrub. This last is of particular concern, as it is a prolific seeder and an aggressive competitor. It can easily colonise and engulf an ecosystem. Marram is common in the dunes and along the coast.

A 4WD track allows access to the beach on the northern side of the river, and there is evidence of vehicles in the dunes. This can disturb birds and do long-term damage to native plant, invertebrate and lizard populations.

46.5 Conservation management

46.5.1 Current

The estuarine area forms the boundary between two hill country sheep stations, Ōwāhanga and Moanaroa, and has been grazed continually for over 120 years. The estuarine margins are mostly unfenced on the southern shore, allowing stock access. On the north bank, a riparian strip is partially fenced, but stock are still permitted to graze the margin. Adjoining landowners conduct control measures as part of property management but there is no targeted conservation management. Horizons Regional Council offers advice and assistance to private landowners wishing to take measures to reduce erosion through the Sustainable Land Use Initiative.

Ōwāhanga Station is administered by Ngāti Papauma through the Aohanga Incorporation.

46.5.2 Potential

Protection and restoration of the entire tidal zone is not feasible given its length; however, the tidal margins adjacent to the mouth still retain fragments of their natural character. If these areas could be protected, then they have the potential to revert to estuarine wetland providing habitat for birds, and improved spawning conditions for inanga.

Other restoration measures could include the fencing of the marginal zone on both sides of the river to exclude stock, thereby protecting against grazing and trampling damage as well as protecting aquatic habitats. The ecological weed density or diversity in the wetland is not currently of the level that requires sustained control, but it may be prudent to monitor the area for future growth.

As both the river margins and the dunes lie in private property, these measures can only be implemented with the cooperation of the landowners.

The improvement of water quality in streams in the Manawatū-Wanganui Regional Council boundaries has been targeted in the One Plan (Environment Court 2012).

46.6 References

Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.

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47. Ākitio River

47.1 Site description

The Ākitio is a large Category B estuarine system, characterised by a dynamic sandspit at its outlet (Table 47A; Figs 47.2 & 47.2), backed by a large tidal pool. The river is tidal for nearly 5 km. The estuarine sediments form an important feeding ground for shorebirds. There is very little in the way of marginal estuarine vegetation, as the edges of the river are in pasture, and the river margins are generally steep, offering little opportunity for the development of saltmarsh (Fig. 47.3).

A bridge across the upper part of the tidal pool is the main access to the coastal settlement of \bar{A} kitio, a few hundred metres south of the river mouth. The Coast Road skirts the southwestern part of the pool, and the margin here has been modified for the road.

47.2 Conservation values

47.2.1 Ecological

The edges of the estuarine system are greatly modified by farming. Native species present here include tauhinu, $ng\bar{a}io$, $w\bar{i}w\bar{i}$, and cutty grass. Further upstream, in the extended upper tidal reach, mudflats lie on the river margin, broken only by the occasional patch of knobby clubrush and $w\bar{i}w\bar{i}$. Some of the low-lying pasture may have contained estuarine vegetation at one time. The occasional specimen of toetoe and giant umbrella sedge in the low-lying pasture is the only suggestion that such areas could have once been wetland.

Table 47A. Ākitio River site information (see also Fig. 47.1).

| SITE NAME | ĀKITIO RIVER |
|--|--|
| Location | Ākitio |
| NZTM (coordinates) | 1889113 5499382 |
| NZ Topo50 | BN37 891 994 |
| Area | Approx. 75 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Tararua District Council, Horizons Regional Council |
| Land status (tenure) | Private—Ākitio Station, Marainanga Station |
| Existing rankings | Ecol Site 1 SSWI: Moderate-High |
| Ecological district | Eastern Hawkes Bay |
| Estuarine classification | Category B |
| Threatened species (number) | 3 |
| At Risk species (number) | 12 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 3 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Browntop grassland Exotic tree land Sandflats Mudflats Subtidall |



Figure 47.1. Ākitio River estuarine site showing areas and places mentioned in the text.



Figure 47.2. The dynamic mouth of the $\bar{\text{A}}$ kitio River mouth forms a large tidal pool amidst extensive sandflats. Photo: Matt Todd.



Figure 47.3. The lower tidal reach of the Ākitio River, looking towards the mouth. Exotic treeland occupies the margins of the river. *Photo: Matt Todd.*

The sandspit and dunes are nesting sites for several bird species, including banded dotterels, white-fronted terns, blue penguins and variable oystercatchers. A number of other species gather here to roost and feed on the mudflats of the estuarine area or in the coastal waters. Southern black-backed and red-billed gulls are frequent visitors, as are pied stilts, spur-winged plovers, black shags, and white-faced herons. Gannets and royal spoonbills may also be seen here occasionally, and there have been reports of black-billed gulls (OSNZ). Caspian terns feed here during the summer months. Further upstream, the river is the hunting ground for many terrestrial bird species seeking fish or insects, and a habitat for waterfowl. The estuarine site was included in the OSNZ (2007) river mouth bird survey.

Seven migratory native freshwater fish species have been found in the catchment, including four species listed as 'At Risk: Declining' (longfin eel, giant kōkopu, inanga and redfin bully; Allibone et al. 2010). Tall fescue is present along the banks—a plant in which inanga have been known to spawn. Because of the extent of the saltwater wedge, coastal marine species will penetrate a long distance upstream with the tide.

There has historically been a large population of pipi in the sandflats (Bill Wright, cited in Department of Conservation 2003), although this is now much reduced. Mud crabs and snails are common in the sediments of the estuarine system. Katipō spiders are known in the nearby dunes, along with a regionally significant population of common and spotted skinks that may extend into the estuarine area.

Table 47B lists native species present in, or utilising, the Ākitio River estuarine system.

Table 47B. Native species present in, or utilising, the Ākitio River estuarine system.

| GROUP | SPECIES | | GROUP | SPECIES |
|---------------------------|----------------------------|--|---------------------------|----------------------|
| Threatened/At Risk plants | Sea sedge* | | Birds continued | Welcome swallow |
| Birds | Banded dotterel+ | | | White-faced heron |
| | Black shag* | | | White fronted tern* |
| | Black swan | | Fish | Banded kōkopu |
| | Black-billed gull+ | | | Common bully |
| | Caspian tern+ | | | Giant kōkopu* |
| | Gannet | | | Inanga* |
| | Kingfisher | | | Longfin eel* |
| | Paradise shelduck | | | Redfin bully* |
| | Pied stilt* | | | Shortfin eel |
| Royal spoonbill* | | | Herpetofauna | Northern grass skink |
| | Southern black-backed gull | | | Spotted skink* |
| | Spur-winged plover | | Threatened/At Risk | Katipō spider* |
| | Variable oystercatcher* | | terrestrial invertebrates | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

47.2.2 Recreational

Ākitio is now a holiday spot, and the greater estuarine area and beach are popular with surfers, swimmers and picnickers. Fishing, birdwatching, shellfish gathering, whitebaiting, and duck hunting all take place here.

47.3 Catchment properties

The catchment mainly consists of sheep farm hill country, with over 80% of the catchment in pasture (MacDonald & Joy 2009). Eleven percent of the area is in scrub and there are only small amounts of indigenous and exotic forest. An area of 58 880 ha is drained, with tributary streams extending as far inland as the Puketoi Range. The dominant soils in the catchment are sedimentary sandstone and mudstone, and erosion is a common occurrence, leading to water turbidity and sedimentation in the river bed. Water quality was almost never too nitrate-rich and 'fair' for phosphorus (Horizons Regional Council 2005). However, it ranked 'very poor' for turbidity measurements (almost never clear enough for swimming). The site was not reported on in the latest state of the environment report (Horizons Regional Council 2013).

On the hills overlooking the estuarine site to the west, the catchment flows through the Moanaroa Bush Recommended Area for Protection (No. 40), which is also a QEII Covenant (5/07/347) (Maxwell et al. 1993).

47.4 Threats

A range of mammalian predators and browsers will be present but their impacts have not been assessed at this site. During the summer, holiday-makers often bring domestic predators with them that, if left uncontrolled, could also impact upon the local wildlife. Three small rookeries are present around the pool including one in the adjacent pine plantation. Rooks have the potential to disturb populations of shore-birds. Rabbits are widespread in the area, and will pose a threat to threatened plants in the dunes, as well as general damage to vegetation.

Koi carp have been reported in the river (MacDonald & Joy 2009). These exotic fish are destructive feeders in the river bed, eating not just vegetation but also juvenile fish, insects, and small crustaceans and can significantly destabilise the structure of the ecosystem. They can have indirect impacts on bird populations by competing for food. However, their presence remains unconfirmed (D. Moss, DOC 2010, pers. comm.)

In a farming environment, introductions of ecological weeds have been regular events during the 19th and 20th centuries. Besides the common pasture weeds of gorse, pampas grass, tall fescue, and crack willow, other ecological weed species in the tidal margins include Spanish broom, vetch, and sweet pea shrub. This last is of particular concern, as it is a prolific seeder and an aggressive competitor that can easily colonise and engulf an ecosystem. Marram is common in the dunes and along the coast.

Siltation in the estuarine system is an ongoing problem, due to the prevalence of soil erosion in the catchment. Fine sediment can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding and inhibits the growth of aquatic vegetation. Eventually, it can significantly alter the character of a small estuarine system.

47.5 Conservation management

47.5.1 Current

The estuarine site forms the boundary between two hill country sheep stations, Ākitio and Marainanga (the homestead of a third station, Moanaroa, is also adjacent to the river mouth), and has been grazed continually for over 120 years. The margins are mostly unfenced, allowing stock complete access to the river and estuarine system. Exotic species such as willow have been historically planted to stabilise banks. Horizons Regional Council offers advice and assistance to private landowners wishing to take measures to reduce erosion through the Sustainable Land Use Initiative.

Horizons Regional Council monitors water quality in the estuarine system on a monthly basis for a range of nutrients and suspended sediment.

Pest control is carried out by the landowners. Control of rooks in the area is conducted by Horizons Regional Council, and numbers have been greatly reduced since 2000 (R. Wilman, Horizons 2009, pers. comm.).

There is an informal community group, based at Ākitio School and supported by local authorities and DOC, which has recently undertaken restoration planting in the dunes near the south side of the river mouth. Pīngao and kōwhangatara have been planted, with sand ladders and a fence constructed for protection. These measures will enhance the indigenous buffering of the tidal margins, and help reduce invasion of ecological weeds to the estuarine ecosystem.

47.5.2 Potential

Protection and restoration of the entire 5 km tidal zone would be difficult and require cooperation from the landowners. However, it may be possible to improve sections of the tidal margins by encouraging landowners to fence off riparian areas on their properties and plant wetland vegetation. Support could be provided in the form of advice and resources. This would not only enhance the river margins but provide habitat for waterfowl and native fish, as well as help absorb sediments and diffuse runoff. Locating , documenting, and restoring potential inanga spawning sites would also be valuable.

The dune area buffering the northern margins of the river mouth contains a number of significant coastal plant species and is also an important site for wildlife. It would be prudent to give greater protection to this area, both physically and legally. Measures could include the fencing of sensitive nesting sites to exclude stock, which would protect against grazing and trampling damage in both the dunes and tidalflats. As a considerable part of the dunes lie on private land, this could only occur with the cooperation of the landowner. Currently, the only access is across the river mouth, but public access to the north side of the river could be along an esplanade strip, if a formed track from the road bridge were developed. Information panels at the site could help raise awareness of the biodiversity in the area.

47.6 References

Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.

Department of Conservation 2003: Nga Whakamaramatanga o te Moana. Unpublished report produced by the Department of Conservation in association with Rangitaane o Wairarapa and Ngati Kahunugnu ki Wairarapa.13 p. http://www.marinenz.org.nz/documents/DoC 2003 Oral History of Kaumatua.pdf

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48. Waimata River

48.1 Site description

This river drains a steep catchment and reaches the sea through a narrow gully. The bar at the mouth frequently prevents discharge, at which point the river backs up (Table 48A; Figs 48.1 & 48.2), forming a small brackish lake. Saltwater probably only enters at high tide, although seepage occurs through the sediments. The estuarine margins have been grazed over a long period, but there is still evidence of saltmarsh vegetation in the river and a dune ecosystem flanking the outlet.

48.2 Conservation values

48.2.1 Ecological

As the margins of the estuarine area have been extensively grazed, there is little native vegetation remaining in the ecosystem. Some fringes of three-square are present on the margin (Fig. 48.2), and there are patches of wīwī, giant umbrella sedge, small-leaved pōhuehue and toetoe scattered along the water's edge. All show evidence of grazing. On the south side of the stream there is an area where knobby clubrush is dominant. Slender clubrush grows in tufts at the river outlet. There are no threatened plant species known at this site.

The only birdlife in evidence were variable oystercatchers and southern black-backed gulls on the beach. Common waterfowl, such as paradise shelducks, are certain to use the estuarine system for roosting and grazing.

Table 48A. Waimata River site information (see also Fig. 48.1).

| SITE NAME | WAIMATA RIVER |
|--|---|
| Location | 8 km north of Ākitio |
| NZTM (coordinates) | 1895818 5507485 |
| NZ Topo50 | BN37 958 075 |
| Area | Approx. 1 ha |
| DOC Office | Whakaoriori / Masterton Office |
| Councils | Tararua District Council, Horizons Regional Council |
| Land status (tenure) | Private—Ākitio Station |
| Existing rankings | None |
| Ecological district | Eastern Hawkes Bay |
| Estuarine classification | Category A |
| Threatened species (number) | 3 |
| At Risk species (number) | 4 |
| Ecosystem value (score 1-5) | 2 |
| Social value (score 1-5) | 2 |
| Restoration potential (score 1-5) | 3 |
| Pressures (score 1–5) NB: 1 = high pressures | 3 |
| Dominant habitat | Tall fescue grassland Three-square sedgeland Marram grassland Knobby clubrush rushland Sandflats Subtidal |

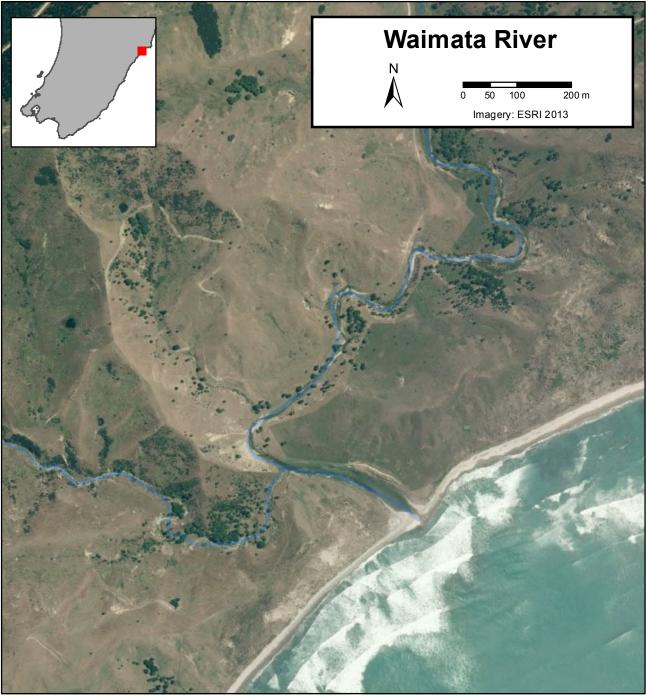


Figure 48.1. Waimata River estuarine site showing areas and places mentioned in the text.

Four migratory native freshwater fish species have been found in the catchment, three of which are listed as 'At Risk: Declining' (longfin eels, inanga and redfin bully; Allibone et al. 2010). In a grazed environment there is little spawning habitat available for inanga. The frequent blocking of the river mouth may hinder the migration of these species at times.

Table 48B lists native species present in, or utilising, the Waimata Stream estuarine system.

48.2.2 Recreational

There is no evidence of historic occupation of the site, although there is a pā site not far away at the Papuka Stream. The river mouth is likely to have been visited to catch eels and waterfowl.

The estuarine site is isolated and seldom visited by recreational users other than the occasional hunter or fisherman.



Figure 48.2. The mouth of the Waimata River is blocked, causing the formation of a small coastal lake. Patches of partially submerged three-square sedgeland may be seen, lining the lake margins. Other saltmarsh vegetation here has been grazed. *Photo: Matt Todd.*

Table 48B. Native species present in, or utilising, the Ōwāhanga River estuarine system.

| GROUP | SPECIES | |
|-------|----------------------------|--|
| Birds | Banded dotterel+ | |
| | Caspian tern+ | |
| | Kingfisher | |
| | Paradise shelduck | |
| | Pied stilt* | |
| | Red-billed gull+ | |
| | Southern black-backed gull | |
| | | |

| GROUP | SPECIES |
|-----------------|----------------------|
| Birds continued | White-faced heron |
| Fish | Common bully |
| | Inanga* |
| | Longfin eel* |
| | Redfin bully* |
| Herpetofauna | Northern grass skink |
| | |

Note: Little detailed survey work for animals has been carried out in many estuarine systems and this is reflected in the site species lists; + denotes Threatened species and * At Risk species.

48.3 Catchment properties

The catchment is short and steep, encompassing some 2100 ha of coastal hill country. Roughly 50% of the catchment is in pasture, while the remainder is a mixture of scrub, exotic forest, and native bush, including the 1000 Acre Bush Recommended Area for Protection (412 ha) (Maxwell et al. 1993).

48.4 Threats

A range of mammalian predators and browsers will be present but mostly their impacts have not been assessed at this site. Stock, particularly cattle, grazing the estuarine margins present a greater challenge as they not only eat the new growth of native species, but trample the banks creating disturbed areas, which are easily colonised by ecological weed species. Trampling by stock also causes bank erosion and sedimentation, which in turn can reduce water quality, inhibit fish migration and smother habitat for aquatic animals. Sedimentation also exacerbates the effects of flooding.

A range of pasture weeds, including gorse, are plentiful along the estuarine margin, and marram is abundant along the coast, although there do not appear to be any significant ecological weeds in the waterway itself, nor are there any species that require immediate action to control or eradicate.

While there is no known monitoring of water quality in the river, a large quantity of algal growth in the stream could indicate nutrient pollution although landuse is not intensive in the catchment.

48.5 Conservation management

48.5.1 Current

Stock have full access to the river on the north bank, while the area is partially fenced on the south side of the mouth, although livestock also probably access this area occasionally. Some control of pests and weeds are carried out by the landowners with unknown conservation benefits. There is no targeted conservation management of the estuarine system.

48.5.2 Potential

Judging by the native species present, even in a grazed condition, this environment would revert back to estuarine wetland if the margins were totally fenced and stock excluded. However, this would require management of the gorse around the margins, as this species will not be overtopped once it is established in such an environment. Restoration of the estuarine margins would provide habitat for waders and waterfowl and promote spawning for inanga in the river.

As the estuarine area is surrounded on all sides by private land, this can only be achieved with the cooperation of the landowners.

The thick algal growth in the river suggests that water quality is an issue in the catchment. Fencing out stock and planting riparian areas would contribute to reducing nutrient pollution as well as sedimentation issues.

48.6 References

Allibone, R.; David, B.; Hitchmough, R.; Jellyman, D.; Ling, N.; Ravenscroft, P.; Waters, J. 2010: Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44(4): 271–287.

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Hume et al. (2007) classification of New Zealand's estuarine systems—the five classes of estuarine systems represented in this region

Category A—Very shallow basins (several metres depth), often elongate in shape and orientated parallel to the open coast shore. For the majority of the time there is no ocean (i.e. tidal or swell wave) forcing because the entrance to the sea is for most of the time barred off. Thus, these estuarine systems have zero intertidal area and are poorly flushed. Episodic flood events can open an entrance for several days or weeks each year, permitting exchange with the ocean. Such entrances are generally narrow, and close when littoral drift overwhelms the ability of tides and river inputs to flush sediment from the entrance. River inputs are small and may be ephemeral. Wind generated two-dimensional circulation and mixing occurs. Because these estuarine systems are shallow, wave suspension of bottom sediments is an important driver of whole-estuarine system sedimentation processes. These estuarine systems are characterized by muddy substrate. No ocean swell enters the system because the entrance is closed for most of the time and, when open, the narrow and shallow entrance filters out wave energy.

Category B—Elongate basins of a simple shape and several to 10 m depth. The majority of the estuarine area is subtidal. The volume of river flow delivered during a tidal cycle is a significant proportion of the volume of the basin, and is greater than the tidal volume entering the basin. Thus, the estuarine system-scale hydrodynamic processes are dominated by river flows and these estuarine systems are well flushed. On shorelines with littoral drift, these estuarine systems have small sand bodies (bars) on the ocean side of the entrance. In deeper systems a circulation pattern (estuarine) can be set up where outflowing freshwater is balanced by the inflow of seawater entrained beneath freshwater and a salt wedge develops. Seawater intrudes a considerable distance up the estuarine system on low gradient coastal plains. Large floods can expel much of the ocean water from the estuarine system. Wind generated two-dimensional mixing and wave driven resuspension are minor as wind fetch and waves are small and depths are largely too great for significant bed stress to be produced. Thus sediments tend to be muddy except in areas of high tidal flows.

Category C—Occur where the mouth of a main river channel connects to shallow lagoons. While the main river channel is mostly subtidal, the lagoons can have a significant intertidal area. The volume of river flow delivered during a tidal cycle is a significant proportion of the volume of the total basin and is greater than the tidal volume entering the basin. The estuarine system-scale hydrodynamic processes are dominated by river flows, although they tend to bypass the lagoons. In the deeper main arm a circulation pattern (estuarine) can be set up where outflowing freshwater is balanced by the inflow of seawater entrained beneath freshwater and a salt wedge develops. The main river channel is well flushed, but seawater remains trapped in the lagoons where the flushing is comparatively poor. Wind generated two-dimensional mixing and wave resuspension of the substrate is minor in the main river channel, but greater in the lagoons because of the larger wind fetch and shallow depths. Wave resuspension produces coarser substrates in the lagoon. On shorelines with littoral drift, these estuarine systems have small sand bodies (bars) on the ocean side of the entrance.

Category D—Are representative of features termed coastal embayments. They are shallow, circular to slightly elongate basins with simple shorelines and wide entrances that are open to the ocean. They are mostly subtidal with small intertidal areas restricted to the headwaters (sheltered areas) of the more elongate types. There is little river influence and circulation is weak and ocean forced. The entrances are wide and open to the ocean, allowing swell to enter

the bay and resuspend seabed sediments. The estuarine system-scale hydrodynamic processes are dominated by the ocean. There are no sand bodies (tidal deltas) on the ocean side of the entrance. Wind generated two-dimensional mixing and wave driven estuarine system-scale sedimentation occurs. As a result the substrate is sandy, except in areas where wave resuspension of the substrate is limited by depth.

Category E—Shallow, circular to slightly elongate basins with simple shorelines and extensive intertidal area. They generally have a narrow entrance to the sea that is usually constricted by a spit or sand barrier. Sand bodies occur as ebb and flood tidal deltas at the mouth on littoral drift shores. On zero drift shores, funnel-shaped entrances with no sand bodies occur. The tidal prism is a large proportion of the estuarine system basin volume. The volume of river flow delivered during a tidal cycle is very small compared to the total volume of the estuarine system. Thus, estuarine system-scale hydrodynamic processes are dominated by ocean forcing. Wind generated two-dimensional circulation, mixing and resuspension occur at high tide. They have good flushing because much of the water leaves the estuarine system on the outgoing tide. Category E estuarine systems generally have homogeneous sandy substrates because of a combination of wave resuspension of the substrate and flushing. They are also well mixed because strong flushing, wind mixing and the shallow depths prohibit density stratification. Salinity is close to that of the sea. Ocean swell can resuspend sediment in the entrance of estuarine systems with wider mouths at high tide when screening from the ebb tidal delta is minimised.

References

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Sites that were excluded from the report

The following sites were excluded from the report (sites that were included in this report can be seen in Table 1 or Figure 1). For rationale see "site selection and survey" methodology section at the front of the report.

Tikotu Stream

Pukerua Bay

Between Wairaka Point and Te Rewarewa Point

Tīrau Bay Stream

Open Bay Stream and Kiakia Stream

Ōhau Bay Stream

Ōpahu Stream

Sheep Gully Stream

Ōteranga Stream

Waiariki Stream

Karori Stream

Ōwhiro Bay Stream

Paiaka Stream

Ōkakaho Stream

Ōrongorongo River

Barneys Stream

Mukamukaiti Stream

Mukamuka Stream

Corner Creek

Wharekauhau Stream

Wharepapa River

Wairarapa Stream

Hurupi Stream

Stream by Pinnacles

Te Ika Pakeke Stream

Whatarangi Stream

Woolshed Creek

Wakapirihika Stream

Waiwhero Stream

Kawakawa Stream

Blueship Creek

Mangatoetoe Stream

Little Mangatoetoe and Kirikiri Streams

Te Roro Stream

Waitetuna Stream

Ōroi Stream

Waikēkenō Stream

Arawhata Stream

Te Uno Uno Stream

Glenburn Stream

Te AwaitiStream

Kaimokopuna Stream

Waiōhuru Stream

Several unnamed watercourses within the survey area

Scoring system used to rank the relative importance of estuarine sites

| CRITERIA | SCORE | | | | | | | |
|--|---|--|--|--|---|--|--|--|
| | 1 | 2 | 3 | 4 | 5 | | | |
| Ecosystem value A site must satisfy two of three criteria in order to achieve a score. | Site area is less than 1 ha. Less than 20% of the site is considered healthy and intact. Contains no rare ecosystems. | Site area is greater than 1 ha. More than 20% of the site is considered healthy and intact. Contains at least one ecosystem found in no more than 10 sites in the ecological district. | Site area is greater than 5 ha. More than 40% of the site is considered healthy and intact. Contains at least one ecosystem found in no more than two sites elsewhere in the ecological district or in no more than 10 other sites in the ecological region. | Site area is greater than 15 ha. More than 60% of the site is considered healthy and intact. Contains at least one ecosystem found in no more than two sites elsewhere in the ecological region or in no more than 10 other sites in the lower North Island (Te Ika-a-Māui). | Site area is greater than 50 ha. More than 80% of the site is considered healthy and intact. Contains at least one ecosystem found in no more than two sites elsewhere in the lower North Island (Te Ika-a-Māui). | | | |
| Social value | Minimum social significance. | Social value to a small sector of the local community. | General social value held by local community. | Specific social value held by local community and small sector of wider community. | Highly significant social value held by local and wider community. | | | |
| Restoration potential | > 50% of the site is structurally modified or < 20% of the indigenous ecosystem remains. | > 20% of the site is structurally modified or 20–40% of the indigenous ecosystem remains. | > 5% of the site is structurally modified or 40–60% of the indigenous ecosystem remains. | < 5% of the site is structurally modified or 60–80% of the indigenous ecosystem remains. | At least 80% of the indigenous ecosystem remains | | | |
| Pressures | More than three disruption types occurring at a severe level. | More than three disruption types occurring at a high level or no more than three disruption types occurring at a severe level. | More than three disruption types occurring at a low level or no more than three disruption types occurring at a high level or no more than one disruption type occurring at a severe level. | No more than three disruption types occurring at a low level or no more than one disruption type occurring at a high level. | No more than one disruption type to ecological integrity occurring at a low level. | | | |

Criteria scores for individual estuarine systems in the Lower North Island (Te Ika-a-Māui)

| ESTUARINE SITE NAME | THREAT- ENED/ | THREAT- ENED/ | TOTAL THREATENED | ECOSYSTEM VALUE | SOCIAL VALUE | RESTORATION POTENTIAL | PRESSURES |
|------------------------|--------------------|-------------------|------------------------|--------------------|-----------------|-----------------------|-----------|
| | AT RISK ANIMALS | AT RISK PLANTS | AND AT RISK SPECIES | | | | |
| Manawatū | 15/17 | 0/3 | 35 | 5 | 5 | 3 | 3 |
| Wairarawa | 1/6 | 0/0 | 7 | 2 | 2 | 3 | 2 |
| Hōkio | 5/9 | 0/1 | 15 | 3 | 4 | 3 | 3 |
| Waiwiri | 1/4 | 0/1 | 6 | 1 | 4 | 4 | 3 |
| Ōhau | 11/14 | 1/2 | 28 | 4 | 3 | 4 | 3 |
| Waikawa | 7/12 | 0/0 | 19 | 4 | 3 | 4 | 3 |
| Waitohu | 10/13 | 0/2 | 25 | 4 | 3 | 4 | 3 |
| Ōtaki | 9/11 | 0/2 | 22 | 3 | 4 | 4 | 3 |
| Mangaone | 2/4 | 0/0 | 6 | 2 | 3 | 3 | 3 |
| Kukutauaki | 4/7 | 0/1 | 12 | 1 | 2 | 3 | 4 |
| Waimeha | 3/8 | 0/0 | 11 | 2 | 1 | 2 | 2 |
| Waikanae | 13/18 | 0/3 | 34 | 5 | 4 | 4 | 2 |
| Wharemauku | 5/13 | 0/0 | 18 | 1 | 2 | 1 | 2 |
| Whareroa | 4/10 | 1/0 | 15 | 3 | 3 | 4 | 4 |
| Wainui | 3/10 | 0/0 | 13 | 3 | 3 | 3 | 3 |
| Taupō | 1/6 | 0/0 | 7 | 1 | 3 | 1 | 1 |
| Te Awarua-o-Porirua | 9/18 | 0/2 | 27 | 4 | 4 | 3 | 2 |
| Mākara | 6/14 | 0/2 | 20 | 4 | 3 | 4 | 3 |
| Kaiwharawhara | 2/9 | 0/0 | 11 | 2 | 3 | 2 | 1 |
| Korokoro | 2/10 | 0/0 | 12 | 2 | 3 | 2 | 1 |
| Te Awa Kairang/Hutt | 6/13 | 0/0 | 19 | 3 | 5 | 3 | 2 |
| Waiwhetū | 2/5 | 0/0 | 7 | 2 | 4 | 3 | 1 |
| Parangarahu Lakes | 7/11 | 0/4 | 22 | 3 | 3 | 4 | 5 |
| Wainuiōmata | 6/13 | 0/1 | 20 | 2 | 2 | 4 | 5 |
| Lake Ōnoke and Lagoons | 11/18 | 1/2 | 32 | 5 | 5 | 3 | 2 |
| Whāngaimoana | 2/2 | 0/0 | 5 | 3 | 2 | 4 | 4 |
| Cape Palliser | 4/8 | 0/0 | 12 | 3 | 4 | 2 | 4 |
| Ōpouawe | 4/9 | 0/0 | 13 | 2 | 3 | 3 | 3 |
| Āwheaiti | 2/3 | 0/0 | 5 | 2 | 2 | 2 | 3 |
| Āwhea | 5/10 | 0/0 | 15 | 2 | 3 | 4 | 3 |
| Ōterei | 4/9 | 1/1 | 15 | 3 | 3 | 4 | 3 |
| Rerewhakaaitu | 1/4 | 0/0 | 5 | 2 | 2 | 2 | 5 |
| Pāhāoa | 4/7 | 0/1 | 12 | 2 | 3 | 3 | 2 |
| Kaiwhata | 2/6 | 0/0 | 8 | 2 | 4 | 3 | 3 |
| Waikaraka | 1/2 | 0/0 | 3 | 3 | 2 | 4 | 3 |
| Patanui | 1/2 | 0/0 | 3 | 4 | 3 | 5 | 5 |
| Waioronu | 3/3 | 0/0 | 6 | 3 | 2 | 5 | 4 |
| Motuwaireka | 7/13 | 0/0 | 20 | 3 | 3 | 5 | 3 |
| Whareama | 5/8 | 0/1 | 14 | 4 | 3 | 3 | 3 |
| Otahome | 1/3 | 0/0 | 4 | 3 | 2 | 4 | 3 |
| 'Humpy' | 1/2 | 0/0 | 3 | 2 | 2 | 4 | 3 |
| Ngakauau | 1/5 | 0/0 | 6 | 2 | 2 | 3 | 3 |

Appendix 4 continued

| ESTUARINE SITE | THREAT- | THREAT- | TOTAL | ECOSYSTEM | SOCIAL | RESTORATION | PRESSURES |
|----------------|---------|---------|-------------|-----------|--------|-------------|-----------|
| NAME | ENED/ | ENED/ | THREATENED | VALUE | VALUE | POTENTIAL | |
| | AT RISK | AT RISK | AND AT RISK | | | | |
| | ANIMALS | PLANTS | SPECIES | | | | |
| Whakataki | 3/11 | 0/0 | 14 | 3 | 3 | 4 | 4 |
| Ōkau | 3/5 | 0/0 | 8 | 3 | 2 | 3 | 3 |
| Mātaikona | 3/12 | 0/0 | 15 | 3 | 3 | 4 | 4 |
| Ōwāhanga | 5/7 | 0/0 | 12 | 2 | 3 | 3 | 3 |
| Ākitio | 3/11 | 0/1 | 15 | 2 | 3 | 3 | 3 |
| Waimata | 3/4 | 0/0 | 7 | 2 | 2 | 3 | 3 |

List of the 34 estuarine sites assessed for risks by Greater Wellington Regional Council (Robertson & Stevens 2007a,b)

Waitohu

Ōtaki

Mangaone

Peka Peka (Kukutauaki)

Ngārara (Waimeha)

Waikanae River

Tikotu*

Wharemauku

Whareroa

Taupō

Pāuatahanui Arm (Te Awarua-o-Porirua Harbour)

Poirirua Arm (Te Awarua-o-Porirua Harbour)

Mākara

Kaiwharawhara

Korokoro

Te Awa Kairangi/Hutt

Wainuiōmata

Ōrongorongo*

Lake Ōnoke

Ōpouawe

Āwhea

Ōterei

Rerewhakaaitu

Pāhāoa

Kaiwhata

Patanui

Motuwaireka

Whareama

Otahome

Humpies

Ngakauau

Whakataki

Ōkau

Mātaikona

Tikotu was rejected as it was deemed at the time of survey to have estuarine function reduced to negligibility through a combination of stream and catchment modification, causing an almost total reduction of freshwater input and estuarine ecosystem values.

Ōrongorongo was rejected as it was deemed to lack sufficient tidal input beyond the mouth of the river.

References

Robertson, B.; Stevens, L. 2007a: Kapiti, Southwest, South Coasts and Wellington Harbour: risk assessment and monitoring recommendations. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.

Robertson, B.; Stevens, L. 2007b: Wairarapa coastal habitats: mapping, risk assessment, and monitoring. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.

^{*} These sites were not included in the current report.

Criteria for listed threat classifications (adapted from Townsend et al. 2008)

1. Threatened:

Nationally Critical:

- (a) very small population (natural or unnatural)
- (b) small population with high ongoing or predicted decline
- (c) population (irrespective of size) with a very high ongoing or precited decline (>70% over 10 years or 3 generations, whichever is longer)

Nationally Endangered:

- (a) small population (natural or unnatural) that has low to high ongoing or predicted decline
- (b) small, stable population
- (c) moderate population and high ongoing or predicted decline

Nationally Vulnerable:

- (a) small, increasing population (unnatural)
- (b) moderate, stable population (unnatural)
- (c) moderate population, with population trend that is declining
- (d) moderate to large population and moderate to high ongoing or predicted decline
- (e) large population and high ongoing or predicted decline

2. At Risk:

Declining:

- (a) moderate to large population and low ongoing or predicted decline
- (b) large population and low to moderate ongoing or predicted decline
- (c) very large population and low to high ongoing or predicted decline

Recovering: Taxa that have undergone a documented decline within the last 1000 years and now have an ongoing or predicted increase of > 10% in the total population or area of occupancy, taken over the next 10 years or 3 generations, whichever is longer.

Relict: Taxa that have undergone a documented decline within the last 1000 years and now occupy < 10% of their former range and meet one of the following criteria: (A) have 5000–20 000 mature individuals and are stable; (B) have > 20 000 mature individuals and are stable or increasing at > 10%. Relict can also include taxa that exist as reintroduced and self-sustaining populations within or outside their former known range.

Naturally Uncommon: Taxa whose distribution is naturally confined to specific substrates, habitats, or geographic areas, or taxa that occur within naturally small and widely scattered populations. This distribution is not the result of past or recent human disturbance, and populations may be stable or increasing.

Data Deficient: There is insufficient data to place taxa in a specific group or category.

Note: threat status only provided for native or endemic species. Also, the threat classification will be reviewed in late 2013 so it will be prudent to reconfirm the status of species at that time.

References

Townsend, A.; de Lange, P.; Duffy, C.; Miskelly, C.; Molloy, J.; Norton; D. 2008: New Zealand threat classification system manual. Department of Conservation, Wellington.

Appendix 7A

Native plants mentioned in the text and their threat status

| COMMON NAME | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|--|---|-------------------------|--------------------------------------|
| Bachelor's button Cotula coronopifolia | | Native | Not Threatened |
| Buchanan's sedge* | Carex buchananii | Endemic | Not Threatened |
| Cabbage tree | Cordyline australis | Endemic | Not Threatened |
| Clubrush | Isolepis prolifera | Native | Not Threatened |
| Coastal kānuka | Kunzea amathicola | Native | At Risk: Declining |
| Cook Strait bristle grass* | Rytidosperma petrosum | Endemic | At Risk: Naturally Uncommon |
| Cook Strait tussock* | Chionochloa beddiei | Endemic | At Risk: Naturally Uncommon |
| Creeping cudweed | Euchiton audax | Endemic | Not Threatened |
| Cutty grass | Carex geminata | Endemic | Not Threatened |
| Duckweed | Lemna disperma | Native | Non Threatened |
| Dwarf musk | Mazus novaezeelandiae subsp. Novaezeelandiae | Endemic | At Risk: Declining |
| Flax | Phormium tenax | Native | Not Threatened |
| Giant umbrella sedge | Cyperus ustulatus | Endemic | Not Threatened |
| Glasswort | Sarcocornia quinqueflora subsp. quinqueflora | Native | Not Threatened |
| Gratiola | Gratiola sexdentata | Native | Not Threatened |
| Fennel-leaved pondweed | Stuckenia pectinata | Native | At Risk: Naturally Uncommon |
| Horse's mane | Ruppia polycarpa | Native | Not Threatened |
| Horokaka | Disphyma australe subsp. australe | Endemic | Not Threatened |
| Kānuka | Kunzea spp. | Native | Not Threatened |
| Karaka* | Corynocarpus laevigatus | Endemic | Not Threatened |
| Karamū | Coprosma lucida | Endemic | Not Threatened |
| Karo | Pittosporum crassifolium | Endemic | Not Threatened |
| Kirk's crassula | Crassula kirkii | Endemic | At Risk: Naturally Uncommon |
| Knobby clubrush | Ficinia nodosa | Native | Not Threatened |
| Koromiko | Hebe stricta var. atkinsonii Endemic | | Not Threatened |
| Kōwhangatara (spinifex)* | Spinifex sericeus Native Not T | | Not Threatened |
| Kuāwa | Schoenoplectus tabernaemontani Native | | Not Threatened |
| Lowland ribbonwood | Plagianthus regius subsp. regius | Endemic | Not Threatened |
| Macroalgae | Enteromorpha sp. Native | | Not Threatened |
| Maniototo button daisy* | Leptinella maniototo | Native | Not Threatened |
| Mānuka | Leptospermum scoparium | Native | Not Threatened |
| Mat daisy* | Raoulia australis | Endemic | Not Threatened |
| Matagouri* | Discaria toumatou | Endemic | Not Threatened |
| Mingimingi | Coprosma propinqua | Endemic | Not Threatened |
| Mud buttercup | Ranunculus limosella | Native | Not Threatened |
| Mud pondweed | Potamogeton suboblongus | Endemic | Not Threatened |
| Mudwort | Limosella lineata | Native | Not Threatened |
| Native musk* | Thyridia repens | Native | At Risk: Naturally Uncommon |
| Native pondweed | Potamogeton cheesemanii | Native | Not Threatened |
| New Zealand celery | Apium prostratum subsp. prostratum var. filiforme | Native | Not Threatened |
| New Zealand iris | Libertia peregrinans | Endemic | Threatened: Nationally Vulnerable |
| New Zealand spinach | Tetragonia tetragonioides | Native | At Risk: Naturally Uncommon |
| Ngāio | Myoporum laetum | Endemic | Not Threatened |
| Oioi | Apodasmia similis | Endemic | Not Threatened |
| Pinātoro | Pimelea urvilleana subsp. urvilleana | Endemic | Not Threatened |
| Pīngao* | Ficinia spiralis | Endemic | At Risk: Declining |

| COMMON NAME | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS | |
|-----------------------|---|-------------------------|---|--|
| Pōhutukawa* | Metrosideros excelsa | Endemic | Not Threatened | |
| Prickly couch | Zoysia minima | Endemic | Not Threatened | |
| Pūkio | Carex secta | Endemic | Not Threatened | |
| Pūrua grass | Bolboschoenus caldwellii | Native | Not Threatened | |
| Pūrua grass | Bolboschoenus medianus | Native | Not Threatened | |
| Pygmy clubrush | Isolepis basilaris | Endemic | Threatened: Nationally Vulnerable | |
| Raupō | Typha orientalis | Native | Not Threatened | |
| Remuremu | Selliera radicans | Endemic | Not Threatened | |
| Ruatahi | Carex coriacea | Endemic | Not Threatened | |
| Saltgrass | Puccinellia stricta | Native | Not Threatened | |
| Saltmarsh ribbonwood | Plagianthis divaricatus | Endemic | Not Threatened | |
| Sand coprosma* | Coprosma acerosa | Endemic | At Risk: Declining | |
| Sand pimelea* | Pimelea villosa | Endemic | At Risk: Declining | |
| Sand sedge* | Carex pumila | Native | Not Threatened | |
| Sand tussock* | Poa billardierei | Native | At Risk: Declining | |
| Scabweed* | Raoulia aff. hookeri | Endemic | Not Threatened | |
| Sea holly | Eryngium vesiculosum | Endemic | At Risk: Declining | |
| Sea lettuce | Ulva sp. | Native | Not Threatened | |
| Sea rush | Juncus kraussii var. australiensis | Native | Not Threatened | |
| Sea sedge | Carex litorosa | Endemic | At Risk: Declining | |
| Seagrass | Zostera muelleri (syn. capricorni, novazelandica) | Native | At Risk: Declining (Secure Oversea | |
| Sebaea | Sebaea ovate | Native | Threatened: Nationally Critical | |
| Sharp spike sedge | Eleocharis acuta | Native | Not Threatened | |
| Shore bindweed* | Calystegia soldanella | Native | Not Threatened | |
| Shore primrose | Samolus repens var. repens | Native | Not Threatened | |
| Shrubby tororaro* | Muehlenbeckia astonii | Endemic | Threatened: Nationally Endangere | |
| Slender clubrush | Isolepis cernua var. cernua | Native | Not Threatened | |
| Slender spike sedge | Eleocharis gracilis | Native | Not Threatened | |
| Small-leaved põhuehue | Muehlenbeckia complexa | Native | Not Threatened | |
| Speckled sedge | Carex testacea | Endemic | Not Threatened | |
| Strathmore weed* | Pimelea prostrata subsp. prostrata | Endemic | Not Threatened | |
| Swamp buttercup | Ranunculus macropus | Endemic | Data Deficient | |
| Swamp nettle | Urtica linearifolia | Endemic | At Risk: Declining | |
| Tarata Tarata | Pittosporum eugenioides | Endemic | Not Threatened | |
| Fauhinu Fauhinu | Ozothamnus leptophyllus | Endemic | Not Threatened | |
| Taupata Taupata | Coprosma repens | Endemic | Not Threatened | |
| Feasel sedge | Carex dipsacea | Endemic | Not Threatened | |
| Thick-leaved māhoe* | Melicytus crassifolius | Endemic | At Risk: Declining | |
| Three-square | Schoenoplectus pungens | Endemic | Not Threatened | |
| - oetoe | Cortaderia toetoe | Endemic | Not Threatened | |
| Vater brome | Amphibromus fluitans | Native | Threatened: Nationally Vulnerable | |
| Vīwī | Juncus edgariae | Endemic | Not Threatened | |
| | Crassula mataikona* | Endemic | At Risk: Naturally Uncommon | |
| | Einadia allanii* | Native | At Risk: Naturally Uncommon | |
| | Glossostigma diandrum* | Native | Not Threatened | |
| | Glossostigma elatinoides* | Native | Not Threatened | |
| | Gracilaria sp.* | Native | Not Threatened | |
| | Lepilaena bilocularis* | Native | Threatened: Nationally Vulnerable | |
| | Schoenus nitens | Native | Not Threatened | |
| | Son Son do Filtorio | Nauvo | 1101 Illioutoriou | |

Note: * denotes non-estuarine species, e.g. those in adjacent dunes or freshwater ecosystems.

Appendix 7B

Exotic plants mentioned in the text

| COMMON NAME | SCIENTIFIC NAME |
|-----------------------|---------------------------------------|
| Allseed* | Polycarpon tetraphyllum |
| American spartina | Spartina alterniflora |
| Arum lily | Zantedeschia aethiopica |
| Asian kelp* | Undaria pinnatifida |
| Banksia* | Banksia integrifolia |
| Barberry* | Berberis glaucocarpa |
| Beggars' ticks | Bidens frondosa |
| Blackberry | Rubus fruticosus |
| Boneseed | Chrysanthemoides monilifera |
| Boxthorn | Lycium ferocissimum |
| Briar* | Rosa rubiginosa |
| Browntop | Agrostis capillaries |
| Brush wattle | Paraserianthes lophantha |
| Buck's horn plantain | Plantago coronopus |
| Buckthorn | Rhamnus alaternus |
| Buffalo grass | Stenotaphrum secundatum |
| Californian thistle | Cirsium arvense |
| Cape ivy | Senecio angulatus |
| Cape pondweed | Aponogeton distachyus |
| Chilean rhubarb | Gunnera tinctoria |
| Climbing dock | Rumex sagittatus |
| Coastal wattle* | Acacia sophorae |
| Crack willow | Salix fragilis |
| Creeping bent | Agrostis stolonifera |
| Dock | Rumex obtusifolius |
| Douglas fir* | Pseudotsuga menziesii |
| Fennel | Foeniculum vulgare |
| Giant reed | Arundo donax |
| Golden willow | Salix alba var. vitellena |
| Gorse | Ulex europaeus |
| Great bindweed | Calystegia sylvatica subsp. disjuncta |
| Grey willow | Salix cinerea |
| Hare's foot trefoil | Trifolium arvense |
| Horned poppy | Glaucium flavum |
| Hornwort | Ceratophyllum demersum |
| Horsetail | Equisetum arvense |
| Ice plant | Carpobrotus edulis |
| Japanese honeysuckle* | Lonicera japonica |
| Kikuyu | Pennisetum clandestinum |
| Macrocarpa* | Cupressus macrocarpa |
| Manchurian rice grass | Zizania latifolia |
| Marram* | Ammophila arenaria |
| Mercer grass | Paspalum distichum |
| Monkey musk | Mimulus guttatus |
| Montbretia | Crocosmia x crocosmiiflora |
| Norfolk Island pine | |
| NOTION ISIANU PINE | Araucaria heterophylla |

Appendix 7b continued

| COMMON NAME | SCIENTIFIC NAME |
|----------------------------------|----------------------------|
| Oxygen weed* | Lagarosiphon major |
| Oxygen weed* | Elodea canadensis |
| Oxygen weed* | Egeria densa |
| Pampas grass | Cortaderia selloana |
| Parrot's feather | Myriophyllum aquaticum |
| Purple loosestrife* | Lythrum salicaria |
| Radiata pine | Pinus radiata |
| Rape | Brassica napus var. napus |
| Reed sweetgrass | Glyceria maxima |
| Rye grass | Lolium perenne |
| Senegal tea* | Gymnocoronis spilanthoides |
| Sharp rush | Juncus acutus |
| Silver poplar | Populus alba |
| Spanish broom | Spartium junceum |
| Spartina (also called cordgrass) | Spartina anglica |
| Sweet pea shrub* | Polygala myrtifolia |
| Tall fescue | Schedonorus phoenix |
| Tree lupin | Lupinus arboreus |
| Undaria* | Undaria pinnatifida |
| Vetch | Vicia sativa |
| Water buttercup | Ranunculus trichophyllus |
| Water celery | Apium nodiflorum |
| Water pepper | Persicaria hydropiper |
| Watercress | Nasturtium officinale |
| Wattle* | Acacia decurrens |
| White clover | Trifolium repens |
| Yarrow | Achillea millefolium |
| Yellow flag iris | Iris pseudacorus |
| Yorkshire fog | Holcus lanatus |
| Yucca | Yucca gloriosa |

Note: * denotes non estuarine species e.g. in adjacent dunes, freshwater or marine ecosystems.

Bibliography

De Lange, P.; Rolfe, J.; Champion, P.; Courtney, S.; Heenan, P.; Barkla, J.; Cameron, E.; Norton, D.; Hitchmough, R. 2013:

Conservation status of New Zealand indigenous vascular plants, 2012. New Zealand Threat Classification Series 3.

Department of Conservation, Wellington. 70 p.

New Zealand Plant Conservation Network. 2010: www.nzpcn.org.nz

Native animals mentioned in the text and their threat status

| BIRDS | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|------------------------|----------------------------|-------------------------|---|
| Arctic skua* | Stercorarius parasiticus | Native-Migrant | Migrant |
| Arctic tern | Sterna paradisea | Native-Migrant | Migrant |
| Australasian shoveler | Anas rhynchotis | Native | Not Threatened |
| Australian coot | Fulica atra | Native | Coloniser |
| Banded dotterel | Charadrius bicinctus | Native | Threatened: Nationally Vulnerable |
| Bar-tailed godwit | Limosa lapponica | Native-Migrant | At Risk: Declining |
| Bittern | Botaurus poiciloptilus | Native | Threatened: Nationally Endangered |
| Black-billed gull | Larus bulleri | Native | Threatened: Nationally Critical |
| Black-fronted dotterel | Elseyornis melanops | Native | Coloniser |
| Black-fronted tern | Childonias albostriatus | Native | Threatened: Nationally Endangered |
| Black-tailed godwit | Limosa limosa | Native-Vagrant | Vagrant |
| Black shag | Phalacrocorax carbo | Native | At Risk: Naturally Uncommon |
| Black swan | Cygnus atratus | Native | Not Threatened |
| Blue penguin* | Eudyptula minor | Native | At Risk: Declining |
| Brown teal | Anas chlorotis | Endemic | At Risk: Recovering |
| Caspian tern | Hydroprogne caspia | Native | Threatened: Nationally Vulnerable |
| Cattle egret | Ardea ibis | Native-Migrant | Migrant |
| Chestnut teal | Anas castanea | Native-Vagrant | Vagrant |
| Common tern | Sterna hirundo | Native-Vagrant | Vagrant |
| Crested tern | Sterna bergii | Native - Vagrant | Vagrant |
| Curlew sandpiper | Calidris ferruginea | Native-Migrant | Migrant |
| Dabchick | Poliocephalus rufopectus | Endemic | Threatened: Nationally Vulnerable |
| Fairy tern | Sternula nereis | Native | Threatened: Nationally Critical |
| Fantail* | Rhipidura fuliginosa | Endemic | Non-Threatened |
| Far eastern curlew | Numenius madagascariensis | Native-Migrant | Migrant |
| Fernbird | Bowdleria punctata | Endemic | At Risk: Declining |
| Fluttering shearwater | Puffinus gavia | Endemic | At Risk: Relict |
| Gannet* | Morus serrator | Native | Not Threatened |
| Glossy ibis | Plegadis falcinellus | Native-Vagrant | Vagrant |
| Great knot | Calidris tenuirostris | Native-Vagrant | Vagrant |
| Greenshank | Tringa nebularia | Native-Vagrant | Vagrant |
| Grey duck | Anas superciliosa | Native | Threatened: Nationally Critical |
| Grey plover | Pluvialis squatarolla | Native-Vagrant | Vagrant |
| Grey teal | Anas gracilis | Native | Not Threatened |
| Grey warbler* | Gerygone igata | Native | Not Threatened |
| Gull-billed tern | Gelochelidon nilotica | Native-Vagrant | Vagrant |
| Hudsonian godwit | Limosa haemastica | Native-Vagrant | Vagrant |
| Kingfisher | Todiramphus sanctus vagans | Native | Not Threatened |
| Little black shag | Phalacrocorax sulcirostris | Native | At Risk: Naturally Uncommon |
| Little egret | Egretta garzetta | Native-Vagrant | Vagrant |
| Little shaq | Phalacrocorax melanoleucos | Native | Not Threatened |
| Little tern | Sternula albifrons | Native-Migrant | Migrant |
| Marsh crake | Porzana pusilla | Native | At Risk: Relict |
| New Zealand dotterel | Charadrius obscurus | Native | Threatened: Nationally Vulnerable |
| New Zealand pipit | Anthus novaeseelandiae | Endemic | At Risk: Declining |

| BIRDS | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|---------------------------------|-------------------------------|-------------------------|--------------------------------------|
| Pacific golden plover | Pluvialis fulva | Native-Migrant | Migrant |
| Paradise shelduck | Tadorna variegata | Endemic | Not Threatened |
| Pectoral sandpiper | Calidris melanotos | Native-Vagrant | Vagrant |
| Pied shag | Phalacrocorax varius | Native | Threatened: Nationally Vulnerable |
| Pied stilt | Himantopus himantopus | Native | At Risk: Declining |
| Pūkeko | Porphyrio melanotus | Native | Not Threatened |
| Red knot | Calidris canutus | Native-Migrant | Migrant |
| Red-billed gull | Larus novaehollandiae | Native | Threatened: Nationally Vulnerable |
| Red-necked stint | Calidris ruficollis | Native-Migrant | Migrant |
| Reef heron | Egretta sacra | Native | Threatened: Nationally Endangered |
| Royal spoonbill | Platalea regia | Native | At Risk: Naturally Uncommon |
| Scaup | Aythya novaeseelandiae | Endemic | Not Threatened |
| Sharp-tailed sandpiper | Calidris acuminata | Native-Migrant | Migrant |
| Shining cuckoo* | Chrysococcyx lucidus | Native | Not Threatened |
| Shore plover | Thinornis novaeseelandiae | Endemic | Threatened: Nationally Critical |
| South Island pied oystercatcher | Haematopus finschi | Endemic | At Risk: Declining |
| Southern black-backed gull | Larus dominicanus | Native | Not Threatened |
| Spotless crake | Porzana tabuensis | Endemic | At Risk: Relict |
| Spotted shag | Stictocarbo punctatus | Endemic | Not Threatened |
| Spur-winged plover | Vanellus miles | Native | Not Threatened |
| Swamp harrier | Circus approximans | Native | Not Threatened |
| Terek sandpiper | Tringa cinerea | Native-Vagrant | Vagrant |
| Tūī* | Prosthemadera novaeseelandiae | Endemic | Not Threatened |
| Turnstone | Arenaria intepres | Endemic | Not Threatened |
| Variable oystercatcher | Haematopus unicolor | Native | At Risk: Recovering |
| Welcome swallow | Hirundo neoxena | Native | Not Threatened |
| White heron | Ardea modesta | Native | Threatened: Nationally Critical |
| White-faced heron | Egretta novaehollandiae | Native | Not Threatened |
| White-fronted tern | Sterna striata | Native | At Risk: Declining |
| White-winged black tern | Chlidonias leucopterus | Native-Migrant | Migrant |
| Wrybill | Anarhynchus frontalis | Endemic | Threatened: Nationally Vulnerable |

| AQUATIC | SCIENTIFIC NAME | BIOGEOGRAPHIC | NEW ZEALAND POPULATION |
|---------------------|-------------------------|---------------|------------------------|
| MACROINVERTEBRATES | | STATUS | THREAT STATUS |
| Mollusca | | | |
| Arthritica sp. | Arthritica sp. | Endemic | Not Threatened |
| Bubble shell | Haminoea zelandiae | Endemic | Not Threatened |
| Cockle | Austrovenus stutchburyi | Endemic | Not Threatened |
| Estuarine limpet | Notoacmea helmsi | Endemic | Not Threatened |
| Green-lipped mussel | Perna canaliculus | Endemic | Not Threatened |
| Large wedge shell | Macomona liliana | Endemic | Not Threatened |
| Mud snail | Potamopyrus antipodarum | Endemic | Not Threatened |
| Mud snail | Potamopyrus estuarinus | Endemic | Not Threatened |
| Mud snail | Halopyrgus pupoides | Endemic | Not Threatened |
| Mudflat snail | Amphibola crenata | Endemic | Not Threatened |
| Mudflat topshell | Diloma subrostrata | Endemic | Not Threatened |
| Mudflat whelk | Cominella gladiformes | Endemic | Not Threatened |
| Nut shell | Nucula hartvigiana | Endemic | Not Threatened |
| Oval trough shell | Cyclomactra ovata | Endemic | Not Threatened |
| Pipi | Paphies australis | Endemic | Not Threatened |
| | | | |

Appendix 8 continued

| Razor shell | Solemya parkinsoni | Endemic | Not Threatened |
|---------------------------|-------------------------|---------|---------------------------------|
| Spire shell | Zeacumantus lutentus | Endemic | Not Threatened |
| Toheroa | Amphidesma ventricosum | Endemic | Not Threatened |
| Top shell | Cantharidus huttonii | Endemic | Not Threatened |
| Trophon | Xymene plebeius | Endemic | Not Threatened |
| Crustacea | | | |
| Hairy-handed crab | Hemigrapsus crenulatus | Endemic | Not Threatened |
| Kōura/freshwater crayfish | Paranephrops planifrons | Endemic | Not Threatened |
| Paddle crab | Ovalipes catharus | Native | Not Threatened |
| Pillbox crab | Halicarcinus whitei | Native | Not Threatened |
| Pillbox crab | Halicarcinus varius | Native | Not Threatened |
| Stalk-eyed mud crab | Macrophthalmus hirtipes | Endemic | Not Threatened |
| Tunnelling mud crab | Austrohelice crassa | Endemic | Not Threatened |
| Annelida | | | |
| Spionid | Boccardiella magniovata | Endemic | Threatened: Nationally Critical |
| | | | |

| FISH | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|--|------------------------------|-------------------------|--------------------------------------|
| Banded kōkopu (whitebait species) | Galaxias fasciatus | Endemic | Not Threatened |
| Banded parrotfish | Pseudolabrus fucicola | Native | Not Evaluated |
| Barracouta | Thyrsites atun | Native | Not Evaluated |
| Black flounder | Rhombosolea retiaria | Endemic | Not Threatened |
| Blue mackerel | Scomber australasicus | Native | Not Evaluated |
| Blue moki | Latridopsis ciliaris | Native | Not Evaluated |
| Blue warehou | Seriolella brama | Native | Not Evaluated |
| Bluegill bully | Gobiomorphus hubbsi | Endemic | At Risk: Declining |
| Common bully | Gobiomorphus cotidianus | Endemic | Not Threatened |
| Common smelt | Retropinna retropinna | Endemic | Not Threatened |
| Conger eel | Conger verreauxi | Native | Not Evaluated |
| Dwarf common sole or speckled sole | Peltorhamphus latus | Endemic | Not Evaluated |
| Eagle ray | Myliobatis tenuicaudatus | Native | Not Evaluated |
| Elephant fish | Callorhynchus milii | Endemic | Not Evaluated |
| Estuarine stargazer | Leptoscopus macropygus | Native | Not Evaluated |
| Estuarine triplefin | Forsterygion nigripenne | Endemic | Not Threatened |
| Garfish | Hyporhamphus ihi | Endemic | Not Evaluated |
| Giant bully | Gobiomorphus gobioides | Endemic | Not Threatened |
| Giant kōkopu (whitebait species) | Galaxias argenteus | Endemic | At Risk: Declining |
| Graham's gudgeon | Grahamichthys radiata | Endemic | Not Evaluated |
| Grey mullet | Mugil cephalus | Native | Not Threatened |
| Gurnard | Chelidonichthys kumu | Native | Range Restricted |
| Hoki | Macruronus novaezelandiae | Native | Not Evaluated |
| Inanga (predominant whitebait species) | Galaxias maculatus | Native | At Risk: Declining |
| Jack mackerel | Trachurus novaezelandiae | Native | Not Evaluated |
| Kahawai | Arripis trutta | Native | Not Evaluated |
| Kōaro (whitebait species) | Galaxias brevipinnis | Native | At Risk: Declining |
| Lamprey | Geotria australis | Native | Threatened: Nationally Vulnerable |
| Longfin eel | Anguilla dieffenbachii | Endemic | At Risk: Declining |
| Long-snout pipefish | Stigmatopora longirostris | Endemic | Not Evaluated |
| New Zealand sole | Peltorhamphus novaezelandiae | Endemic | Not Evaluated |
| Pilchard | Sardinops neopilchardus | Native | Not Evaluated |
| Pipefish | Leptonotus norae | Endemic | Not Evaluated |
| Red cod | Pseudophycis bacchus | Native | Not Evaluated |

| T. P. C. | | | |
|--|---------------------------------|-------------------------|--------------------------------------|
| FISH | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
| Redfin bully | Gobiomorphus huttoni | Endemic | At Risk: Declining |
| Rig | Mustelus lenticulatus | Native | Not Threatened |
| Robust blenny | Grahamina gymnota | Endemic | Not Evaluated |
| Rock cod | Lotella rachinus | Native | Not Evaluated |
| Rough skate | Zearaja nasuta | Endemic | Not Evaluated |
| Sand flounder | Rhombosolea plebeia | Endemic | Not Threatened |
| Seahorse | Hippocampus abdominalis | Native | Not Evaluated |
| Shortfin eel | Anguilla australis | Native | Not Threatened |
| Shortjaw kōkopu (whitebait species) | Galaxias postvectis | Endemic | Threatened Nationally Vulnerable |
| Snapper | Chrysophrys auratus | Native | Not Evaluated |
| Spotted stargazer | Genyagnus novaezelandiae | Endemic | Not Evaluated |
| Spotty | Pseudolabrus celidotus | Endemic | Not Threatened |
| Sprat | Sprattus antipodum, S. muelleri | Endemic | Not Evaluated |
| Tarakihi | Nemadactylus macropterus | Native | Not Evaluated |
| Torrentfish | Cheimarrichthys fosteri | Native | At Risk: Declining |
| Trevally | Caranx georgianus | Native | Not Evaluated |
| Variable triplefin | Forsterygion varium | Native | Not Evaluated |
| Yellow-belly flounder | Rhombosolea leporina | Endemic | Not Evaluated |
| Yellow-eyed mullet | Aldrichetta forsteri | Native | Not Evaluated |

| REPTILES | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|------------------------|--------------------------------|-------------------------|--------------------------------------|
| Copper skink | Oligosoma aeneum | Endemic | Not Threatened |
| Marlborough mini gecko | Woodworthia "Marlborough mini" | Endemic | Not Threatened |
| Northern grass skink | Oligosoma polychroma | Endemic | Not Threatened |
| Raukawa gecko | Woodworthia maculatus | Endemic | Not Threatened |
| Spotted skink | Oligosoma lineoocellatum | Endemic | At Risk: Relict |
| Wellington green gecko | Naultinus punctatus | Endemic | At Risk: Declining |
| | | | |

| TERRESTRIAL INVERTEBRATES | SCIENTIFIC NAME | BIOGEOGRAPHIC STATUS | NEW ZEALAND POPULATION THREAT STATUS |
|---------------------------|---|-------------------------|--------------------------------------|
| Katipō spider | Latrodectus katipõ | Endemic | At Risk: Declining |
| Moth | Ericodesma aerodana | Native | At Risk: Declining |
| Moth | Notoreas perornata "Wairarapa Wellington" | Endemic | Threatened: Nationally Vulnerable |
| Native dragonfly | Uropetala carovei | Native | Not Threatened |

Note: * denotes fish species which migrate between freshwater and the sea. Althought many species migrate through estuarine systems, inanga is the only freshwater fish species that uses estuarine habitats for spawning.

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Site land status and existing rankings explanations

The 'Land status' listing includes land tenure or management by private owners, district or regional councils, and DOC within the following categories:

- Conservation Area: Area containing predominantly natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing recreational and visitor opportunities.
- Crown Land: Any land defined in the Land Act (1948) as 'vested in Her Majesty which is not for the time being set aside for any public purpose or held by any person in fee simple'. These areas are administered primarily by Land Information New Zealand and DOC, and may include marginal strips and the beds of streams and rivers.
- Ecosystem Management Unit (EMU): The Department of Conservation has adopted a strategic goal of protecting a representative suite of New Zealand's native ecosystems (Intermediate Outcome Objective 1.1). Ecosystem Management Units are management areas which contain one or more ecosystems; together, the full suite of EMUs contains examples of all of the terrestrial ecosystem types within New Zealand. The EMUs are ranked using ecological modelling to find the most effective and efficient way to achieve representation of all ecosystem types. Higher-ranked sites are those which, when managed, will contribute the most to the goal of protecting a representative suite of ecosystems. It is important to note that EMUs are not necessarily high-value or high-priority sites, and not all EMUs need to be managed; the current strategy is to progressively implement management of the highest-ranked 500 sites.
- Esplanade Reserve: see Local Purpose Reserve.
- Fee simple/freehold/private: Ownership of private land is the ownership of 'an estate in fee
 simple', which for almost all practical purposes is the equivalent of full ownership of the land
 fee simple and confers the lawful right to exercise over, upon, and in respect to the land, every
 act of ownership imaginable. It does not permit enjoyment of that land by someone else unless
 conferred by right or statute.
- Forest Park: Extensive area containing high value habitats and recreational opportunities, along with moderate-high biodiversity and scenic values. Administered by DOC on the second tier of legal protection status.
- Historic Reserve: An area possessing places, objects and natural features as are of historic, archaeological, cultural, educational or other special interest.
- Key Native Ecosystem (KNE): Greater Wellington Regional Council's (GWRC's) Biodiversity Strategy 2011-2021 provides a common focus across the council's departments, and guides activities relating to biodiversity. One of its goals is: High value biodiversity areas are protected. In order to achieve this goal, the Key Native Ecosystem (KNE) programme seeks to protect some of the best examples of ecosystem types in the Wellington region by managing, reducing, or removing threats to their values. Sites with the highest biodiversity values have been identified and then prioritised for management. KNEs are managed in accordance with three-year KNE plans prepared for each area by the GWRC's Biodiversity department in collaboration with the landowners and other stakeholders. These plans outline the ecological values and threats specific to each KNE, set out objectives for biodiversity management, and prescribe the operational actions and budget required to work towards achieving the objectives.
- Local Purpose Reserve: Land managed and developed for educational, community, social or other local purposes not included in other reserve purposes. These reserves area administered by the local district council and allow for high flexibility in site management. For each reserve,

a sub-classification is applied which specifies the primary purpose. Sub-classifications in this report include: esplanade, plantation, soil conservation and river control, rural, riverbank, foreshore, bush, environmental and landscape protection, community, etc. Management of the reserve/facility may be carried out on a daily basis by a private tenant or organisation. This includes domains and a number of other parks and reserves in this report.

- Marginal Strip: Land retained by the Crown to provide public access to and along public waterways and lakes. Available primarily for conservation and public access.
- Railway Land: Transport corridors for road and rail are also classified as Crown Land, administered by the New Zealand Transport Agency. As these areas have explicitly not been put aside for public purpose, access is not necessarily permitted.
- Recreation Reserve: Area provided for public recreation with an emphasis on preservation of open spaces and outdoor recreational activities.
- Regional Park: Area containing land and/or environmental values of 'regional significance'.
 These parks are administered by regional councils, and are generally characterised by high levels of public accessibility and recreational value, and moderate-high levels of scenic and biodiversity value.
- Scenic Reserve: Area possessing significant qualities of scenic interest or beauty or significant features or landscapes.
- Scientific Reserve: Established to protect ecological groupings, plant or animal communities, soils and landforms for scientific study, research and education.
- State Forest: Area of exotic forest, owned by the Crown but managed as a commercial resource by a private company. May be secondarily managed for recreational purposes, usually by the local or regional authority.
- Wildlife Refuge: Area which provides a haven for any classes of wildlife or possesses important wildlife habitat not otherwise protected.
- Wildlife Reserve: Area protected for the conservation, management and public appreciation of wildlife.
- Wildlife Sanctuary: Established to protect a particular species within a defined geographic area.

The 'Existing rankings' category includes (in alphabetical order):

- Area of Significant Conservation Value: Areas identified in the GWRC Regional Coastal Plan
 as having either significant or important conservation value.
- DOC covenants: Similar to a QEII covenant, but the area to be protected is required to
 have conservation or historic values aligned with the natural heritage priorities of DOC.
 Administration and active management of the protected land passes to DOC, but the
 landowner retains title.
- Ecosite: Ecological sites identified in the Kāpiti Coast District Plan as having areas of significant indigenous vegetation or significant habitats of indigenous plants.
- Ecol Site: Sites identified during the 1980s as being potentially of conservation significance.
 Such sites only gained actual significance if identified as a WERI, SSWI or RAP at a later date.
- Horizons Regional Council Priority Wetland: A prioritisation of wetlands by Horizons Regional Council for the wetlands within the Region (Lambie 2008). Wetlands are assigned a priority band, 'A' (highest priority) through 'D' (lowest priority), based on weighted scores of indicators including biological diversity, size, representativeness, contribution to remaining area, and presence of threatened or rare species.
- Ngā Whenua Rāhui: A fund established with the purpose of protecting indigenous ecosystems on Māori land. Management is based around the principles of tino-rangatiratanga (ownership

- and control) and local cultural values. Areas protected may be placed under a long-term kawenata (covenant). Funding usually includes assistance for practical issues such as fencing and pest control.
- QEII covenants: A Queen Elizabeth II open space covenant is a legally binding protection agreement for privately owned indigenous ecosystems, which is registered on the title of the land. It is voluntary but once in place binds the current and all subsequent landowners. No modification or development of the protected ecosystem may take place without the express permission of the QEII Trust. Areas under covenant may continue to be administered by the landowner. Protection status on the land is regarded to be equivalent to that of top tier Conservation Land.
- Ramsar: The Ramsar Convention on Wetlands (1971) is an international treaty for the
 conservation or sustainable use of wetlands and their resources. Listed wetlands are chosen
 based on criteria including being a representative, rare or unique example or a natural wetland
 type and are important for conserving biological diversity. Candidate sites are also included
 within this report.
- Recommended Area for Protection (RAP): Areas identified as important during the Protected Natural Areas Programme (1981–2000) which sought to identify an ecologically representative protected natural areas system. In later years, areas were given either Priority 1 or 2 status.
- Site of Special Wildlife Interest (SSWI): Compiles data from extensive surveys undertaken during the 1980s to identify good wildlife habitat. The emphasis was on those species that can be relatively rapidly located at a site. The SSWI database does not include areas of significant vegetation or habitats of threatened plant species unless wildlife of interest was also found.
- Wetlands of Ecological and Representative Importance (WERI): A computer database
 developed in the 1980s that contains records on approximately 3000 wetlands throughout
 New Zealand. Information includes: size; location; land ownership; classification (hydroclass,
 geomorphic origin, community class, or dominant plant species); modifiers and threats; buffer,
 wildlife and vegetation values; other ecological values; cultural values; significance; and
 sources of information (DOC 1995).
- Waters of National Importance (WONI): A nationwide assessment of 4706 river catchments, carried out during the early 2000s, in order to identify and rank those that best represent the full range of indigenous biodiversity (Chadderton et al. 2004). A river is listed as Type I if the majority of the catchment is assessed as nationally significant, Type II if it contains special features (such as a wetland) that are of significance.

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Habitat classification as per Atkinson (1985)

| 1. Forest | Woody vegetation in which the cover of trees and shrubs in the canopy is >80% and in which tree cover exceeds that of shrubs. Trees are woody plants >10 cm DBH*. Tree ferns ≥10 cm DBH are treated as trees. |
|--|---|
| 2. Treeland | Vegetation in which the cover of trees in the canopy is 20–80%, with tree cover exceeding that of any other growth form, and in which the trees form a discontinuous upper canopy above either a lower canopy of predominantly non-woody vegetation or bare ground, e.g. māhoe/bracken treeland. (Note: Vegetation consisting of trees above shrubs is classified as either forest or scrub depending on the proportion of trees and shrubs in the canopy). |
| 3. Vineland | Vegetation in which the cover of unsupported (or artificially supported) woody vines in the canopy is 20–100% and in which the cover of these vines exceeds that of any other growth form or bare ground. Vegetation containing woody vines that are supported by trees or shrubs is classified as forest, scrub or shrubland. Examples of woody vines occur in the genera <i>Actinidia</i> , <i>Clematis</i> , <i>Lonicera</i> , <i>Metrosideros</i> , <i>Muehlenbeckia</i> , <i>Ripogonum</i> , <i>Vitis</i> and others. |
| 4. Scrub | Woody vegetation in which the cover of shrubs and trees in the canopy is > 80% and in which shrub cover exceeds that of trees (cf. Forest). Shrubs are woody plants < 10 cm DBH. |
| 5. Shrubland (including tussock-shrubland) | Vegetation in which the cover of shrubs in the canopy is 20–80% and in which the shrub cover exceeds that of any other growth form or bare ground. It is sometimes useful to separate tussock-shrublands as a sub-class for areas where tussocks are >20% but less than shrubs. (Note: The term scrubland is not used in this classification.) |
| 6. Tussockland (including flaxland) | Vegetation in which the cover of tussocks in the canopy is 20–100% and in which the tussock cover exceeds that of any other growth form or bare ground. Tussocks include all grasses, sedges, rushes, and other herbaceous plants with linear leaves (or linear non-woody stems) that are densely clumped and >10 cm height. Examples of the growth form occur in all species of <i>Cortaderia</i> , <i>Gahnia</i> and <i>Phormium</i> , and in some species of <i>Chionochloa</i> , <i>Poa</i> , <i>Festuca</i> , <i>Rytidosperma</i> , <i>Cyperus</i> , <i>Carex</i> , <i>Uncinia</i> , <i>Juncus</i> , <i>Astelia</i> , <i>Aciphylla</i> , and <i>Celmisia</i> . It is sometimes useful to separate flaxland as a sub-class for areas where species of <i>Phormium</i> are dominant. |
| 7. Fernland | Vegetation in which the cover of ferns in the canopy is 20–100% and in which the fern cover exceeds that of any other growth form or bare ground. Tree ferns >10 cm DBH are excluded as trees (cf. Forest). |
| 8. Grassland | Vegetation in which the cover of grass in the canopy is 20–100% and in which the grass cover exceeds that of any other growth form or bare ground. Tussock grasses are excluded from the grass growth form. |
| 9. Sedgeland | Vegetation in which the cover of sedges in the canopy is 20–100% and in which the sedge cover exceeds that of any other growth form or bare ground. Included in the sedge growth form are many species of <i>Carex</i> , <i>Uncinia</i> and <i>Scirpus</i> . Tussock sedges and reed-forming sedges (cf. Reedland) are excluded. |
| 10. Rushland | Vegetation in which the cover of rushes in the canopy is 20–100% and in which the rush cover exceeds that of any other growth form or bare ground. Included in the rush growth-form are some species of <i>Juncus</i> and all species of <i>Sporadanthus</i> , <i>Leptocarpus</i> , and <i>Empodisma</i> . Tussock rushes are excluded. |
| 11. Reedland | Vegetation in which the cover of reeds in the canopy is 20–100% and in which the reed cover exceeds that of any other growth form or open water. Reeds are herbaceous plants growing in standing or slowly running water that have tall, slender, erect, unbranched leaves or culms that are either hollow or have a very spongy pith. Examples include <i>Typha</i> , <i>Bolboschoenus</i> , <i>Scirpus lacustris</i> , <i>Eleocharis sphacelata</i> and <i>Baumea articulata</i> . |
| 12. Cushionfield | Vegetation in which the cover of cushion plants in the canopy is 20–100% and in which the cushion-plant cover exceeds that of any other growth form or bare ground. Cushion plants include herbaceous, semi-woody and woody plants with short densely packed branches and closely spaced leaves that together form dense hemispherical cushions. The growth form occurs in all species of <i>Donatia</i> , <i>Gaimardia</i> , <i>Hectorella</i> , <i>Oreobolus</i> and <i>Phyllachne</i> as well as in some species of <i>Aciphylla</i> , <i>Celmisia</i> , <i>Centrolepis</i> , <i>Chionohebe</i> , <i>Colobanthus</i> , <i>Dracophyllum</i> , <i>Drapetes</i> , <i>Haastia</i> , <i>Leucogenes</i> , <i>Luzula</i> , <i>Myosotis</i> , <i>Poa</i> , <i>Raoulia</i> and <i>Scleranthus</i> . |
| 13. Herbfield | Vegetation in which the cover of herbs in the canopy is 20–100% and in which the herb cover exceeds that of any other growth form or bare ground. Herbs include all herbaceous and low-growing semi-woody plants that are not separated as ferns, tussocks, grasses, sedges, rushes, reeds, cushion plants, mosses or lichens. |
| 14. Mossfield | Vegetation in which the cover of mosses in the canopy is 20–100% and in which the moss cover exceeds that of any other growth form or bare ground. |

Appendix 10 continued

| 15. Lichenfield | Vegetation in which the cover of lichens in the canopy is 20–100% and in which the lichen cover exceeds that of any other growth form or bare ground. |
|----------------------------|---|
| 16. Rockland | Land in which the area of residual bare rock exceeds the area covered by any one class of plant growth-form. Cliff vegetation often includes rocklands. They are named from the leading plant species when plant cover is >1%, e.g. [koromiko] rockland. |
| 17. Boulderfield | Land in which the area of unconsolidated bare boulders (>200 mm diam.) exceeds the area covered by any one class of plant growth-form. Boulderfields are named from the leading plant species when plant cover >1%. |
| 18. Stonefield/gravelfield | Land in which the area of unconsolidated bare stones (20–200 mm diam.) and/or gravel (2–20 mm diam.) exceeds the area covered by any one class of plant growth-form. The appropriate name is given depending on whether stones or gravel form the greater area of ground surface. Stonefields and gravelfields are named from the leading plant species when plant cover is >1% |
| 19. Sandfield | Land in which the area of bare sand (0.02–2 mm diam.) exceeds the area covered by any one class of plant growth-form. Dune vegetation often includes sandfields which are named from the leading plant species when plant cover is >1%. |
| 20. Loamfield/peatfield | Land in which the area of loam and/or peat exceeds the area covered by any one class of plant growth-form. The appropriate name is given depending on whether loam or peat forms the greater area of ground surface. Loamfields and peatfields are named from the leading plant species when plant cover is >1%. |

^{*} Diameter at breast height, or DBH, is a standard method of expressing the diameter of the trunk or bole of a standing tree.

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