

# Kaiwharawhara Stream & Estuary

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## ECOLOGICAL VALUES

Submitted to  
**Trelissick Park Group**

**Front cover:**

Aerial view of Kaiwharawhara reclamation and stream mouth. The channelized and modified nature of this section of Kaiwharawhara Stream can be seen passing under the motorway and rail line before running adjacent to the industrial buildings along Kaiwharawhara Road.

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TRELISSICK PARK GROUP  
KAIWHARAWHARA STREAM & ESTUARY ECOLOGICAL VALUES

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## EXECUTIVE SUMMARY

- This document presents a summary of the ecological values within the catchment, including the estuary, based on existing reports and field investigations. Key issues are then identified, from which principles and recommendations for future management and enhancement of this site are presented.
- The Kaiwharawhara Stream, estuary and surrounding reclamation is a significant site for Wellington city. The area is seen as a desirable recreational destination and link within the Sanctuary to Sea Walkway and the proposed Great Harbour Way – Te Aranui o Poneke project. Furthermore, Kaiwharawhara is the largest stream system in Wellington City and one of the few remaining tributaries with a relatively natural estuary mouth into the harbour
- The terrestrial flora and fauna within the catchment are considered to be of high ecological value, in a large part due to the successful efforts of numerous community groups to restore and enhance these components.
- A general trend of decreasing water quality is observed as the Kaiwharawhara Stream approaches the Estuary, particularly in the industrial area in the lower catchment.
- The Kaiwharawhara Stream is contained within a concrete channel as it enters the estuary, at which point it is bound on both sides by reclaimed land. The estuary itself is dominated by gravel and is not considered to be particularly estuarine in character. This is in part a consequence of the estuary no longer being in its original as a result of numerous reclamations.
- The lower Kaiwharawhara Stream reach within the industrial area and the estuary, is currently of very low ecological value, especially when compared to the catchment upstream of the industrial zone. This area of stream has been impacted on significantly through high levels of contamination and modification (e.g. channelization, reduced riparian vegetation, invasive weed species, sedimentation). To date, restoration and conservation efforts have been limited and largely involved sporadic riparian and amenity planting, with little or no ongoing maintenance.
- The importance of Kaiwharawhara Stream as one of the few remaining tributaries with a natural estuary mouth into the Wellington Harbour should not be underestimated. Thus, while considerable time and money would need to be invested in order to make any meaningful improvement to the ecological value of the site, this represents one of the last few opportunities in the District to do so.

## 1.0 INTRODUCTION

The Kaiwharawhara Stream, estuary and surrounding reclamation is a significant site for Wellington city. The area is seen as a desirable recreational destination and link within the Sanctuary to Sea Walkway and the proposed Great Harbour Way – Te Aranui o Poneke project. Furthermore, Kaiwharawhara is the largest stream system in Wellington City and one of the few remaining tributaries with a natural estuary mouth into the harbour. Not surprisingly, significant successful restoration efforts have been undertaken by Council and community groups within the catchment.

The site is recognised in a number of key strategic documents, including:

- GWRC Biodiversity Strategy
- WCC Biodiversity Strategy & Action Plan
- Project Kaiwharawhara (includes Kaiwharawhara Stream Care Project)
- WCC's Sanctuary to Sea Walkway Concept
- Great Harbour Way Issues & Opportunities Report
- WCC's City Gateway Project
- WCC's 2040: The Future of our Central City
- WCC Open Space Strategy

Project Kaiwharawhara is a joint initiative of Greater Wellington, the Wellington City Council, and a number of local community groups and businesses. The Project Kaiwharawhara area encompasses the stream from Karori Wildlife Sanctuary, the Korimako Stream and tributaries downstream to the Wellington Harbour. The project vision is to protect and enhance the natural landscape, ecosystems, homes and recreation areas, with the stream being a local focus. Considerable work has been done in the upper catchment down to Trelissick Park, with only small scale planting and rubbish collection around the mouth of the estuary.

The Port Nicholson Settlement Trust recognises the value Kaiwharawhara Stream, including the estuary and has keen interest in its future and the way in which it is managed<sup>1</sup>. Kaiwharawhara Stream from the top of Ngaio Gorge to where it discharges into Wellington Harbour is one of the areas specifically referred to in the Deed of Settlement between Taranaki Whānui ki Te Upoko o Te Ika and the Crown and is subsequently referred to in the Port Nicholson Block Claims Settlement Act 2009 as an area of Statutory Acknowledgement with participation rights for the Port Nicholson Trust (refer to Map in Appendix 1).

This document presents a summary of the ecological values within the catchment, including the estuary, based on existing reports and field investigations. Key issues are then identified, from which principles and recommendations for future management and enhancement of this site are presented.

## 2.0 SITE CONTEXT

The Kaiwharawhara catchment is located in the western suburbs of Wellington (see Map 1). Though mainly an urban catchment, the headwaters begin in the Karori Wildlife Sanctuary and flow through native bush reserves (including Otari-Wilton Bush and Trelissick Park) and then through industrial and

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<sup>1</sup> Pers com Liz Mellish, Port Nicholson Settlement Trust.

commercial areas in the lowermost reaches before entering the Wellington Harbour at the estuary mouth near the reclamation.

The catchment is approximately 19 km<sup>2</sup> and is described by Blaschke *et al.* (2004) as comprising three lobes. The northern lobe is the largest, being 10 km<sup>2</sup> and surrounds Korimako Stream and incorporates part of the Outer Green Belt from Mt Kaukau south. The southern lobe is 7 km<sup>2</sup> and surrounds the upper Kaiwharawhara Stream and incorporates Karori Sanctuary and Otari-Wilton's Bush, the Inner Town Belt to the east and the Outer Green Belt to the west. The third lobe is 2 km<sup>2</sup> and surrounds the lower Kaiwharawhara Stream and crosses the Wellington Fault line via Ngaio Gorge and incorporates Trelissick Park (Blaschke *et al.* 2004).

### 3.0 STUDY AREA

Though taking the whole catchment into consideration, the focus study area encompasses the estuary and stream environs affected by tidal influences; during spring tide, this would include the area of the estuary mouth up as far as Woods Waste disposal site on School Road (see Map 2).

### 4.0 LAND OWNERSHIP & RECLAMATION

As a result of Wellington's topography and associated shortage of flat land, a number of reclamations have occurred over the history of settlement in the area. In 1855, 117 acres of land below the high-water mark were vested in the superintendent of Wellington province; the land granted ran from the 1852 reclamation at Willis Street along the length of Lambton and Thorndon Quays to Kaiwharawhara (Waitangi Tribunal 2003). Reclamations in the area of Kaiwharawhara continued through the 19<sup>th</sup> and 20<sup>th</sup> centuries, resulting not only in a highly modified stream mouth, but also the complete replacement of some of the estuarine components with the reclaimed land.

As a consequence, it is unlikely that the current location of the estuary is in the same position as it was at the time of European settlement and when Kaiwharawhara Pa was present<sup>1</sup>. It has been noted by others (Stevens *et al.* 2004; Todd *et al.* 2010), that the estuary is poorly defined and not particularly estuarine in character with no formation of a lagoon in the lower reaches.

Ownership of the land associated with the Kaiwharawhara reclamation (adjacent to the stream mouth) is complex and fragmented. This has been exacerbated by land transfer which has not been officially gazetted, formally documented, legal technicalities around the transfer of the reclaimed land, and errors in the transfer of titles. Centreport has title to a large portion of the reclamation but the Department of Conservation (DOC), Transport Agency (NZTA), and the Crown also appear to own land within the site area.

The mid-reach of the estuary, between the railway culvert and Hutt Rd, is listed as the Kaiwharawhara Stream Conservation Area (R27014; DOC 1996); upstream of Hutt Rd the stream bed is the responsibility of Wellington City Council.

The stream mouth is historically significant as a site of the Kaiwharawhara Pa and adjacent kainga (Adkin 1959) and along with a number of other sites around Wellington Harbour, has been part of a Ngāti Tama claim under the Treaty of Waitangi (Waitangi Tribunal 2003).



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## 5.0 STUDY OBJECTIVES

This report seeks to:

- Co-ordinate existing information and fill any critical information gaps.
- Identify key ecological values, issues and opportunities.
- Produce a set of guiding principles for the future enhancement of the study area.

## 6.0 METHODS

Both the vegetation and streams are integral components of the ecological corridor that exists from the Karori Wildlife Sanctuary down to the mouth of the Kaiwharawhara (from the sanctuary to the sea), enabling the movement of terrestrial and aquatic fauna respectively. Consequently, the following sections provide a summary of the existing terrestrial, freshwater and estuarine ecological values occurring within the catchment, as well as a summary of supporting field investigations.

Desktop investigations included a review of GWRC SOE monitoring and a range of published and unpublished reports (see Section 12.0 for a list of cited references). Also, GIS data sets included LCDBII and REC stream classifications.

The field investigations were undertaken in February 2011 and focused on two general areas (see Map 3): one being within the study area downstream of the Mobil fuel tanks through the industrial area (LOWER-03; see Plate 1 & 2), and the other being slightly upstream of the fuel tanks within Trelissick Park (UPPER-01; see Plates 1 & 3). The following sampling was undertaken at each of the sites:

- 1) In total, a 100m reach of stream was fished using an electric fishing machine to determine what species were present. This involved double passes over ten 10m reaches, which included varying series of pools, runs and riffles.
- 2) Macroinvertebrate samples were collected following the methodology outlined by Stark *et al.* (2001). Three samples were collected per site using Protocol C1 (hard-bottomed, semi-quantitative) and sent to Ryder Consultants for identification.

Water quality parameters were sampled at the upstream site (UPPER-01), and at three sites in the lower Kaiwharawhara Stream (LOWER-01, LOWER-02, LOWER-03) (see Map 3). The parameters analysed included total suspended solids (mg/L), temperature (°C), pH, dissolved oxygen (ppm) and turbidity (NTU). Three readings for each parameter were taken and the mean calculated for the site.

In addition to water quality, a composite sediment sample was collected from the mouth of the Kaiwharawhara Stream (see Map 3) and sent to Hills Laboratory for analysis of heavy metals and PAHs.



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**Plate 1:** Freshwater survey sites: (a) LOWER-03, (b) UPPER-01.



**Plate 2:** Stream morphology and substrate at LOWER-03



**Plate 3:** Stream morphology and substrate at UPPER-01.

## 7.0 KAIWHARAWHARA ECOLOGY

The following sections describe the terrestrial (flora and fauna), aquatic and estuarine values within the Kaiwharawhara Stream Catchment.

### 7.1 Terrestrial Values

#### 7.1.1 Vegetation

The different vegetation types within the catchment and the surrounding area are shown in Map 4 (derived from the Land Cover Data Base (LCDBII)). The catchment contains some significant primary lowland forest remnants, large areas of advanced secondary growth, and reversion of pasture to scrub in the surrounding hills (Kingett Mitchell 2005). According to Blaschke *et al.* (2004), nearly 20% of the catchment is covered in dominantly indigenous vegetation. Furthermore, some 600 ha of vegetation is 'natural' or in the process of recovering from previous disturbance following Maori and European arrivals. The seed source for regenerating vegetation has been via both seed banks in the soil as well dispersed by birds. Broadleaf and ferns are the predominant regenerating species, however emergent canopy species are often absent from the assemblage.

Established residential gardens in the catchment also provide an important source of habitat and feeding resources for avifauna.

#### 7.1.2 Riparian Vegetation

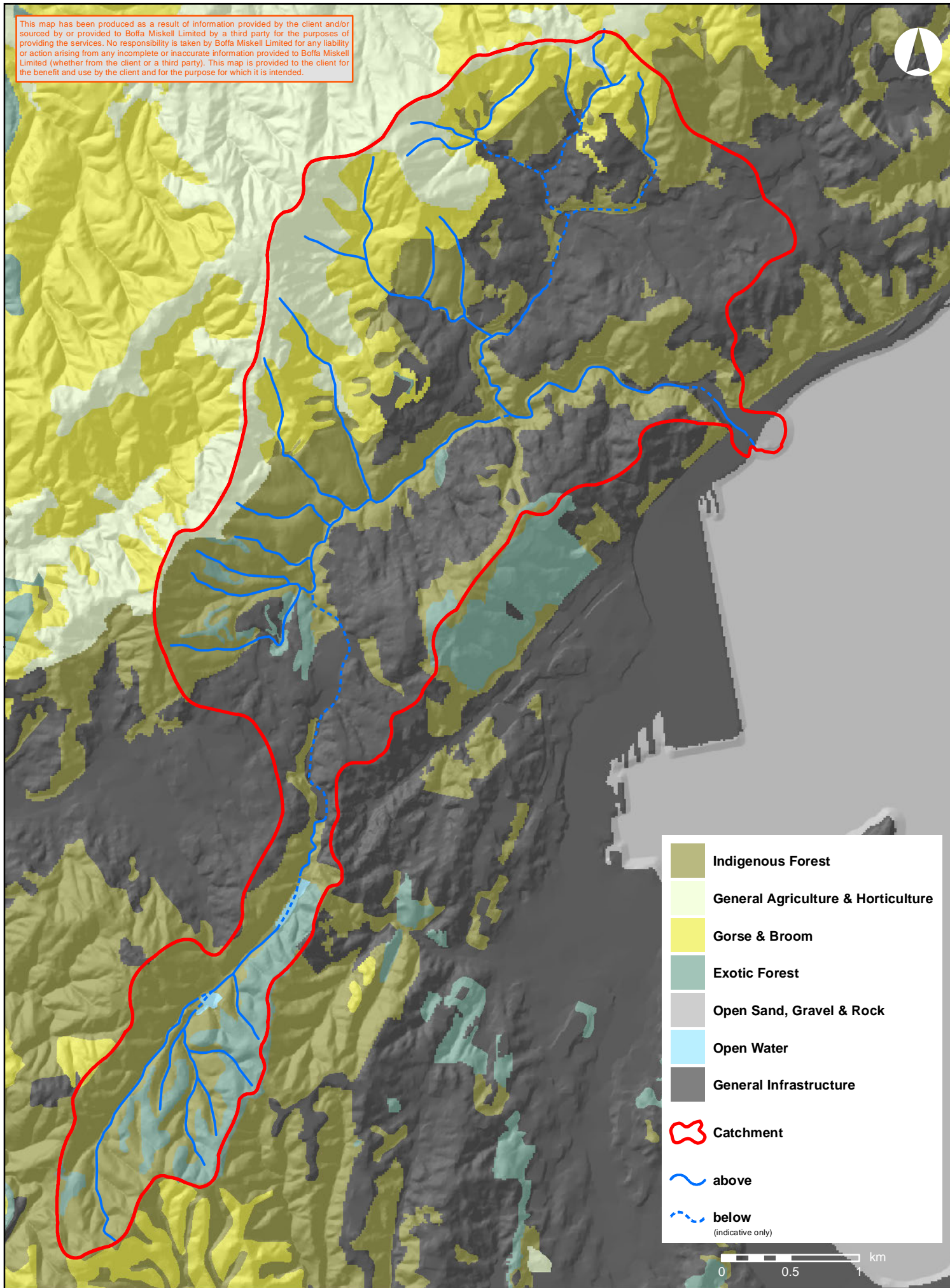
The extent of the riparian margins and species present varies significantly throughout the catchment. The upper portion of the catchment is dominated by indigenous vegetation comprising of *Brachyglottis repanda* (rangiora), *Hebe parviflora* var. *arborea* (koromiko-taranga), *Aristotelia serrata* (wineberry/makomako), *Melicytus ramiflorus* (whiteywood/mahoe), with a *Corynocarpus laevigatus* (karaka) canopy of between 15–20m. There are areas of weed infestations on the stream banks typically dominated by *Pteridium esculentum* (bracken), *Tradescantia fluminensis*, *Paraserianthes lophantha* (brush wattle), *Cytisus scoparius* (broom) and *Foeniculum vulgare* (fennel).

#### 7.1.3 Fauna

The relatively large and extended areas of native vegetation throughout the catchment provide habitat and feeding resources for a rich diversity of terrestrial species. Species diversity has also increased due to the efforts of the Karori Wildlife Sanctuary (a fenced area of largely native habitat in to which a number of native species have been translocated) and ongoing predator control in Otari Wilton Bush, Trelissick Park and Khandallah Park. The Sanctuary alone contains dozens of reptile species and over 30 native bird species. As populations of avifauna species (both translocated and naturally occurring) increase within the Sanctuary, individuals are dispersing outside of the fenced area, with species such as kaka and kakariki now being regularly observed elsewhere in the catchment.



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0 0.5 1 km

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## 7.2 Freshwater Aquatic Values

### 7.2.1 Stream Morphology

Kingett Mitchell (2002) described the upper stream reaches of the Kaiwharawhara Stream as flowing through riffle/run channel morphology, with regenerating native bush for approximately 2 km before changing to semi-urban landuse. The middle reaches continue to flow through riffle/run channel morphology before flowing into Ngaio Gorge. The lower reaches flow through braided run/riffle channel morphology within Ngaio Gorge and run/pool below the gorge. In terms of substrate, the upper reaches are dominated by large cobbles and gravels, with small cobbles, gravels and fine sediment becoming increasingly abundant downstream (Kingett Mitchell 2002). The combination of a steep catchment and urban stormwater systems in the lower catchment, transports water rapidly down the catchment resulting in frequent high flows which erode the stream channel, leaving it deeply incised in places (Blaschke *et al.* 2004). The main channel has been modified in a number of places by the construction of headwater reservoirs and dams, and by diversions through a number of pipes and tunnels.

Two major sections of the Kaiwharawhara Stream are piped, both occurring under disused landfills. The first is a 440 m section that spans from the northern end of the reservoir, under Appleton Park to Curtis Street. The second piped section is 846 m running under Ian Galloway Park. Though not completely piped, the stream runs in a concrete lined channel for much of the final 2 km before entering the Wellington Harbour (Blaschke *et al.* 2004) (see Plate 4).



**Plate 4:** Channelisation of lower Kaiwharawhara Stream

### 7.2.2 Water & Sediment Quality

Water quality has been an ongoing issue in the Kaiwharawhara Stream, historically receiving septic tank effluent, tip leachate, and industrial wastes including paints, zinc and electroplating wastes (Stoffers *et al.* 1986). Sources of these contaminants within the catchment include a number of disused landfills (e.g. Appleton Park, Ian Galloway Park, Anderson Park, Otari Native Plant Museum and Creswick Terrace Park), stormwater contaminants from roads and the railway line (Pb, Cu, Zn) which runs alongside the main northern tributary (Kingett Mitchell 2002, 2005). The sewage system largely follows the stream network (Kingett Mitchell 2002). The major pipeline was replaced in 1994, resulting in a number of abandoned pipes throughout the system (Kingett Mitchell 2002).



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GWRC undertakes annual monitoring of freshwater quality within the Wellington Region. Parameters measured for the water quality index (WQI) include dissolved oxygen (DO, % saturation), visual clarity (m), nitrite-nitrate nitrogen (NNN, mg/L), ammoniacal nitrogen (mg/L), dissolved reactive phosphorus (DRP, mg/L) and *E. coli* (cfu/100 mL). In terms of the Kaiwharawhara Stream, the lowest monitoring point is at School Rd (Todd *et al.* 2010).

The GWRC 2009/10 annual monitoring recorded a WQI rating of “Fair” for the Kaiwharawhara Stream, ranking it 40<sup>th</sup> out of the 55 streams monitored; the stream did not meet guideline compliance (median values) for *E. coli*, NNN and DRP (Pierre & Cockeram 2010).

Kingett Mitchell (2005) recorded elevated levels of dissolved reactive phosphorus and high concentrations of cadmium in the water column of the Kaiwharawhara Stream. Levels of zinc and copper rarely exceeded water quality guidelines, and total manganese concentrations did not exceed the recommended guidelines for moderately disturbed ecosystems (ANZECC 2000). Reports of high concentrations of iron are in part due to landfill leachate (Kingett Mitchell 2005). However, in the GWRC 2009/10 annual monitoring, there were no exceedances in the heavy metals tested for (dissolved arsenic, cadmium, chromium, copper, lead, nickel and zinc) (Pierre & Cockeram 2010).

Kaiwharawhara Stream at Ngaio Gorge was among the four sites which exceeded the MfE (2000) guidelines for filamentous periphyton streambed cover during the GWRC 2009/10 annual freshwater monitoring (Pierre & Cockeram 2010). These exceedances were attributed the predominant land use in the catchments (pastoral or urban) and the occurrence of prolonged periods without sufficient flows to remove the algal growth (Pierre & Cockeram 2010).

Both Kingett Mitchell (2005) and Todd *et al.* (2010) report that the water quality of the Kaiwharawhara Stream drops off significantly after the stream passes through the industrial/ commercial area at the bottom of Ngaio Gorge (Todd *et al.* 2010). This trend was again observed in the water quality results obtained in 2011 (Table 1).

While only providing a snapshot in time (February 2011), our sampling confirmed the water quality issues with elevated TSS levels and lower dissolved oxygen levels.

**Table 1:** Water Quality Results – February 2011.

PARAMETER	TRIGGER VALUES <sup>2</sup> (ANZECC 2000)	UPPER-01	LOWER-01	LOWER-02	LOWER-03
Total suspended solids (mg/L)	< 4	10.7	5	6.7	1.7
pH	7.2 and 7.8	7.5	7.4	7.9	8.2
Dissolved Oxygen (ppm)	> 5 mg/L	3.7	10.2	11.4	11.2
Turbidity (NTU)	< 5.58	1.5	1.2	3.5	1.1
Temperature (° C)	21.5 (February)	14.9	17.5	18.6	17.3

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<sup>2</sup> For New Zealand lowland rivers.

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### 7.2.3 Aquatic Macro-invertebrates

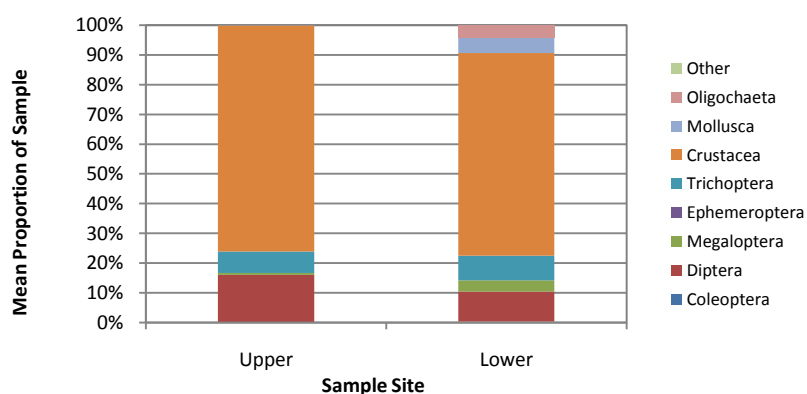
Kingett Mitchell (2002) sampled aquatic macro-invertebrates at six sites in Kaiwharawhara Stream and two sites in Korimako Stream. The number of pollution sensitive EPT taxa was highest at the headwater sites (94.07% in Koromiko and 78.71% in Kaiwharawhara) and lowest immediately below the Karori dams (0.001%) and the disused landfill (0.01%). A low %EPT taxa was also recorded from the downstream commercial site (5.06%). The same general trend was observed for QMCI, indicating that water quality was highest in the headwaters (6.6 and 7.7 in Kaiwharawhara and Korimako respectively), and lowest below the disused landfill (3.3), within the commercial area (3.3) and in a tributary stream running alongside the railway line (3.1).

The 2009/10 GWRC annual monitoring of Kaiwharawhara Stream at Ngaio Gorge recorded a QMCI of 3.26 and a 32.6% EPT taxa. Thus, while the QMCI for this area was similar to that recorded by Kingett Mitchell (2002), the %EPT taxa was considerably higher.

The results of the February 2011 macro-invertebrate sample at the upper (UPPER-01) and lower (LOWER-03) Kaiwharawhara stream sites are shown Table 2. Most measures were slightly higher at the upper site, except for the %EPT abundance and taxonomic richness. The high proportion of crustacea at both sites is due to the abundance of the freshwater shrimp (*Paracalliope*), indicative of the tidal influence at these sites.

**Table 2:** Freshwater Macro-invertebrate Results - February 2011

PARAMETER	UPPER	LOWER
Total abundance	508	442
Taxonomic richness	10	14
EPT	3	3
%EPT abundance	7	8
MCI	88	80
QMCI	4.7	4.4



**Figure 1:** Macro-invertebrate community composition.



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#### 7.2.4 Fish

The NIWA Freshwater Fish Database (FFDB) holds a total of 23 records from the Kaiwharawhara Stream Catchment, with sampling occurring sporadically between 1964 to 2009. These records comprised a total of 15 identified fish species, two unidentified species, and koura (freshwater crayfish). Of the known fish species (excluding koura), 11 are native and four are introduced (Table 3). Seven of the 11 native species are classified as *At Risk*, while the remaining four species are *Not Threatened* (Allibone *et al.* 2010).

Most recently, Kingett Mitchell (2002) who sampled six locations in the Kaiwharawhara Stream and two locations in the Korimako Stream, recorded banded kokopu, inanga, redfin bully, shortfin eel, longfin eel, brown trout, *Galaxias* sp. and koaro. Inanga were the most abundant species at the lowermost site, while eels and brown trout were numerically most abundant in all other sites sampled. In fact, inanga and redfin bully were only recorded at the lowermost site.

Fishing in February 2011 at two sites in the lower section of the Kaiwharawhara Stream, recorded two elver, two unidentified eel, seven longfin eel (size range 30-80 cm) and two trout (15 and 25 cm) at the upper site (UPPER-01). Fishing at the lower site (LOWER-03) recorded five elver, five unidentified eel, three longfin eel (size range 30-60 cm) and one common bully (7 cm). Interestingly, a large culverted section and a debris trap occur in the length of stream between the two sample sites. Both of these structures may act to some degree as a barrier to fish passage (see Plate 5).

**Table 3:** Identified fish species within the Kaiwharawhara Catchment.

	SPECIES		THREAT CLASSIFICATION <sup>3</sup>	YEARS RECORDED
NATIVE	<i>Anguilla australis</i>	Shortfin eel	Not Threatened	1979, 1982, 2004,
	<i>Anguilla dieffenbachii</i>	Longfin eel	At Risk - Declining	1979, 1982, 1984, 2002, 2004, 2009, 2011 (BML)
	<i>Galaxias argenteus</i>	Giant kokopu	At Risk - Declining <sup>PD</sup>	1982, 2002
	<i>Galaxias brevipinnis</i>	Koaro	At Risk - Declining	1964, 1979, 2004
	<i>Galaxias fasciatus</i>	Banded kokopu	Not Threatened	1963, 1964, 1979, 2002, 2004
	<i>Galaxias maculatus</i>	Inanga	At Risk - Declining <sup>CD, DP</sup>	1984
	<i>Galaxias postvectis</i>	Shortjaw kokopu	At Risk - Declining <sup>DP</sup>	2004
	<i>Gobiomorphus cotidianus</i>	Common bully	Not Threatened	1984, 2011 (BML)
	<i>Gobiomorphus gobioides</i>	Giant bully	Not Threatened <sup>DP</sup>	2002
	<i>Gobiomorphus hubbsi</i>	Bluegill bully	At Risk - Declining <sup>DP</sup>	2004, 2006
	<i>Gobiomorphus huttoni</i>	Redfin bully	At Risk - Declining	1982, 1984, 1985, 2002, 2004, 2006
INTRODUCED	<i>Carassius auratus</i>	Goldfish	Introduced	1984, 2002
	<i>Cyprinus carpio</i>	Koi carp	Introduced	1984
	<i>Perca fluviatilis</i>	Perch	Introduced	2009
	<i>Salmo trutta</i>	Brown trout	Introduced	1963, 1979, 1982, 1984, 1985, 2002, 2004, 2009, 2011 (BML)

<sup>3</sup> Allibone *et al.* (2010) with qualifiers: CD=Conservation Dependent; DP=Data Poor; PD=Partial Decline.



**Plate 5:** Culvert entrance behind K Road and debris trap between UPPER-01 and LOWER-03 sites.

### 7.3 Kaiwharawhara Stream Mouth & Estuary

#### 7.3.1 Terrestrial Component

The Kaiwharawhara Stream mouth is bound on one side by reclaimed land for the Interislander ferry marshalling area, and on the other by the Kaiwharawhara Reclamation. The approximate 5 ha of reclaimed land consist of a deposition of man-made rubble which is bordered by a 2-4m high bank of unconsolidated fill on the seaward side (see Plate 6). The inland component of the reclamation area serves as a storage area for railway and port equipment (Stevens *et al.* 2004). The little vegetation that is present at the stream mouth is dominated by introduced weeds and potential pest species, particularly *Cortaderia selloana* (pampas grass), *Paraserianthes lophantha* (brush wattle), and *Lupinus arboreus* (tree lupin). Of the 4.81 ha area mapped by Stevens *et al.* (2004), 4.26 ha comprised largely exotic species, and the remaining 0.55 ha was unvegetated (0.03 ha cobble field and 0.52 ha gravel field). In addition, to plant pests, there is considerable rabbit sign on the reclamation.

Consequently, the reclamation area has previously, and continues in its current state, to be of very low ecological value (Truebridge *et al.* 1978, Stevens *et al.* 2004).

The Trelissick Park Group have expressed the desire to see the restoration of the Kaiwharawhara Stream margins continued, and the reclamation area to ultimately form the terminus of the Wellington City Council's planned 'Sanctuary to Sea' walkway. In addition, a circum-harbour cycle and pedestrian route has also been promoted by the Great Harbour Way Coalition and the Wellington City Council, which could possibly pass through the reclamation. The two routes would likely meet at the estuary. However, this would require some lateral thinking regarding access, as the transport corridor would need to be crossed at some point (Todd *et al.* 2010)





**Plate 6:** Kaiwharawhara Stream mouth, estuary and reclamation.

### 7.3.2 Estuarine Component

Stevens *et al.* (2004) describe the Kaiwharawhara estuary as being dominated by gravel and “*not particularly estuarine in character, having confined beds and little intertidal area*”. Likewise, Todd *et al.* (2010) describe it as a “*small waterway with poorly defined and restricted mouth, but with no formation of a lagoon in the lower reaches*”.

The Kaiwharawhara stream-mouth has been hugely modified by the development of road and rail into central Wellington (see Plate 7). Apart from a short stretch of gravel at the stream mouth, most of the lower estuary has been constrained by concrete culverts and is devoid of vegetation. In the upper part of the estuary above the railway culvert, the banks are lined with concrete walls, however some planting has occurred (Todd *et al.* 2010).

Below the railway culverts, the estuary offers little habitat for birdlife or fish; the regular inundation of the gravel banks by the tide deem them of little use to nesting shorebirds, and the modified margins and gravel beds of the estuary offer no suitable habitat for inanga spawning (Todd *et al.* 2010). In fact, in terms of subjective rankings of actual and potential value of inanga spawning habitats in 21 catchments in the greater Wellington area, Taylor & Kelly (2001) ranked Kaiwharawhara as the lowest.

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**Plate 7:** Low value habitat at stream mouth

The combination of roading, railway and shipping activities have resulted in the area having a long-term pollution problem. Previous studies have reported elevated levels of heavy metal contaminants in sediments and shellfish in the Kaiwharawhara area (Stoffers et al. 1986, Wear & Haddon 1992). The results of the 2011 sediment sampling recorded exceedences of lead and zinc at the Kaiwharawhara Stream mouth (Table 4).

**Table 4:** Sediment Quality Results - February 2011.

CONTAMINANT	ISQG-LOW TRIGGER VALUE <sup>4</sup>	KAIWHARAWHARA STREAM MOUTH
Arsenic	20	3.8
Cadmium	1.5	0.139
Chromium	80	15.7
Copper	65	25
Lead	50	<b>57</b>
Mercury	0.15	0.062
Nickel	21	10.6
Zinc	200	<b>250</b>

Based on biodiversity, conservation and cultural values, restoration potential and physical risk, Todd *et al.* (2010) identified the Kaiwharawhara Stream estuary as being of Low value. Furthermore, in terms of priority ranking, the estuary was listed as 50<sup>th</sup> out of the 52 estuaries included in their study for the Wellington Hawke's Bay Conservancy (excluding Hawke's Bay and Chatham Islands Areas).

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<sup>4</sup> Interim Sediment Quality Guidelines (ANZECC 2000)



## 8.0 KAIWHARAWHARA STREAM CATCHMENT ISSUES

From the descriptions above, the key ecological issues for the Kaiwharawhara study area and wider catchment can be summarised as:

- Water quality and pollutants derived from stormwater;
- Erosion and sedimentation derived from stormwater and catchment erosion;
- Flooding;
- Loss of original vegetation cover, including riparian vegetation;
- Weed species;
- Fish passage;
- Accumulation of rubbish.

## 9.0 CURRENT CONSERVATION MANAGEMENT

Neither KiwiRail, who runs the Interislander facility on the south side of the stream mouth and is the primary user of the railway network, nor CentrePort, who owns the land on either side, actively manage the site (Todd *et al.* 2010). The reclamation site in particular is currently severely degraded, acting as a large source for invasive plant species that would devalue any restoration efforts in the estuary and stream without extensive management. Project Kaiwharawhara activities have included the restoration planting around the estuary, and the erection of a public information board, however the maintenance of the site since has been sporadic, in part due to access issues. The Trelissick Park Group are able to occasionally organise clean-up sessions to remove litter from the area (Todd *et al.* 2010).

In the upper part of the estuary, a riparian strip has been restored by local business, providing some overhanging vegetation. Plantings include native plants such as *Metrosideros excelsa* (pohutukawa), *Coprosma repens* (taupata), and *Hebe stricta* var. *atkinsonii* (koromiko). Once again in this case, the planted areas have not been managed or maintained, and consequently adventive species such as *Ulex europaeus* (gorse), *Brassica napus* (rape), *Foeniculum vulgare* (fennel) and a suite of grasses are growing in abundance. Further up the estuary, where the stream runs through a commercial area, the native planting has been better managed, and trees and shrubs (including *Plagianthus regius* (lowland ribbonwood), taupata, *Phormium tenax* (flax), koromiko, and *Cortaderia toetoe* (toetoe)) overhang the water, but here too adventive grasses are well represented (Stevens *et al.* 2004).

## 10.0 FUTURE MANAGEMENT

The lower reach of the Kaiwharawhara Stream and estuary are impacted by activities occurring both upstream in the wider catchment (e.g. land use, contaminants from stormwater runoff and disused landfill leachates, stream piping), as well as activities occurring in the immediate vicinity (e.g. industrial wastes, water pollution, stream channelization), resulting in it being highly modified and degraded. All of these factors contributed to the site being of low ecological value.

Priority actions that could be undertaken within the lower reach of the stream (downstream of the fuel tanks) and the areas of land either side of the stream mouth to improve the ecological value of the area are outlined below. The considerable efforts and investment that are required to make any meaningful improvement are acknowledged. Furthermore, this will require an on-going and long-term commitment by a number of stakeholder parties. Because of the high level and permanent nature of the modification

to the stream within the study area, management efforts will need to encompass both the reclamation and the area to the south of the stream mouth.

To rehabilitate Kaiwharawhara estuary to improve some of its ecological values and recognise its value as the largest stream system in Wellington City and one of the few remaining tributaries with a natural estuary, it would need a range of activities that would go well beyond riparian planting and minor associated works. It would require major commitment from many agencies and substantial long term funding. Even with this commitment, the degree of permanent modification and channelization severely constrains the space available for this work.

As noted, the planting near the estuary and immediately adjoining areas has, in ecological or landscape terms, achieved very little, given the time and effort made by various volunteer groups. This is in contrast to the results achieved in forested sections of the Kaiwharawhara Stream where it flows through Trelissick Park, which has been sustained over many years; or the protection and enhancement that has been achieved for the Stream with the creation of the Karori Wildlife Sanctuary.

### **10.1 Weed and Pest Control**

Todd *et al.* (2010) recommend that any plan to restore the ecosystem in the Kaiwharawhara estuary must include a comprehensive weed control plan for the reclamation area. The abundance of invasive species occurring there is acting as a prolific seed source for the spread of weed species into previous restoration areas. Such a plan would not only include the initial removal phase of the invasive species, but the ongoing management of the site to prevent any re-invasions.

In addition, efforts should be made to control rabbits so that they do not impact on any future plantings.

### **10.2 Estuarine and Riparian Planting**

Riparian planting provides terrestrial habitat as well as improving stream systems (e.g. shade, temperature, dissolved oxygen, input of organic matter etc). Todd *et al.* (2010) suggest that the spawning habitat for inanga in the estuary could be improved by the planting of rushes and flax, particularly on the south bank of the middle section of the estuary, where the bed is not so stony. Further, Todd *et al.* (2010) suggest that the planting of riparian shrubs could be extended on both sides of the stream to provide extra vegetation cover of the stream bed, and to discourage the growth of weeds (Todd *et al.* 2010). However in its current state, the area for riparian vegetation is restricted due to the concreting of at least one stream bank. Thus, significant modification to the concrete channelling would need to be made in order to possibly undertake planting in some areas, assuming such modifications are possible.

Opportunities for planting estuarine species at the stream mouth are limited due to the mobile nature of the gravel beach, the immediate commencement of the concrete channel at the back of the current beach (see Plate 6), and the high volume of water that flows into harbour following storm events.

### **10.3 Instream Habitat**

The streambed within the study area is characterised by extensive areas of fine sedimentation and silt, which is likely to have reduced the depth of the hyporheic zone, important habitat for a number of aquatic invertebrates. This, combined with the concrete channelization of the stream, has resulted in the instream habitat being generally limited in terms of quality and diversity.



Improvements to instream habitat could be achieved through the addition of larger substrates (rocks and cobbles). However, due to such improvements needing to be made within the lower reaches of the Kaiwharawhara Stream and at the stream mouth, it is likely that they would be susceptible to the high volumes and flow levels of stormwater that may come down through the catchment during some rain events. Thus, such improvements to instream habitat are likely to need ongoing management or may not be sustainable.

#### **10.4 Disturbance to Stream-mouth and Estuarine Substrate**

Todd *et al.* (2010) note that harbour sediment pollution problem is a long-term issue that ultimately may require dredging if it is to be resolved. Dredging may release some heavy metals back into the environment when the fine sediments to which they bond are temporarily suspended into the water column. More importantly, resuspension and deposition of the fine sediments is likely to smother immobile benthic organisms (Wear & Haddon 1992). This same issue would need to be considered if any works were to be undertaken around the current bridge structure at the stream mouth entrance.

Thus, disturbance to the streambed should be kept to a minimum and restricted to works that are for the purpose of improving the ecological health of the stream.

### **11.0 SUMMARY**

The study area, which includes the lower Kaiwharawhara Stream reach within the industrial area and the estuary, is currently of very low ecological value, especially when compared to the catchment upstream of the industrial zone. This area of stream has been impacted on significantly through high levels of contamination and modification (e.g. channelization, reduced riparian vegetation, invasive weed species, sedimentation). To date, restoration and conservation efforts have been limited and largely involved sporadic riparian and amenity planting, with little or no ongoing maintenance.

If a restoration project is carried out it should focus on weed control (both along the riparian margin and on the reclamation), increasing riparian planting, improvement of instream habitat, creation of instream habitat diversity, and halting the modification of the stream bed and banks.

The importance of Kaiwharawhara Stream as one of the few remaining tributaries with a natural estuary mouth into the Wellington Harbour should not be underestimated. Immediately north of the Kaiwharawhara Stream mouth entrance, the Ngauranga Stream is piped for a considerable distance before entering directly into the harbour under the motorway and railway line (see Plate 8). By piping streams all the way to the harbour, an important component of the aquatic ecosystem is removed; that being the transition from a freshwater to marine environment (and all the flora and fauna associated with it). The Wellington Harbour is not only lacking in such habitats, but those that remain are generally degraded and severely impacted, as is shown in the case of the Kaiwharawhara estuary. Thus, while considerable time and money would need to be invested in order to make any meaningful improvement to the ecological value of the site, this represents one of the last few opportunities in the District to do so.

However, in undertaking a restoration project, the serious limitations imposed by the industrialisation of this stream mouth and lower reaches and its position as a receiving environment for an urban catchment, need to be acknowledged. This will ultimately limit the scale of restoration and the degree that a “natural system” can be recreated.

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**Plate 8:** Ngauranga Stream mouth entrance.

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**APPENDIX 1 - Areas referred to in Deed of Settlement between Taranaki Whanui ki Te Upoko o Te Ika and the Crown**



## The Crows Nest



Confluence with the  
Wellington Harbour

## Kaiwharawhara Stream

4282

## Areas referred to in the Deed of Settlement between Taranaki Whānui ki Te Upoko o Te Ika and the Crown

for and on behalf of Taranaki Whānui ki Te Upoko o Te Ika  
for and on behalf of the Crown

SO 408069