MORPHUM ENVIRONMENTAL LTD

Engineers & Consultants

Tāmaki Path

Ecological Impact Assessment

Final

Prepared for GHD by Morphum Environmental Ltd

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Executive Summary

Morphum Environmental Ltd (Morphum) was engaged by GHD Ltd (GHD) to prepare an Ecological Impact Assessment (EcIA) for the construction of the proposed Tāmaki Path. The Tāmaki Path is a proposed shared pedestrian and cycleway which traverses approximately 3.9 km from the Omaru Creek mouth in the north, to the Panmure Wharf in the south.

The scope of this EcIA includes a description of existing freshwater, coastal and terrestrial ecological values, and identifies the potential and actual ecological impacts associated with upgrading the existing path network and construction of new sections of the path, including a new 53 m span bridge across the Omaru Creek.

Environmental constraints and opportunities mapping was undertaken at the commencement of the project following initial site investigations. Environmental constraints and opportunities identified from initial site investigations were mapped against the proposed path alignment as set out in the FrameGroup feasibility reports. The Mauri Model was used as a framework to document potential impacts and opportunities of the proposed alignment on the Environmental, Cultural, Social and Economic wellbeings. A total of 219 items, 180 which constitute the baseline assessment with 29 supplementary alternative consideration were documented during the constraints mapping process. This process was essential to avoiding environmental impacts wherever possible. This design process was employed to achieve outcomes that meet the definition of Green Infrastructure, which manage risks of negative impacts and maximise enhancement of social and environmental values.

Six main ecological zones were identified and mapped along the proposed path alignment (native regenerating bush, mixed coastal, mangroves, mown, grazed and rank grass), with indigenous vegetation remnants north of Omaru Creek assessed as having the highest ecological value (moderately high).

A number of terrestrial and marine significant ecological areas are located in the vicinity of the project area and the Tāmaki Estuary is recognised as a national “hotspot” of bird diversity and for nationally vulnerable endangered bird taxa. The public reserves along the Tāmaki Estuary are known to be utilised by a number of shorebird species as a high tide roost, and Point England Reserve is a known breeding ground for the northern New Zealand dotterel (Endemic - Recovering).

The potential effects of the construction of the pathway on avifauna include disturbance or displacement of individuals, and reduced movement between feeding grounds and roosting sites. This is mitigated through the staged progression of works including ensuring works in the vicinity of Point England Reserve are timed to avoid the peak breeding season of NZ dotterels (August to December). It is also recommended that monitoring of avifauna be undertaken before, during and after the construction process to inform an adaptive management approach.

The presence of potential lizard habitat was identified in the vicinity of the project area and six species have been recorded in this location, according to DOC’s herpetofauna database. Of those species recorded, it is expected that copper skink are likely to be relatively abundant near the vicinity of the project footprint within rank grass, and ornate skink (threatened –declining) may be present in similar habitat. Given the potential habitat for moderate and high value lizard species in the project area, a lizard survey is recommended to determine lizard abundance and project-specific Wildlife Permit requirements.

Two permanent watercourses traverse the project area – the Omaru Creek mouth in the northern path section and the Riverside Reserve Stream in the south. Ecological impacts along the proposed path are greatest in the vicinity of Omaru Creek. The bridge construction footprint is likely to result in a moderate magnitude of effect involving the permanent loss of approximately 155 m^2 of vegetation on

the northern banks of the Omaru Creek (including three mature pōhutukawa trees), and 166 m^2 of mature mangroves. .

The overall level of effect on ecological values from this activity is considered to be high, and mitigation actions, and additional planting are identified to offset these impacts including:

- Avoiding vegetation clearance during peak bird breeding season
- Remediation of 283 m^2 of riparian vegetation around the bridge abutments
- Offset enhancement planting of 465 m^2

Areas for optional enhancement planting have also been recommended along the proposed Tāmaki path (although this is not part of the resource consent application for the construction of the proposed path). It is noted that this enhancement planting is not part of the resource consent application for the construction of the Tāmaki Path. It is indicative only, and illustrates Council's future aspirations for enhancement of the coastal environment.

The construction of the bridge at Omaru Creek will also result in the direct mortality of benthic fauna and permanent loss of benthic habitat within the footprint of the timber piles. This is collectively estimated at <1m^2 and is consequently considered to be of low impact to the existing values of the stream mouth or wider SEA. The proposed staged construction of cofferdams around the work area will provide a dry work site and seal off the area to reduce the risk of discharge of suspended sediments or other contaminant to the coastal marine area. However, the construction of the dams may result in the entrainment of fish and an appropriate fish management plan is recommended to rescue and relocate fish during dewatering.

The potential level of effect of discharges (sediment, spills or construction debris) into the Tāmaki Estuary, Omaru Creek and Riverside Reserve Stream during construction works for the path is considered to be high and controls are required to minimise the likelihood of this occurring. It is noted that an Environmental Management Plan (EMP) will be developed for construction works including erosion and sediment control measures consistent with TP90 of GD05 as appropriate.

Following avoidance, remediation, and mitigation of the potential ecological effects of the proposed pathway, the overall level of effect of the construction of the proposed pathway is considered to be low. Note that if the recommended mitigation measures are not implemented, the impact is considered the 'without mitigation' level. It is recommended that this impact assessment is revised following any alterations to the proposed design or construction methodology.

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1.0 Introduction

1.1 Scope

Morphum Environmental Ltd (Morphum) was engaged by GHD Ltd (GHD) to prepare an Ecological Impact Assessment (EcIA) for the construction of the proposed Tāmaki Path. The Tāmaki Path is a proposed shared pedestrian and cycleway which traverses approximately 3.9 km from the Omaru Creek mouth in the north, to the Panmure Wharf in the south (refer to proposed path alignment in Figure 2). It forms a section of Auckland Council's Greenway Paths, an initiative to increase connectivity by improving links between open space facilities. The proposed path is aligned with existing walkways through public reserves which are a combination of grass, concrete, gravel and board walks.

The scope of this EcIA includes a description of existing freshwater, coastal and terrestrial ecological values, and identifies the potential and actual ecological impacts associated with upgrading the existing path network and construction of new sections of the path, including a new bridge structure across the Omaru Creek.

Short-term ecological impacts during the construction phase as well as long-term ecological effects resulting from the presence and use of the Tāmaki path are assessed. The EcIA outlines recommended mitigation and offset requirements, where required.

Two additional technical reports have been prepared for the proposed Tāmaki Path project alongside this report:

- Arboricultural Assessment Tāmaki Path Project (Greenscene, 2017); and,
- Tāmaki Estuary Pathway Project, Auckland: Archaeological Survey and Assessment (Time Depth Enterprises, 2017)

Reference has been made to the arboricultural report throughout this document where individual trees have been identified as being impacted by the proposal.

1.2 Description of Existing Environment – Character Zones

The proposed Tāmaki Path traverses through a sequence of 'character zones' each with their own set of unique characteristics. These are illustrated in Figure 1and described in Table 1.

Three of the original eight character zones (A, C and D) have been removed from the proposal and do not form part of this resource consent application.

Impacts have been assessed separately within the northern and southern sections of the project area (refer to Figure 2) in order to inform two separate resource consent applications for the north and south sections of the Path respectively.

Three site visits were undertaken by Morphum in 2016 (June 17th and 23rd, and November 28th) to identify and assess the ecological value of features within each character zone of the proposed path.

Figure 1: Character zones along proposed path alignment

Table 1: Description of Existing Character Zones along the Proposed Tāmaki Path Route

Character Zone	Description
B. Pt England Coastal	Flat to rolling pasture along coastal/cliff edge with white sandy beaches below. Semi-rural landscape character defined by adjacent pastoral land uses. Traverses the Omaru Creek mouth into the south-eastern corner of Wai O Taiki Nature Reserve. Point England Reserve is currently utilised for sports and informal recreation. An existing path traverses the coastal perimeter of the reserve, used by pedestrians and cyclists.
E. Riverside Residential	Narrow, predominantly flat grass path along coastal edge – suburban / coastal landscape character.
F. Dunkirk / Riverside Reserve	Narrow, predominantly flat parkland along coastal edge - suburban / coastal landscape character. Traverses the Riverside Reserve Stream.
G. Mt Wellington War Memorial Reserve	Flat, open grass and sport fields – suburban / coastal landscape character.
H. Panmure Wharf and Boat Ramp	Predominately flat with character defined by a mix of open space/active sports fields, suburban and coastal edges, marina activity and views to the estuary.

Figure 2: Proposed path alignment showing the northern and southern split for reporting purposes

1.2.1 Catchment History and Land Use

The proposed Tāmaki Path runs adjacent to the western edge of the Tāmaki Estuary. Tāmaki Estuary is a tidal inlet of the Waitematā Harbour covering an area of approximately 1,600 hectares (ha) and stretching across 17 km. It has a predominately urban catchment of 11,500 ha (Kelly, 2008) comprising eight stormwater catchments. The main channel has a maximum depth of approximately 14 m but much of it is less than 5 m deep (Abrahim and Parker 2002, in Kelly 2008). Several tributaries radiate out from the main channel, including Pakuranga Creek, Panmure Basin, Otahuhu Creek and Ōtara Creek. Records show human association with the Tāmaki Estuary dates back to approximately 900 AD (Kelly, 2008). The Tāmaki catchment was occupied by Maori communities until around 1840, and European settlement started in the mid-to-late half of the 19th century. Since the 1950s many parts of the estuary have been modified, including reclamation of the foreshore within Mount Wellington Reserve, and the construction of bridges, wharves, marinas, breakwaters, a weir (Otara Creek), stormwater ponds and boat ramps.

The Tāmaki Estuary receives stormwater and occasionally wastewater discharges throughout its length, and major industrial areas that discharge to the estuary include Tāmaki, Mount Wellington and East Tāmaki (Kelly, 2008).

The proposed Tāmaki Path falls within the Tāmaki North stormwater catchment, which covers a total area of 1,197.6 ha and contains the Omaru Creek and Panmure sub-catchments. Locations of intermittent /permanent streams within the project area are illustrated in Map 1 of Appendix 1.

Land use within the Tāmaki North catchment is predominately residential, and the commercial/industrial centres of Glen Innes, Point England and Panmure are located through the centre and to the west of the catchment. The Panmure Basin and Mount Wellington are situated in the south of the catchment and numerous public open spaces are scattered throughout the catchment, including those along the eastern Tāmaki Estuary foreshore in the vicinity of the proposed Tāmaki Path – Wai O Taiki Nature Reserve, Point England Reserve, Riverside Ave Reserve, Johnson's Reserve and Mt Wellington War Memorial Reserve. An overview of the Tāmaki North Catchment is provided in Table 2.

Table 2: Tāmaki North Catchment Overview

Attribute						
Catchment Area	1,197.6 ha					
Imperviousness	43.6 %					
Land Use Type	Public Open Space	Residential	Business	Special Purpose	General	Coastal
Land use (% catchment)	15.8	48.7	13.3	0.4	16.9	4.9
Receiving Environment	Tāmaki Estuary					

A Stormwater Management Plan has been developed for the Omaru Creek sub-catchment (Harrison Grierson, 2016), to support a large-scale land development and intensification project known as the Tāmaki Regeneration Area. This will see the construction of approximately 7,500 new homes developed through the public sector and an additional 11,000 through the private sector.

1.2.2 Ecological District

The proposed Tāmaki Path lies within the Tāmaki Ecological District (ED) of the Auckland Conservancy.

A description of the Tāmaki ED is outlined in the Auckland Protection Strategy (Lindsay *et al.,* 2009). The Tāmaki ED includes the low lying hills, pumice and volcanic deposits of the North Shore, the Auckland isthmus and South Auckland, and incorporates all the catchments draining into the Waitematā Harbour. The ED extends to the foothills of the Waitakere Ranges in the west, the Hunua Ranges to the east, and Rodney to the north.

All ecosystems in this ED are severely depleted with less than 5% of the original extent reported to remain, with the exception of kauri forest (20% of the estimated original extent remaining). Coastal ecosystems (estuarine, wetlands, shrublands and forest) are identified as priority ecosystems for protection in this ED. Coastal estuarine, shrubland and forest ecosystems are present in the project area.

Threatened species recorded in this district are listed in Table 3:

Table 3: Threatened Flora and Fauna Recorded in the Tāmaki ED

Nationally Critical	Nationally Endangered	Nationally Vulnerable	Declining
Category 1: Flora			
Centipeda minima Sneezeweed	*Picris burbidgeae* Native Oxtongue	*Anogramma leptophylla* Annual fern	*Brachyglottis kirkii var. kirkii* Kirk's daisy
Epilobium hirtigerum Hairy willow herb			*Carex litorosa* Sea sedge
Fissidens berteroi Aquatic moss			*Kunzea ericoides var. linearis*
			Ptisania salicina King Fern
			Drosera pygmaea Pygmy Sundew
Category 2: Avifauna			
Anas superciliosa superciliosa Grey duck	*Larus bulleri* Black-billed gull	*Anarhynchus frontalis* Wrybill	
		Charadrius bicinctus bicinctus Banded dotterel	
		Charadrius obscurus aquilonius Northern NZ dotterel	*Eudyptula minor iredalei* Northern little blue penguin
		Chalinolobus tuberculata Long tailed bat (North Island)	
	Egretta sacra sacra Reef Heron		*Larus novaehollandiae scopulinus* Red billed gull
		Hydropogne caspia Caspian tern	
		Nestor meridionalis septentrionalis North Island kaka	*Sterna striata striata* Whitefronted tern

	Calidris canutus Lesser knot	
		Limosa lapponica Bar-tailed godwit
		Gallirallus philippensis Banded rail
Category 3: Herpetofauna		
		Cyclodina ornata Ornate skink
		Naultinus elegans elegans Auckland green gecko
Category 4: Ichthyofauna		
		Anguilla dieffenbachii Longfin eel
		Galaxias argenteus Giant kokopu
Lindsay et al., 2009, NZ Birds Online (accessed July 2017)		

1.2.3 Geology and Soils

The geological map for the region (GNS Science, 2013) shows a range of geological features along the length of the proposed Tāmaki Path. The northern section of the path is shown to be underlain by late pliocene to middle pleistocene pumiceous river deposits, described as pumiceous mud, sand and gravel with muddy peat and lignite: rhyolite pumice, including non-welded ignimbrite, tephra and alluvia.

The area immediately south of Omaru Creek, within Point England Reserve, is underlain by neogene sedimentary rocks, described as alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits.

The southern section of the proposed Tāmaki Path, beyond Point England Reserve is shown to be underlain by Auckland basaltic tuff (late pleistocene - holocene igneous rocks), described as lithic tuff, and comprising comminuted pre-volcanic materials with basaltic fragments, and unconsolidated ash and lapilli deposits (GNS Science 2013).

Soils along the length of the proposed Tāmaki Path are also variable and reflect the underlying geology. According to the Auckland Unitary Plan Operative in Part (updated July 2017) (AUP-OP), soils below the northern section of the path (from Point England Road to Wai O Taiki Bay) are classified as alluvial. Soils immediately south of the Omaru Creek mouth, within Point England Reserve, are classified as Waitematā residual soils and beyond Point England Road to the south, isthmus volcanic soils are present.

1.2.4 Topography

The topography is typically of flat grade along the length of the proposed Tāmaki Path, with the exception of the stream gully systems and coastal cliffs.

The Tāmaki North catchment is relatively flat through the centre until the channel of Omaru Creek, an entrenched floodplain (Harrison Grierson, 2016). The catchment rises in the west up to elevations of 80 m along the St Johns Road ridge, and 120 m at Mount Wellington.

1.2.5 Hydrology

Two main watercourses cross the proposed Tāmaki Path into the Tāmaki Estuary – the Omaru Creek and its tributaries through Maybury and Pt England Reserves and the Riverside Reserve Stream.

The Omaru Strormwater Master Plan (Harrison Grierson, 2016), reports that the hydrology of the Omaru Creek catchment has been significantly modified by historic urban development which has included piping of long lengths of watercourses, causing impacts on water quality, erosion and flooding. The main stem of the creek is 'natural' for a significant length, although most of the tributary streams and upper catchment are now piped, leaving the main stem and a few larger tributaries open to natural stream processes.

The Omaru Creek catchment is covered by the Stormwater Management Area - Flow 2 (SMAF 2) overlay in the AUP-OP. The objective of this overlay is the protection of high-value rivers, streams and aquatic biodiversity in identified catchments from the adverse effects of stormwater runoff associated with urban development and where possible enhance those values.

2.0 Assessment of Ecological Values

2.1 Terrestrial Ecological Values

2.1.1 Outstanding Natural Features and Landscapes

Areas with outstanding natural feature and landscape values along the proposed path are identified in the AUP-OP. Objectives and policies of the AUP-OP aim to protect the visual and physical integrity of these natural features and landscapes from inappropriate land use and development, whilst recognising and providing for their cultural significance to Mana Whenua.

Table 4 summarises the outstanding nature features that have been identified in the AUP-OP within the vicinity of the proposed path.

Table 4: Outstanding Natural Features

Feature Code	Feature Type	Location	Description
159	Point England accretionary lapilli	South-eastern extent of Point England reserve	Point England accretionary lapilli. An exposure of rhyolitic, coignimbritic deposits from the Taupo Volcanic Zone. A thin bed of accretionary lapilli (chalazoidites or 'volcanic hailstones') is visible near the base of a low eroded sea cliff in the Tāmaki River foreshore.
197	Tāhuna Tōrea cuspate foreland and shell spit	Tāhuna Tōrea	Tāhuna Tōrea is the largest, most accessible and outstanding example of a cuspate foreland formed from two sand/shell spits in the Auckland region. A low triangular shell and sand spit encloses salt marsh and ponds at the western end, with a narrow shell spit extending a further 1km out across the Tāmaki Estuary. The distal shell spit shifts in response to wind, wave and tidal action.

2.1.2 High Natural Character

The natural characteristics and qualities of areas with outstanding natural character, or high natural character values are also preserved and protected from inappropriate use and development in the AUP-OP. Tāhuna Tōrea is identified in the high natural character overlay of the AUP-OP (scheduled ID 142). High bio-physical values and perceptual values contribute to a high overall natural character evaluation of the area.

2.1.3 Significant Ecological Areas

There are two Terrestrial Significant Ecological Areas (SEAs) within the project vicinity and several marine SEAs. Terrestrial SEAs are located along the coastal cliffs at the eastern extent of Point England Reserve and at the Omaru Creek salt wedge, and marine SEAs are located along the length of the Tāmaki Estuary.

Terrestrial SEA's are identified based on their values for representativeness, threat status and rarity, diversity, stepping stones, and overall uniqueness in accordance with Schedule 3 of the AUP-OP. These factors are summarized below:

- **Representativeness** – example of an indigenous ecosystem that contributes to the 10% of the natural extent of each of Auckland's original ecosystem types in each ecological district.
- **Threat Status and Rarity** – Habitat that has been assessed using the IUCN threat classification as threatened, habitat of threatened fauna or flora, indigenous vegetation in LENZ IV <20%, indigenous vegetation within indigenous wetlands or dunes.
- **Diversity** – Extends across at least one environmental gradient, supports a typical species richness or species assemblage for its type
- **Stepping Stones Migration pathways, buffers** – facilitates movement of fauna across the landscape, buffer for protection areas, part of a network of sites that cumulatively provide habitat,
- **Uniqueness/Distinctiveness** – fauna or flora endemic to the Auckland region, unusual combinations of species, type localities, intact sequence of outstanding condition, largest specimen or population.

An area is considered to be an area of significant indigenous vegetation and/or a significant habitat of indigenous fauna in the coastal marine area (marine SEA) if it meets one or more of the factors below, as specified in Schedule 4 of the AUP-OP.

- **International or National Significance** – an area recognised internationally or nationally for marine ecosystem or biodiversity values.
- **Threat Status and Rarity** – Habitat required to provide for the life cycle of threatened or protected marine plants or animals or ecosystems identified in coastal policy statement 11b(iii).
- **Uniqueness or Distinctiveness** – endemic ecosystems or habitats of endemic fauna or flora
- **Diversity** – intact sequences of habitat extending across environmental gradients or areas of high habitat or species diversity.
- **Stepping Stones, Buffers, Migration Pathways** - facilitates movement of fauna, part of a network of sites that cumulatively provide habitat, part of migratory pathways or important roosting or feeding areas.
- **Representativeness** – Example of an indigenous marine ecosystem that's makes up at least 10% of the natural extent of each of Auckland's original marine ecosystems.

Details of the SEA's in the vicinity of the project area, including locations and factors met under Schedules 3 and 4 of the AUP-OP are presented in Table 5 and Table 6 below. Locations of SEAs, outstanding natural features and high natural character areas are illustrated in Map 2 of Appendix 1.

It is considered likely that the coastal fringes have been designated as an SEA due to indigenous vegetation that extends across the estuary to coastal bank environmental gradient sequence that supports more than one indigenous habitat, community or ecosystem, in addition to facilitating the movement of indigenous species across the landscape and contributing to the resilience and ecological integrity of surrounding area. The Wai O Taiki nature reserve and Omaru Creek reserves provide an important ecological corridor that links the Tāmaki Estuary via riparian reserves to the Ōrākei Basin.

Table 5: Terrestrial Significant Ecological Areas in the vicinity of the project area

Terrestrial SEA	Criteria met	Tāmaki Path reference	SEA description
SEA_T_3196	• Diversity • Stepping stones, migration pathways and buffers	Path does not intersect SEA. SEA located approximately 10 m to the east of the proposed path.	Located along the coastal cliffs at the eastern extent of Point England Reserve and includes the southernmost tip of Point England Reserve.
SEA_T_3140	• Stepping stones, migration pathways and buffers	SEA located approximately 460 m to the west (upstream) of the proposed path.	Omaru Creek salt wedge
SEA_T_6096	• Threat status and rarity	SEA located approximately 1 km to the west (upstream) of the proposed path.	Maybury Reserve

Table 6: Marine Significant Ecological Areas in the vicinity of the project area

Marine SEA	Tāmaki Path reference	SEA description
SEA_T_3196	Path does not intersect SEA – path alignment located to the west of the SEA.	Located along the coastal cliffs at the eastern extent of Point England Reserve and includes the southernmost tip of Point England Reserve.
SEA_T_3140	SEA located to the west of the proposed path.	Omaru Creek salt wedge
SEA-M1-47	Located along the eastern bank of the Tāmaki Estuary, below Panmure wharf.	Tāmaki River East Roost Tāmaki Estuary is a regionally important wildlife habitat. Tāmaki River East Roost is one of the roosting sites used by some of the hundreds of wading birds that feed within the Tāmaki Estuary. There are a number of other roosting sites (notably Pakuranga Creek Roost and the Tāmaki River East Roost), which are used by hundreds of wading birds which feed in the estuary. Intertidal banks (such as the Tāmaki East Bank) contain extensive beds of shellfish and are important feeding grounds for these birds.
SEA-M2-48	Located along the eastern bank of the Tāmaki Estuary, opposite Point England Reserve.	Tāmaki East Bank This intertidal bank is a feeding ground for the hundreds of wading birds that use the Tāmaki Estuary. This area also includes part of the Farm Cove ignimbrite, most of which is above MHWS.

SEA-M2-49a	Extends length of receiving environment for entire path alignment	Tāmaki Estuary West Large river estuary where considerable areas of intertidal flats have accumulated and a sand-shell spit has built up near the entrance. The spit has been modified to create a variety of freshwater and estuarine habitats. Saltmarsh and mangrove habitats fringe the estuary. The intertidal banks contain extensive beds of shellfish and are a feeding ground for these birds. The spit and associated northern and southern intertidal banks, together comprise a wildlife habitat of regional importance.
SEA-M1-49c	Located on Tāhuna Tōrea spit	This area has been modified to create a variety of freshwater and estuarine habitats. The area provides an interesting complex of marine, intertidal, freshwater and terrestrial habitats for a wide range of birds. It has added value because of its proximity to, and ready access for, a large number of people.
SEA-M2-49w1	Located to the east of Point England and Riverside Reserves (along the eastern banks of the Tāmaki Estuary).	Extensive areas of feeding habitat for waders along this coastline.

2.1.4 Vegetation Assessment

The inferred historic extent of Auckland's indigenous terrestrial ecosystems has been mapped by Auckland Council (Singers *et al.* 2017), based on the national ecosystem classification system developed by the Department of Conservation. This shows that one distinct forest ecosystem type would have naturally occurred along the length of the project site:

- WF7 – Puriri Forest. Characteristic flora is described as broadleaved forest with abundant puriri and composition corresponding to variants in landform and soil type. This forest type provides fruit and nectar for kereru and tui and habitat for the more common native bush birds.

Many of Auckland's ecosystem types are thought to have been reduced from pre-human times to less than ten per cent of their original extent. The conservation status of the above ecosystem type was evaluated using the International Union for the Conservation of Nature (IUCN) Red List of Ecosystems criteria (Singers *et al.* 2017). This method evaluates multiple symptoms of risk produced by different processes of ecosystem degradation, including factors such as changes in the distribution of an ecosystem, its physical environment and its component species, all of which indicate different aspects of the severity of the risks.

Remaining puriri forest (WF7) in Auckland has been assessed as **critically endangered** under the IUCN criteria.

The current extent of terrestrial ecosystems has also been mapped by Auckland Council (Singers *et al.*, 2017). According to this assessment, the following ecosystems are present in the vicinity of the project site:

- SA1 – mangrove forest and scrub (tidally influenced Omaru Creek and immediately north of this along coast), with a threat status of **least concern**
- PL and VS5 – Planted vegetation and regenerating broadleaved species scrub/forest (Wai O Taiki Nature Reserve). These ecosystems have been assigned a threat status of **least concern.**
- TL - Treeland (along the coast of Point England Reserve, in Pt England Reserve north of Omaru Creek and Johnson's Reserve in the south).

Land Environments of New Zealand (LENZ) is an environmental classification intended to underpin a range of conservation and resource management issues. Areas of indigenous vegetation associated with LENZ category Level IV that have less than 20% indigenous cover remaining can typically be considered to be of high ecological value as these are priority areas for protection (Ministry for the Environment & Department of Conservation 2007). The LENZ Level IV environment types detailed in Table 7 are present along the proposed path alignment.

Of these, two areas fall into Level IV categories with less than 20% indigenous cover remaining (the western portion of Point England Reserve, and south of Riverside Reserve). These categories have a threat status of chronically threatened and acutely threatened, respectively.

Table 7: LENZ environment types identified in project area

LENZ Level IV Classification	Location	Threat Criteria	Threat Category
A6.1a	Omaru Creek mouth	>30% left and <10% protected	Critically under-protected
A6.1b	Eastern coastal section of Point England Reserve	20-30% left	At Risk

A7.1a	From Riverside Reserve to the end of the proposed path, and west of this beyond the catchment boundary.	10-20% left	Chronically threatened
A7.2a	North of Riverside Reserve, covering majority of Point England Reserve and Omaru Creek.	<10% remaining	Acutely threatened

Based on three site walk-overs in 2016, six main ecological zones were identified along the proposed path alignment. Characteristic vegetation types within these ecological zones are described in

Table 8, with indicative photos. These are broadly mapped in Map 3, Appendix 1. A full list of species observed along the proposed path alignment is provided in Appendix 2.

The existing vegetation along the proposed path is typically dominated by a mixture of coastal species along the coastal fringe, including mature pōhutukawa, flax, cabbage trees, karo, ngaio and karamu. Mature exotic species were also observed in some sections of the alignment (pine, macrocarpa, tree privet and eucalyptus) and exotic garden plants and weeds were common, especially in the narrow coastal strips close to residential properties.

The area north of Omaru Creek (Wai O Taiki Nature Reserve) contains established native bush, characterised by a mature canopy and regenerating understory, and dominated by coastal broadleaved species, including pōhutukawa, mahoe, matipo, karaka, kohekohe and karo. This is generally consistent with the extent of current ecosystems identified by Singers *et al.* (2017), which includes planted vegetation and regenerating broadleaf species in Wai O Taiki Nature Reserve, and treeland along the coast of Point England Reserve. On the southern side of Omaru Stream contains a mix native and exotic species dominated by African boxthorn and tree privet.

A number of mature native and exotic trees are located in the southern section creating pinch points along the proposed path in narrow coastal strips. One notable tree is located at 194 Riverside Ave. This is a large old pohutukawa tree, which will need to be pruned considerably to allow for overhead clearance along the proposed path. Further detail is provided in the arboricultural assessment provided by Greenscene (2017).

One distinct forest ecosystem type would have naturally occurred along the project area, which is now considered critically endangered (Puriri forest). However, this ecosystem is no longer remaining and current ecosystems along the proposed path have no threat status according to Singers *et al.*(2017). Indigenous vegetation within the project area is considered to be of high ecological value according to the LENZ Level IV classification, as less than 20% of indigenous cover is remaining in these Level IV categories on a national scale.

Table 8: Summary of ecological zones observed during site visits

Ecological Zones	Description	Indicative species	Example
1 Coastal vegetation	A mixture of native low growing, scrub and mature canopy species along the coastal fringe. Mature exotics occasionally present, and in some locations exotic garden plants and weeds.	Pohutukaka Ngaio Karo Flax Cabbage trees Karamu Pine Wattle Gorse Kikuyu Canna lily	
1a Coastal vegetation	Canopy dominated by exotic species along the coastal fringe.	Macrocarpa Eucalyptus Wattle Box thorn Tree privet Locust	
2 Regenerating native bush	Regenerating pohutukawa – broadleaf forest with some canopy closure. Highest ecological value bush remnant along site. Borders Omaru Creek northern bank and pasture, in Wai O Taiki Nature Reserve. Minimal exotic species observed on site, with tui observed within pohutukawa.	Pohutukawa Mahoe Matipo Karaka Karamu Cabbage Tree Kohekohe Karo Japanese spindle Hawthorn	
3 Rank grass	Rank grass located along coastal margins.	Kikuyu	
4 Mown grass	Public reserves and open spaces, including Point England Reserve, Riverside Reserve, Dunkirk Reserve, Mount Wellington War Memorial Reserve, Johnson Reserve and Panmure Wharf Reserve.	Mixture of kikuyu and other exotic grass species	

5 Grazed grass	Located in pasture within Point England Reserve	Mixture of kikuyu and other exotic grass species	
6. Mangrove	Mouth of Omaru Creek	Mangrove	

2.1.5 Ecological Corridors

Ecological corridors allow for the movement of flora and fauna, expanding their range and increasing the sustainability of the population, as well as, the sustainability of biodiversity across the region as a whole. The Wai O Taiki nature reserve and Omaru Creek reserves provide an ecological corridor that links the Tāmaki Estuary via riparian reserves to the Ōrākei Basin. Reserves along the length of the estuary also provide an important ecological corridor for coastal fauna and flora between significant natural areas such as Tāhuna Tōrea in the north and the Panmure basin further south.

An evaluation of the ecological values of parks and reserves within the Maungakiekie-Tāmaki Board Area was undertaken by Auckland Council (Webb, 2012) with the purpose of recommending ecological restoration initiatives. Of the 130 parks and reserves assessed, Wai O Taiki Nature Reserve was ranked the highest priority for restoration, due to its significant connectivity with existing ecological corridors. Other reserves situated along the path alignment (Point England Reserve, Maybury Reserve and Riverside Reserve) were allocated the highest score for ecological connectivity and ranked highly overall for ecological restoration priority.

2.1.6 Avifauna

2.1.6.1 Shorebirds

Maps produced by the Ornithological Society surveys indicate that the Tāmaki Estuary is a national "hotspot" of bird diversity in coastal habitats and for nationally vulnerable endangered bird taxa. (Robertson *et al.,* 2007). It contains extensive sand and mudflats, a rich food resource for shore birds. The value of this area is reflected in the designated marine SEAs (discussed in 2.1.3 above) which contain regionally important wildlife habitat for wading birds on the east and west banks of the Tāmaki Estuary.

The Tāmaki Estuary is utilised by a range of New Zealand resident and migratory shore birds, and the mid to lower-reaches hold particular importance due to the availability of roosting and feeding areas (Kelly, 2008). Tāhuna Tōrea, approximately 770 m north of the northern extent of the proposed Tāmaki Path, is a particularly high value "natural" area, with scrub, wetland, saltmarsh, estuary, shellbank, and sandflat habitats and is used by a variety of coastal and wetland birds. The outlet to Panmure Basin is also notable for its large, pied shag colony. Little and black shags, white-faced herons, gulls and kingfishers are also common in this area (Cameron *et al.* 1997).

Hayward and Morley (2005) recorded 15 species of bird during ecological surveys of Tāmaki Estuary, of which 13 could be considered coastal or wetland species. The Atlas of Bird Distribution in New Zealand (Robertson *et al.,* 2007) reports that up to 31 coastal bird species frequent the Tāmaki Estuary and/or adjoining area.

Further inland, the Point England reserve is utilised by a number of shorebird species as a high tide roost, and it is a known breeding ground for New Zealand dotterels with up to four pairs forming nest sites annually (Lee, 2016). Productivity can be estimated based on the average number of chicks fledged per breeding pair with management of a breeding site considered to be effective if productivity values are greater than 0.5 for three consecutive years (Dowding and Davis, 2007). To date, successful fledging has only been observed for one chick resulting in a three year (2013-2015) average productivity rating of 0.083, maximum of 0.25 (Lee, 2015).

Favoured breeding habitat for northern New Zealand dotterel include sandy beaches and shell banks and sandbars in harbours though in urban areas, they will utilise short grass (including airport runways and motorway verges) bare earth, or shingle (including construction sites) (Dowding and Greene, 2012). Their breeding season runs from September to February (DoC, 2015).

A total of 2,075 northern New Zealand dotterels was counted in the 2011 breeding-season census (Dowding, 2013). Up to 27 dotterels have been observed roosting within Point England Reserve (Lee, 2016), representing at least 1% of the total population. The large size of Point England Reserve and the location of the coastal walkway outside the fenced perimeter is considered to help to reduce human disturbance of the roosting flocks (Lovegrove, 2016).

In addition to dotterels, shorebirds including most commonly, white-faced herons, royal spoonbill, South Island oystercatchers, variable oystercatchers, Caspian terns, and pied stilts have been reported to roost on the Point England Reserve (Lee, 2016).

Roosting shorebirds were also observed during site visits in reserves along the southern section of the proposed path (Riverside, Dunkirk and Mount Wellington War Memorial Reserves) (Figure 3. It is noted that Dunkirk Reserve is managed as an off-leash dog exercise area and consequently is not expected to provide suitable nesting habitat.

Table 9 lists all coastal bird species reported to be present within the Tāmaki Estuary and their threat classification criteria. Of these, seven species have been classified as 'threatened' (nationally critical, nationally endangered, or nationally vulnerable), according to the New Zealand Threat Classification System Lists (Robertson *et al.,* 2017).

Figure 3: Oyster catchers roosting at Dunkirk/Riverside Road Reserve

2.1.6.2 Terrestrial Birds

The riparian margins of Omaru Creek provide an ecological corridor and roosting, nesting, and feeding resources for terrestrial native bird species.

Incidental observations of avifauna during site visits included numerous tui, and observations recorded on data platform Naturewatch NZ (accessed 2017) over the last 10 years in the vicinity of the project area included observations of the domestic muscovy duck, goldfinch, spur winged plover and Australasian shoveler, all within Point England Reserve.

All records of bird species observed in the vicinity of the project area, including threat classification status are listed below in Table 9.

Table 9: Avifauna observed or likely to occur in project area

Species	New Zealand Status	Threat Classification criteria*
Australasian gannet (*Morus serrator*)	Native	Not threatened
Australasian shoveler (*Anas rhynchotis)*	Native	Not threatened
Banded dotterel (*Charadrius bicinctus bicinctus*)	Endemic	Nationally vulnerable
Bar-tailed godwit (Limosa lapponica)	Native	Declining
Black-billed gull (*Larus bulleri*)	Endemic	Nationally critical
Black shag (*Phalacrocorax carbo Novaehollandiae*)	Native	Naturally uncommon
Black swan (*Cygnus atratus*)	Introduced	Not threatened
Blue penguin spp (*Eudyptula minor spp*)	Native	Declining
Caspian tern (*Sterna caspia*)	Native	Nationally vulnerable
Eastern bar-tailed godwit (*Limosa lapponica baueri*)	Resident	Declining
Goldfinch (*Carduelis carduelis*)	Introduced	Not threatened
Grey duck (*Anas superciliosa Superciliosa*)	Native	Nationally critical
Lesser knot (*Calidris canutus canutus*)	Resident	Nationally vulnerable
Little black shag (*Phalacrocorax sulcirostris*)	Native	Naturally uncommon
Little shag (*Phalacrocorax melanoleucos brevirostris*)	Endemic	Not threatened
Mallard (*Anas platyrhynchos Platyrhynchos*)	Introduced	Not threatened
Muscovy duck (*Cairina moschata*)	Introduced	Not threatened
Northern New Zealand dotterel (*Charadrius obscurus aquilonius*)	Endemic	Recovering
New Zealand kingfisher (*Halcyon sancta vagans*)	Native	Not threatened
Paradise shelduck (*Tadorna variegate*)	Endemic	Not threatened
Pied shag (*Phalacrocorax varius varius*)	Native	Nationally vulnerable
Pied stilt (*Himantopus himantopus*)	Native	Not threatened
Pukeko (*Porphyrio porphyria Melanotus*)	Native	Not threatened
Tui (*Prosthemdra novaeseelandiae*)	Endemic	Not threatened
Red-billed gull (*Larus novaeholladiae Scopulinus)*	Endemic	Declining
Red-necked stint (*Calidris ruficollis*)	Native	Migrant
Reef heron (*Egretta sacra sacra*)	Native	Nationally endangered
Royal spoonbill (*Platalea regia*)	Native	Naturally uncommon
Sharp-tailed sandpiper (*Calidris acuminate*)	Native	Migrant

South Island pied oystercatcher (*Haematopus ostralegus Finschi*)	Endemic	Declining
Southern black-backed Gull (*Larus dominicanus Dominicanus*)	Native	Not threatened
Spur-wing plover (*Vanellus miles Novaehollandiae*)	Native	Not threatened
Tui (*Prosthemdra novaeseelandiae*)	Endemic	Not threatened
Variable oystercatcher (*Haematopus unicolor)*	Endemic	Recovering
White-faced heron (*Ardea novaehollandiae Novaehollandiae*)	Native	Not threatened
White-fronted tern (*Sterna striata*)	Native	Declining
Wrybill (*Anarhynchus frontalis*)	Endemic	Nationally vulnerable

**Robertson et al., 2017*

2.1.7 Herpetofauna

A review of the Department of Conservation's (DOC's) herpetofauna database was undertaken by EcoGecko Consultants (EcoGecko) in October 2016. A desktop assessment identified potential lizard habitat in the vicinity of the project area and details of species that have been observed and recorded within a 10 km radius of the proposed path alignment are provided in Table 10 below.

Of those species identified, four have an At Risk (relict or declining) threat status (the moko skink, forest gecko, ornate skink and egg-laying skink). Of these, it is expected that copper skink are likely to be relatively abundant near the vicinity of the project footprint within rank grass, and ornate skink may be present in similar habitat. Mown grass is not considered to be suitable habitat although this may be crossed occasionally. Forest geckos may also be present within coastal and regenerating bush. No Auckland Green gecko's have been observed within a 10 km radius of the path however they may be present within the area. Other skink species are likely to be restricted to known populations on offshore islands. A lizard survey has not been conducted on site and the records summarised below may not capture the full extent of lizard distribution or abundance on site.

Table 10: Native lizard observations within 10 km of the proposed Tāmaki Path[1]

Species Name	Common Name	Threat Status	Distance found from site ±100m	Preferred Habitat Type
Oligosoma aeneum	Copper skink	Not threatened	2.1 km, 3.1 km, 6.7 km, 8.5km, 8.6 km (4 records), 8.7 km, 9.0 km, 9.1 km	Grassland, shrubland, forest
Oligosoma moco	Moko skink	At risk –relict	4.9 km, 8.5 km (3 records), 8.7 km, 9.0 km, 9.1 km (2 records)	Grassland, shrubland,
Mokopirirakau granulatus	Forest gecko	At risk – declining	6.0 km, 6.3 km	Forest and some records in mangroves
Oligosoma ornatum	Ornate skink	At risk – declining	6.7 km, 8.6 km (3 records), 9.3 km, 10 km	Grassland, shrubland, forest

Oligosoma smithi	Shore skink	Not threatened	8.5 km (3 records), 8.6 km, 9.1 km	Shoreline including grasslands, sand dunes, driftwood, rocky coasts
Oligosoma suteri	Egg-laying skink	At risk - relict	10 km	Shore platforms, boulder beaches, rocky coasts.

(EcoGecko, 2016; Hitchmough, 2012)
Although no Naultinus elegans elegans (Auckland green gecko) were recorded within a 10 km radius this species should be considered as these native lizards may also be potentially present within this region.

2.1.8 Bats

Long-tailed bats have been recorded in the Waitakere and Hunua Ranges, Riverhead, Pakiri and Swanson (Auckland Council, 2017). Long –tailed bats roost in in large canopy trees (rimu, puriri, totara, pukatea), beneath the bark or in cavities. Mature exotic trees such as pine, gum and macrocarpa can also provide suitable habitat. Roost sites are often located on forest edges and near waterways.

No reports have been located of bat populations or sightings in the vicinity of the Tāmaki Estuary. While the pines north of the proposed path may provide suitable habitat for bats, no records are known and no such vegetation is proposed to be removed as part of the application.

2.2 Freshwater Ecological Values

Auckland Council's Freshwater State of the Environment monitoring programme measures the quality of the region's freshwater resources through the assessment and evaluation of environmental stressors and the effectiveness of the Auckland Council's policy initiatives and management approaches.

Auckland Council operates a long term river water quality monitoring programme throughout the region including monthly sampling of water quality variables at 36 sites. Omaru Creek (at Maybury St) was ranked the lowest for water quality of all 36 sites in 2014 and 2015 with all parameters (dissolved oxygen, temperature, pH, nitrogen, phosphorus, heavy metals, E. coli), excluding turbidity, exceeding parameter thresholds at some stage during the year (Holland, *et al.* 2015).

The State of Auckland Freshwater Report Cards report on five indicators o (water quality, flow patterns, nutrient cycling, habitat quality and biodiversity) and graded on a scale of A to F, with F being the lowest score. The Maungakiekie-Tāmaki reporting area (Auckland Council, 2016) includes freshwater ecology and water quality data from Omaru Creek, Anne's Creek (south of the Tāmaki North Catchment) and Riverside Ave Reserve Stream. These watercourses have been given an overall grade of F. All indicators were given an F grade with the exception of flow patterns, which were given an E grade. The health of Maungakiekie-Tāmaki's rivers is considered to be impaired. Urban development has led to a high level of impervious surface in the area. This has follow-on effects for rivers in the area leading to high water temperatures, changes to the natural flow patterns and increased pollution from contaminated stormwater.

An overview of stream ecological values (fish records and predicted current MCI values) in the project area is provided in Map 4 of Appendix 1. It is noted that the MCI values should be used with caution as the model of MCI scores tends to overestimate predicted scores for urban areas and is not applicable for tidally influenced reaches.

2.2.1 Omaru Creek

An ecological evaluation of Omaru Creek was undertaken of by Golder (2014) during the development of a Watercourse Management Plan. This assessment concluded that Omaru Creek does not provide good habitat for stream communities and poor water quality was observed in most reaches. Riparian vegetation was observed to be patchy, with exotic species dominating the canopy and ground cover, and problematic weed species common in the catchment. The stream mouth of Omaru Creek is part of the large designated marine SEA which is contiguous with terrestrial SEA_T_3140 which includes the inland extent of mangroves in Omaru Creek (refer to Table 5 and Table 6 in Section 2.1.3 for further information on SEA's).

Overall fish diversity was found to be low, with only two native species recorded (banded kokopu and shortfin eel). Man-made fish barriers to fish migration were found in the catchment in the form of culverts, and chemical barriers from urban effluent may also exist. Three records of fish observations in the lower reaches of Omaru Creek (within Point England Reserve) are held in the NZ Freshwater Fish Database (NZFFDB) (NIWA, accessed July 2017). These were *Gambusia affinis* (2003), an unidentified species (2003), and common bully (2000).

Macroinvertebrate Community Index (MCI) scores reported in the lower sections of Omaru Creek range from 71 to 76 (Auckland Council, 2014). This is above the interim MCI guideline of 68, proposed for streams in areas of 'Urban' land use under the AUP-OP – Macroinvertebrate Community Index (AUP-MCI) however scores below 80 are typically considered to be indicative of poor quality environments where highly tolerant macroinvertebrate species dominate most of the time (Stark and Maxted, 2007). Representative photos of Omaru Creek in the vicinity of the proposed bridge, and the existing bridge are provided in Figure 4 and Figure 5 below.

Figure 4: Lower, tidally influenced reach of Omaru Creek

Figure 5: Existing bridge across Omaru Creek

2.2.2 Riverside Reserve Stream

Riverside Reserve Stream comprises an approximately 340 m section of permanent open watercourse which runs from Pilkington road to the Tāmaki Estuary. This stream is piped in the upper reaches through industrial and residential land use, and through Boundary Reserve.

The lower 73 m downstream of Dunkirk Road through Riverside Reserve is tidally influenced and forms part of the large designated marine SEA (Figure 6) (refer Table 6 in Section 2.1.3 for further information on SEA's).

Riparian vegetation along the lower reaches of this watercourse (within Riverside Reserve) is limited, comprising predominately mown grass and scattered mature pōhutukawa, providing low stream shading. A concrete apron is constructed at the base of the culvert at Dunkirk Road, showing evidence of undercutting and erosion and creating a barrier to fish passage during low tide (Figure 7).

No records were found in the NZFFDB along this stream and no areas of potential inanga spawning habitat were observed within the lower reach. Based on the piped extent of this watercourse, the potential fish passage barrier and the lack of riparian vegetation in the lower, unmodified reaches, habitat for stream communities is likely to be poor.

Figure 6: Riverside Reserve Stream, facing east (downstream) towards Tāmaki Estuary

Figure 7: Culvert and concrete apron below Riverside Road

2.2.3 Point England Overland Flow Paths

Two ephemeral stream cross the proposed pathway adjacent to Pt England Reserve. A defined channel is formed downstream (towards the coastal fringe) from OLFP B.

Figure 8: OLFP A north point England reserve

Figure 9: OLFP B north Point England reserve

2.3 Coastal Ecological Values

The mouth of Omaru Creek is approximately 660 m in length and is mangrove dominated as it flows into Wai-O-Taiki Bay. The Creek is tidally influenced to just above the confluence of the first tributary and the main channel. This creates a transitional zone that interfaces from marine to brackish and freshwater ecosystems (Harrison and Grierson, 2016).

The Tāmaki North catchment adjoins the middle reaches of the Tāmaki Estuary, containing a mixture of tidal mudflats, marginal strips of mangroves, mud-covered low-lying shore platforms and sandy high-tidal beaches. In the outer reaches of the estuary, the tidal flats are sandier and shellier, the shore platforms have less mud cover, and the tidal shell spits and banks are more prevalent (Harrison Grierson, 2016). Tāhuna Tōrea Nature Reserve is a coastal, high character area, located in the Tāmaki River. It contains an assemblage of coastal escarpments, sandspit landforms, intertidal wetlands and mudflats that form the mouth of the Tāmaki River where it enters the Hauraki Gulf.

As discussed in Section 2.1.3 and 2.1.6, a number of significant ecological areas are located within the Tāmaki Estuary, including areas identified as internationally or nationally significant habitat for wading birds.

Benthic invertebrates and sediment chemistry are sampled from eight sites across the Tāmaki Estuary as part of the Auckland Council's stormwater contaminant monitoring programme and benthic health monitoring. A gradient in contaminant levels and benthic community health occurs with higher concentrations of contaminants and muddiness in settling zones in the upper parts of the estuary with improving condition towards the mouth of the estuary with greater flushing and mixing (Auckland Council, 2016).

The most recent state of the environment monitoring has assigned an overall environmental health grade of D for the Tamaki Estuary (Auckland Council, 2016). The health of benthic communities are ranked from 1 (healthy) to 5 (degraded). Benthic communities in the uppermost estuary sites had the worst condition (health rank 5). The monitoring site near Benghazi Road had the highest recorded grade of 'good' (mid estuary, adjacent to Dunkirk Reserve) (Auckland Council, 2016).

Hayward and Morley (2005) compiled a list of 16 fish species either recorded during their surveys, or collected by Larcombe (1973), Auckland Museum or Kingett Mitchell and Associates (1996). This list of species is included in Table 11, along with species' conservation status. Of these 16 species, one has an At Risk – Declining threat status (inanga). It is noted that data obtained by Kingett Mitchell and Associates (1996) was from the upper reaches of the estuary. Speckled sole, sand flounder, snapper, estuarine stargazer, anchovy, sand goby, and estuarine triplefin may also be expected to be found within the Tāmaki Estuary (Francis *et al.* 2005, in Kelly, 2008).

Table 11: Fish recorded in the Tāmaki Estuary

Species	Common name	Source	Conservation Status
Acanthoclinus fusus	Olive rockfish	H&M	ND
Arenigobius bifrenatus	Australian bridled goby	AK	Introduced
Aldrichetta forsteri	Yellow-eyed mullet	KM	Not threatened
Forsterygion lapillum	Common triplefin	H&M	Least concern
Forsterygion nigripenne	Cockabully	L	Not threatened
Forsterygion varium	Variable triplefin	H&M	ND
Galaxias maculates	Inanga	KM	At Risk - Declining
Girella tricuspidata	Parore	AK	ND
Gobiomorphus cotidianus	Common bully	KM	Not threatened

Gobiomorphus gobioides	Giant bully	KM	Not threatened
Gonorynchus gonorynchus	Sandfish	AK	ND
Lissocampus filum	Pipefish	AK	ND
Mugil cephalus Grey	Mullet	KM	ND
Notolabrus celidotus	Spotty	KM	Least concern
Retropinna retropinna	Smelt	KM	Not threatened
Rhombosolea leporine	Yellow-belly flounder	KM	ND

Sources are: H&M – Hayward and Morley (2005); L – Larcombe (1973); Auckland Museum – AK; and, Kingett Mitchell and Associates (1996) – KM
ND – No Data

2.4 Ecological Valuation

2.4.1 Matters for Consideration

Terrestrial vegetation and habitat values are considered to be very high where an area is considered to have high value for several matters of ecological significance including representativeness, rarity, diversity, and ecological context; if nationally threatened species are present; or if the site meets one of the National Priorities for Biodiversity Protection (EIANZ, 2015).

Vegetation and habitats that support one of the national priorities for protecting rare and threatened native biodiversity identified by the Ministry for the Environment may be considered to have high ecological values (MfE, 2007; EIANZ, 2015). These national priorities are:

1. To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV that have 20 percent or less remaining in indigenous cover).
2. To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.
3. To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.
4. To protect habitats of acutely and chronically threatened indigenous species.

Overall, a site that is of very high ecological value is likely to be nationally important, a high value site is likely to be regionally important, and a moderate value site is likely to be important at the level of the ecological district (EIANZ, 2015).

2.5 Summary of Existing Ecological Values

A summary of ecological zones and values is provided in Table 12, Table 13, and Table 14.

The existing vegetation along the proposed path is typically dominated by a mixture of coastal species along the coastal fringe, including mature pohutukawa, flax, cabbage trees, karo, ngaio and karamu. The area north of Omaru Creek (Wai O Taiki Nature Reserve) contains established native bush, characterised by a mature canopy and regenerating understory, and dominated by coastal broadleaved species, including pōhutukawa, mahoe, matipo, karaka, kohekohe and karo. Significant ecological areas are located around the coastal fringes of Point England Reserve, within the Omaru Creek corridor and at the Omaru Creek salt wedge.

Areas of indigenous vegetation associated with land environments (LENZ Level IV) that have less than 20% indigenous cover remaining can typically be considered to be of high ecological value as these are priority areas for protection (MfE & DoC 2007). This includes categories A7.1a (Chronically

Threatened) and A7.2a (Acutely Threatened), which cover the majority of the existing indigenous vegetation along the proposed path project area (Omaru Creek, the western section of Point England Reserve and south from Riverside Reserve). However, it is acknowledged that the LENZ classification dataset is at a high-level, national scale, and the current terrestrial vegetation types identified along the path alignment are classified as of 'least concern' under the IUCN criteria (Singers *et al*. 2017). For these reasons, indigenous vegetation remnants within the LENZ 'Acutely Threatened' and 'Chronically Threatened' areas are considered to be of moderately high ecological value.

The Tāmaki Estuary is a national "hotspot" of bird diversity in coastal habitats and for nationally vulnerable endangered bird taxa and marine significant ecological areas have been identified recognising the regional importance of the area for wildlife habitat. The Point England reserve is known to be utilised by a number of shorebird species as a high tide roost, and it is a known breeding ground for the threatened (recovering) northern New Zealand dotterel. Seven coastal bird species classified as threatened (nationally critical, nationally endangered or vulnerable*)* are reported to be present within the vicinity of the proposed path primarily using sports fields and reserves as high tide roosting habitat. These are considered to be of high value under the fourth national priority for biodiversity. The riparian margins of Omaru Creek also provide an ecological corridor and roosting, nesting, and feeding resources for terrestrial bird species, although no threatened species have been recorded in this area.

The presence of potential lizard habitat was identified in the vicinity of the project area and four species have been identified as likely to be present on site however it is noted that a specific survey has not been completed at this time. In the interim, a conservative valuation has been utilised in this report to account for the potential presence of threatened (declining) species (ornate skink, forest gecko) within preferred habitat types.

Ecological evaluations of the Omaru Creek have concluded that the stream has poor water quality and habitat for stream communities. Limited data is available for the Riverside Reserve Stream; the stream is piped in the upper reaches and is lacking in riparian vegetation in the lower reaches, indicating habitat for stream communities is also likely to be poor. 16 fish species were recorded in the Tāmaki Estuary, one of which has an At Risk – Declining threat status (inanga). A gradient in contaminant levels and benthic community health occurs with higher concentrations of contaminants and muddiness in settling zones in the upper parts of the Tāmaki estuary with improving condition towards the mouth of the estuary with greater flushing and mixing (Auckland Council, 2016).

Table 12: Summary of terrestrial ecological zones and values northern section Pt England Reserve

Ecological Zone	Canopy	Understory	Ground Cover	Approximate Area m^2	Botanical Value	Lizard Habitat Value	Bird Habitat Value	Other Ecosystem Services
1. Mixed Coastal	Mixed	Mixed	Mixed	13,962	Moderate - High	Moderate	Moderate	Moderate
1a. Exotic Coastal	Exotic	Exotic	Mixed	1,283	Low	Moderate	Moderate	Moderate
2. Regenerating native bush	Native	Native	Native	9,496	Moderate - High	Moderate	Low	High
3. Rank grass	N/A	N/A	Exotic	8,299	Low	Moderate - High	Moderate	Low
4. Mown grass	N/A	N/A	Exotic	147,197	Very Low	Low	Very High	Low
5. Grazed grass	N/A	N/A	Exotic	206,642	Very Low	Low	Very High	Low
6. Mangroves	Native	N/A	N/A	4,083	Low	Low	High	Moderate

Table 13: Summary of terrestrial ecological zones and values southern section Riverside to Panmure

Ecological Zone	Canopy	Understory	Ground Cover	Approximate Area m^2	Botanical Value	Lizard Habitat Value	Bird Habitat Value	Other ecosystem Services
1. Mixed Coastal	Mixed	Mixed	Exotic	15,695	Moderate - High	Moderate	Moderate	Moderate
1a. Exotic Coastal	Exotic	Exotic	Mixed	1,084	Low	Moderate	Moderate	Moderate
3. Rank grass	N/A	N/A	Exotic	8,299	Low	Moderate - High	Moderate	Low
4. Mown grass	N/A	N/A	Exotic	153,410	Very Low	Low	High	Low

Table 14: Summary of coastal ecological values

	Benthic health	Fish Habitat Value	Bird Habitat Value	Other ecosystem Services
Tāmaki Estuary	Low	High	Very High	High

3.0 Proposed Activity

The proposed Tāmaki Path will create a continuous connection along the edge of the Tāmaki Estuary from Panmure Wharf up to the existing path north of Omaru Creek. The proposed path will comprise a wide, unimpeded shared path for walking and cycling and cover approximately 3.9 km.

Environmental constraints and opportunities mapping was undertaken at the commencement of the project following initial site investigations, for the original path alignment. Avoidance measures and impact management associated with the proposed path alignment are discussed further in sections 6.0 and 7.0 below.

A three metre wide concrete path will be constructed in the following sections (refer to Figure 1 for section zones) acknowledging that there will be some specific 'pinch point' locations where the width may be reduced to 2.5 metres (such as in areas of coastal erosion and in close proximity to the dripline of scheduled trees):

- Section E – Riverside Reserve Local Path
- Section F – Riverside Reserve and Dunkirk Reserve Local Path
- Section G – Mount Wellington War Memorial Reserve Local Path
- Section H – Panmure Wharf Local Path.

A three metre wide shell path will be constructed in Section B – Point England Reserve coastal local path, with reduced 2.5 metre sections through 'pinch points'.

A new timber bridge will be constructed across the Omaru Creek mouth, connecting with the existing coastal path north of the Creek. At the Riverside Reserve Stream, a 3 m wide single span, straight timber bridge is proposed to be constructed, approximately 20 m long. Timber boardwalks will be constructed over areas of tree roots.

The construction of retaining walls is proposed at a number of locations along the path, including the coastal path edge leading up to the Omaru Creek bridge. These will be constructed in accordance with Auckland Council Parkland Design Guidelines.

A boardwalk will be constructed above the overland flow path located in the north-eastern extent of Point England Reserve.

3.1 Proposed Construction Stages

Construction of the proposed Tāmaki Path is proposed to be staged, with the following sections expected to be completed during the summer earthworks season (January – April) (Stage 1):

- Omaru Creek Bridge;
- Dunkirk Reserve Bridge;
- Section B – Point England Reserve coastal local path;
- Section G – Mount Wellington War Memorial Reserve Local Path; and,
- Section H – Panmure Wharf Local Path.

The remainder of the proposed path will be completed throughout the year as provided for in a detailed construction schedule (Stage 2). Proposed construction stages are illustrated in Figure 10.

Typical sequencing for construction of the remainder of the proposed path through public reserves is expected to include:

- Service diversions and below ground works.
- Vegetation and topsoil removal and stockpiling.

- Stabilisation of ground in the grassed areas to allow for vehicle machinery access.
- Construction of boardwalks and retaining walls.
- Construction of final surfacing (exposed aggregate concrete with or without shell, Aggrok surfaces for amenity areas).
- Construction of timber bridges and other structures.
- Undertake final surfacing works along the alignment.
- Install wayfinding signage.
- Reinstate vegetation in accordance with mitigation planting plans.
- Open the path cyclist and pedestrian movements.

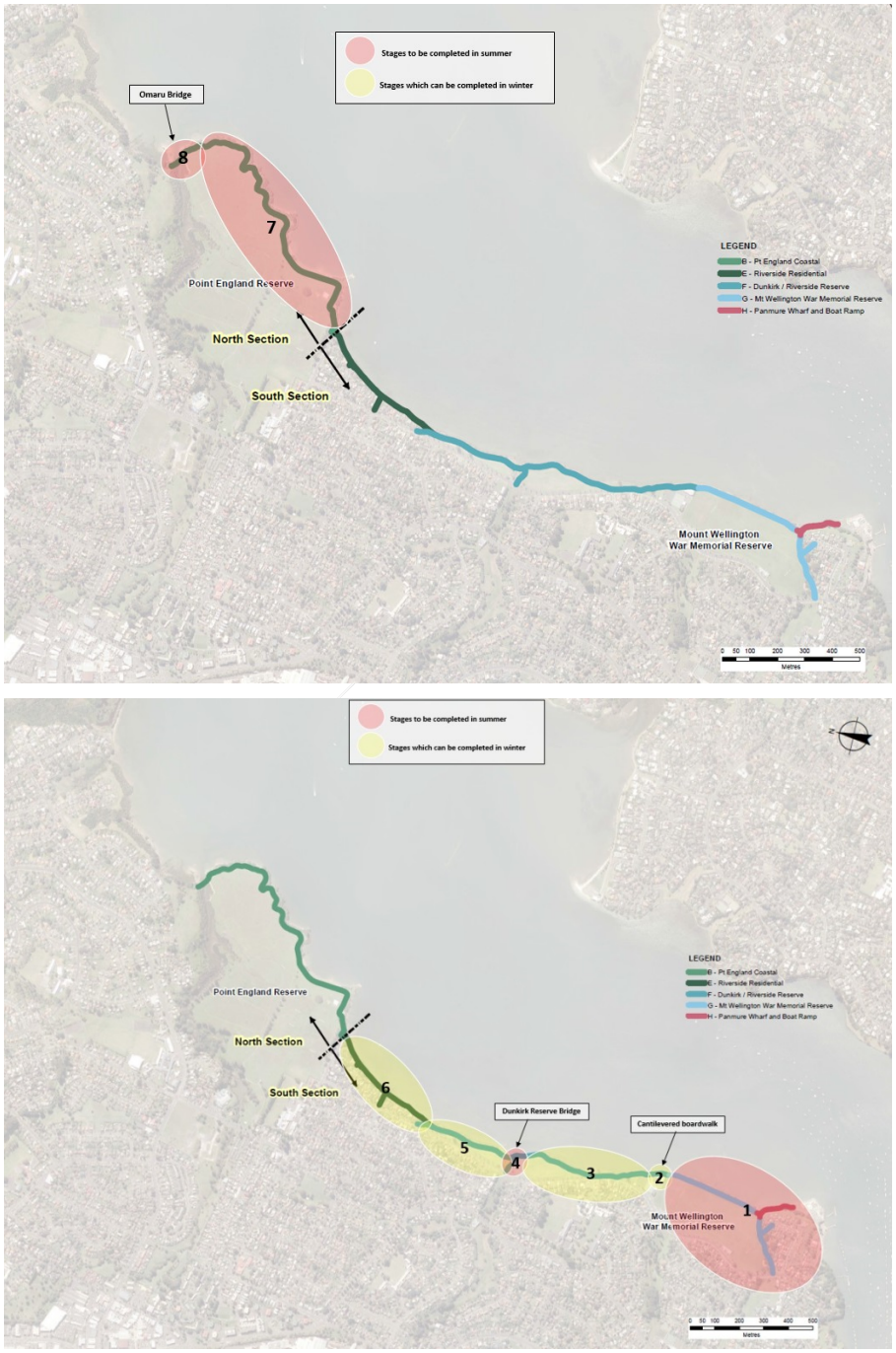

Figure 10: Proposed construction stages for the Tāmaki Path

3.2 Path Design and Specifications

The construction footprint along the proposed path through public reserves is anticipated to be approximately 5 m.

The path alignment will allow for a minimal 500 mm set-back or clearance buffer from all existing site features and landscape elements (e.g. trees, furniture, retaining walls, vegetation etc.). The maximum desirable gradient along the length of the path is 3%, and the cross fall of the path will be as flat as practical while ensuring rainwater drainage from the surface. Provision will be made to eliminate the risk of falling from the path through the use of balustrades, barriers and wheel stops.

The predominant material proposed for the Tāmaki path construction is a lightly exposed aggregate 10 mm basalt aggregate concrete path, with shell and a small amount of black oxide to reduce glare. This will be installed over a compacted base and subbase to engineered specification. Timber surfaces will be used on all bridges and boardwalks (FSC certified hardwood or H4 treated pine) and a permeable path solution will be utilised for sections of the path which traverse tree roots. A stabilised aggregate (aggrock) will be utilised as a base for all picnic tables and bench seat locations, as well as all non-vegetated areas within 0.5 m of the path edge.

No lighting is proposed along the path at this stage.

3.3 Omaru Creek Bridge

A 53 m long timber bridge is proposed to be constructed across the Omaru Creek Mouth. This will be 3 m wide and contain four 9.25 m spans and a 16 m mid-span.

It is proposed that an 8 m wide construction footprint will be required on either side of the Omaru Creek, to allow for areas of cut and fill and machinery access. This will require the clearance of approximately 400 m^2 of vegetation) within the footprint.

3.3.1 Bridge Construction Methodology

Details of the proposed works associated with the bridge construction are outlined in the Tāmaki Path Construction Methodology Plan (GHD, 2017), and include the following:

- Mangrove removal at the footprint of the proposed bridge timber piles
- Other vegetation removal where machinery access is required from both ends of the proposed bridge;
- Excavation for the north and south abutments of approximately 37.5 m^3
- Installation of timber piles, cross braces, bearers, joists, timber decking, timber balustrades and steel handrails;
- Reinstatement of the area impacted by the project.

The proposed plan and section of the bridge are illustrated in Figure 11 and Figure 12 below.

Vehicle access to the construction site will be via the existing vehicle access points on Point England Road or Elstree Ave for the southern side of the bridge and Kiano Place or Kotae Road for the northern side of the bridge.

3.3.1.1 Earthworks and Excavation

Heavy vehicle movements associated with land disturbance and bulk earthwork operations are likely to be limited to the delivery and removal of the machinery and plant required to undertake the earthworks and removal of soil.

Stabilised access ways will be constructed to lead to the area of works, to avoid damage to the existing path and park grounds, in accordance with TP90 and GD05 (i.e. it will maintain a minimum gravel depth of 150 mm over a 10 m length and minimum 4 m width on a geotextile layer).

The region within the two abutments will require some excavation and armouring of the ground (14 m^3 TLB and 25.5 m^3 TRB). This includes the piles at the two abutments. A crane will be utilised on either side of the timber bridge to lift and allow bolting of the joists to the bearers.

Sediment and erosion control measures are proposed to prevent contaminated water from entering the watercourse, including silt fences and a container impoundment system. However a detailed sediment and erosion control plan has not been prepared at this time.

3.3.1.2 Vegetation Clearance

Vegetation will be cleared in access ways and within the 8 m wide construction footprint across Omaru Creek. It is assumed that no additional vegetation clearance will be required for access ways.

Riparian vegetation on the true left bank (north) of the Omaru Creek comprises native, regenerating vegetation, including three mature pōhutukawa trees, and minimal exotic species. The true right bank (south) of the Omaru Creek comprises predominately exotic weed species in addition to coastal scrub. Following bridge construction, landscaping is proposed to reinstate cleared vegetation on either side of the bridge with native plantings. Mangroves under the footprint of the proposed bridge will be cut down to seabed level during low tide. The mangrove roots will be left in place to avoid unnecessary disturbance of the marine mud. The piles will then be bored or driven through any roots located in the proposed pile locations. Cleared mangroves will be mulched and disposed outside of the coastal marine area.

Total vegetation clearance is estimated at:

- 155 m^2 on the true left;
- 128 m^2 on the true right; and,
- 116 m^2 of mangroves

3.3.1.3 Noise Requirements

Works will be undertaken in accordance with the requirements of NZS 6803: 1999 'Acoustic – Construction Noise' and any relevant resource consent conditions. All works on the site including earthworks and the use of associated heavy machinery shall be undertaken during the agreed work hours.

3.3.1.4 Omaru Creek

The construction methodology for the proposed timber bridge will be staged to allow for flows through the Omaru Creek.

A coffer dam will be constructed on one side of the stream channel to allow flow of water through the other side of the channel and the construction of the piles, cross braces, bearers on a dry area. Once this section is complete, the cofferdam will be removed and constructed on the other side of the channel, allowing the remaining piles, cross bracers and bearers to be constructed.

A pump will be required to dewater the region within the coffer dam with water discharging via an approved treatment device (turkey's nest or similar).

250 mm timber piles will be driven into the sea bed. It is proposed that construction will be undertaken from the banks to avoid tracking machinery to the coastal marine area where feasible. Where this is not feasible, additional controls will be required to minimise potential impacts of the

movement of machinery on benthic fauna and mudflat habitats. With 5 cross sections requiring four piles each, this results in the estimated footprint of 0.98 m^2.

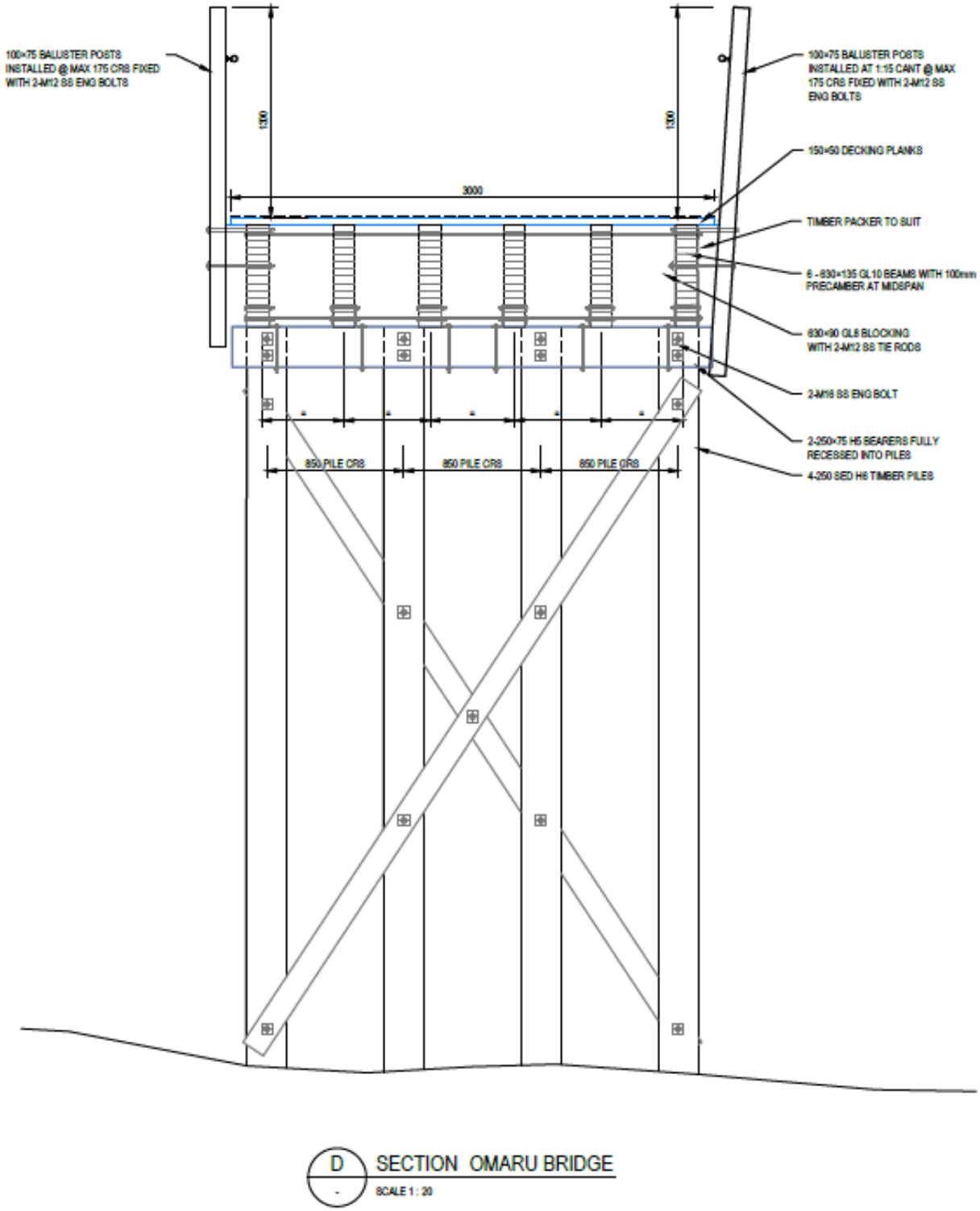

Figure 11: Proposed section drawing of Omaru Creek Bridge (GHD, 2016)

Figure 12: Proposed plan drawing of Omaru Creek Bridge (GHD, 2016)

3.4 Riverside/Dunkirk Reserve Stream Bridge Construction Methodology

A 10 m long and 3 m wide timber bridge is proposed to be constructed across the Riverside Reserve stream mouth.

An outline of the proposed construction methodology to build the bridge over the Riverside Reserve Stream channel is provided in GHD's Tāmaki Path Construction Methodology Plan (GHD, 2017). The outline of each step to complete this stage is listed below:

- Establish site offices and machinery storage areas at Dunkirk and Riverside Reserves.
- Install construction signage and traffic (including pedestrian) management.
- Remove vegetation (grass only) and strip topsoil and stockpile.
- Install erosion and sediment control, and tree protection measures.
- Install bridge piles.
- Install bridge abutments.
- Construct bridge bearers and joists.
- Fill around abutment areas to form the bridge approaches.
- Install decking, balustrades and handrails.
- Form path basecourse and surface (exposed aggregate concrete with or without shell, and Aggrok) at the approaches.
- Topsoil and reinstate vegetation

Works will be undertaken in accordance with the requirements of NZS 6803: 1999 'Acoustic – Construction Noise' and any relevant resource consent conditions. All works on the site including earthworks and the use of associated heavy machinery shall be undertaken during the agreed work hours.

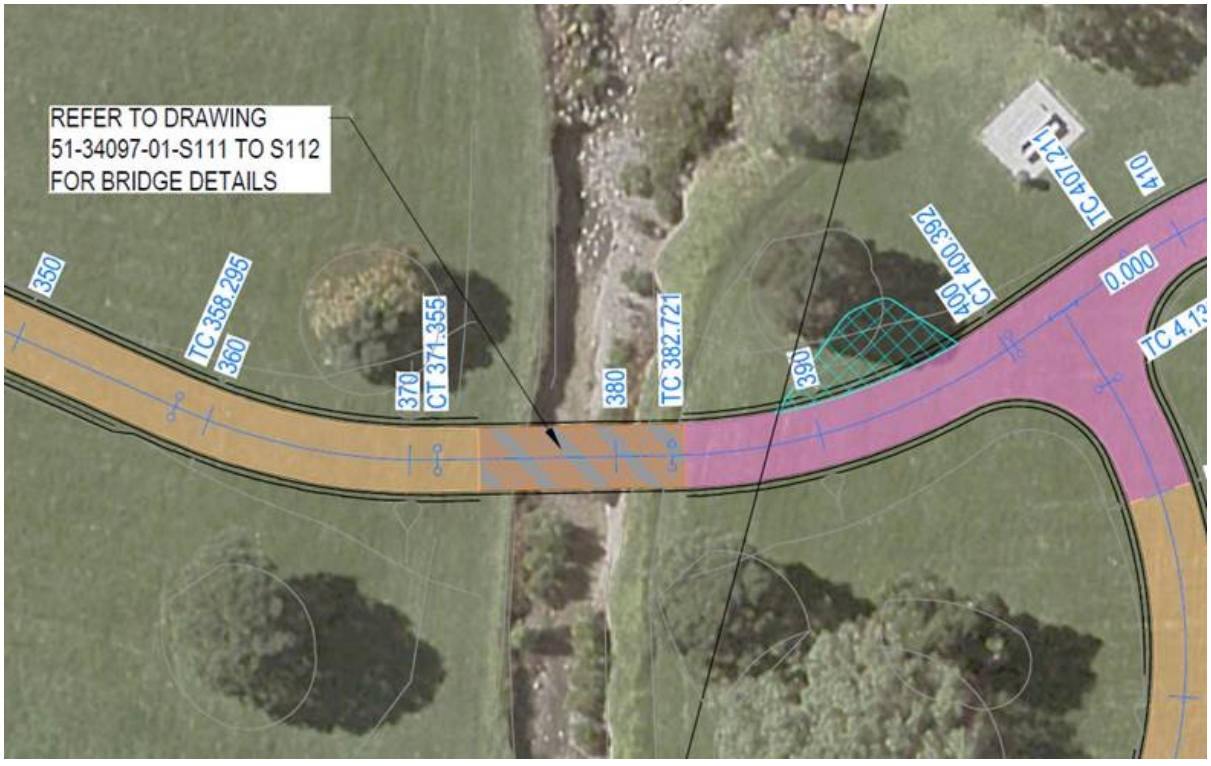

Figure 13: Proposed plan drawing of Dunkirk Reserve Straight Bridge (GHD, 2016)

4.0 Ecological Impact Assessment – Northern Section

Potential and actual impacts of the proposed shared path alignment on the vegetation, herpetological, avian, coastal and freshwater values were assessed and ranked for severity using the EIANZ Ecological Impact Assessment Guidelines 2015. Key criteria used are summarised in Appendix 3. Impacts have been divided into the northern and southern sections of the path (as illustrated in Figure 2) to align with the planning approach and documentation for this project. Impacts on the northern path section are discussed below and summarised in Table 19.

4.1 Assessment of Effects on Flora

A range of activities carried out as part of the proposed works has the potential to cause disturbance to trees' root systems and damage to above-ground parts of the affected trees, resulting in adverse tree health and aesthetic effects. An assessment of these effects and recommended tree protection methodologies are provided in the arboricultural assessment (Greenscene Ltd, 2017).

4.1.1 North Omaru Creek Riparian Vegetation

Approximately 155 m^2 of vegetation is proposed to be removed from the construction footprint in this area, including three mature pōhutukawa trees, approximately 5 m tall. A small proportion of exotic vegetation will also be removed within this footprint.

This vegetation has intrinsic value as indigenous vegetation within a landscape with less than 20 percent remaining indigenous cover. Additional impacts on indigenous fauna associated with the loss of habitat values are discussed in subsequent sections.

In addition to the direct loss of vegetation, vegetation clearance will fragment this block of regenerating native bush and increase edge effects including increased potential for weed invasion bordering the pathway. However a break in vegetation cover <10 m wide is unlikely to adversely impact habitat connectivity for fauna.

Vegetation clearance on the banks of Omaru Creek has the potential to lead to bank instability and erosion, and reduce filtration of surface sheet flow, resulting in increased levels of active sediment deposition in the watercourse and receiving environment.

The magnitude of effects resulting from the permanent loss of vegetation is considered to be moderate. Consequently, the overall level of effect on ecological values resulting from vegetation clearance in this location is considered to be high and further mitigation actions are warranted.

4.1.2 South Omaru Creek Riparian Vegetation

Approximately 128 m^2 of predominately exotic vegetation and weeds will be removed from the southern banks of the Omaru Creek.

The magnitude of effects resulting from the permanent loss of vegetation is considered to be moderate. However, this portion of the coastal vegetation is dominated by exotic species (see Figure 14) and is therefore considered to be of 'low-moderate' ecological value not 'moderate-high'. The overall level of effects resulting from vegetation clearance in this location is considered to be low.

Figure 14: Indicative south Omaru creek vegetation (black locust canopy and privet understory)

4.1.3 Mangroves

Approximately 116 m^2 of mangroves are proposed to be removed within the footprint of the Omaru Creek Bridge.

The main potential adverse ecological effects of mangrove removals are as follows:

- Muddy organic rich and oxygen poor sediment at the removal site
- Microalgae blooms
- Changes to benthic communities (loss in species diversity with a shift towards opportunist species).

Key principles to avoid potential adverse impacts on the site have been implemented into the development of the proposed mangrove management activity include:

- Minimising the proposed area of clearance;
- Mangroves are removed by cutting at the base of the trunk, leaving the root mass intact to avoid disturbance of sediments;
- Adhering to key principles of low impact mangrove removal methods including:
  - non-mechanical removal via hand clearance
  - minimising disturbance of fauna (clearing outside of breeding season);
  - minimising movement footprint to reduce trampling;
  - disposal of cut vegetation outside the CMA.

It is recommended that mangroves are mulched on land and utilised for terrestrial planting maintenance within the reserve to minimise transport and associated fuel requirements.

Given the area of mangroves to be left intact, the magnitude of effects resulting from the permanent loss of vegetation is considered to be low. The overall level of effect is considered to be very low.

4.2 Assessment of Effects on Avifauna

Impacts on avifauna are considered likely as a result of vegetation clearance through Omaru Creek and through ongoing use of the path in the vicinity of coastal bird roosting and nesting sites.

4.2.1 Omaru Creek

Vegetation clearance through the construction footprint of Omaru Creek will result in the permanent loss of habitat for avifauna, including roosting and nesting sites, and food sources. The highest value potential roosting sites include the three mature Pohutakawa that will be removed through this area.

Vegetation clearance will displace any resident birds and may result in increased competition for remaining food and roosting sites.

Vegetation clearance would also result in direct mortality of eggs and juveniles of resident avifauna if vegetation clearance is conducted within the main breeding season (September to December). Due to the highly mobile nature of adult birds, it is unlikely that vegetation clearance would result in any direct mortality of adult indigenous avifauna. All birds are protected under the Wildlife Act (1953) except those listed in Schedule 5; consequently, mitigation of the potential direct harm to birds is required.

Additional short-term effects generated during construction of the Omaru Creek bridge include disturbance from noise and vibration, which may temporarily displace individuals within the vicinity.

Long term effects in the vicinity of the Omaru Creek bridge include disturbance from the long term use of the bridge, however given there is an existing walkway, potential disturbance from increased traffic associated with this upgrade is considered to be negligible.

In the North Island, banded rail (*Gallirallus phillippensis assimilis)* are restricted to mangrove and saltmarsh habitat. As a cryptic species, it is possible that this At Risk – Declining species (Robertson *et al.*, 2017) may be present either permanently or occasionally within the mangroves to be removed. Adult birds disturbed during clearance activities (short term) are likely to move away from the immediate area.

The magnitude of effects of the construction of the proposed path and bridge on avifauna in Omaru Creek is considered to be low, given the mobile nature of these species and their ability to relocate during temporary disturbance. Overall, the level of effect from the construction and ongoing use of the proposed path on avifauna in Omaru Creek is considered to be low.

4.2.2 Point England Reserve

Coastal birds are known to utilise the public reserves along the extent of the path for roosting and nesting. Point England has been identified as a high-tide roost for many species of native avifauna and breeding ground for NZ dotterels (recovering).

Disturbance is a critical factor for roosting shorebirds and frequent disturbance can have a serious negative effect on energy budgets and ultimately the birds' ability to migrate and breed successfully.

During construction of the proposed path and bridge, noise and vibration from machinery may cause temporary disturbance of coastal birds in these locations or reduce movement between coastal feeding grounds and high tide roosting sites. Machinery access ways for the path construction may also cause displacement of roosting and nesting sites.

The proposed construction period near Pt England reserve is the summer earthworks season, January to April which falls outside of the main dotterel breeding season (August – December). However if these periods should overlap, disturbance may have an adverse effect on the breeding success of

threatened NZ dotterels. It is noted that fledging success of NZ dotterel at Point England is currently low

An adaptive management approach to the staging of construction of Stage 1 of the pathway is recommended to avoid construction during the active breeding period of NZ dotterels within the reserve.

Long-term effects from increased human access and on-going use of the proposed path, including potential disturbance of roosting and nesting sites and permanent displacement of individuals are considered to be negligible given the existing use of the coastal path and sports fields.

The magnitude of effect from the construction of the proposed path in this location is considered to be low as the footprint of works is located along the existing walkway, and effects associated with noise and disturbance during the construction period will be short term and temporary, and will avoid peak breeding season.

Overall, the level of effect from the construction of the proposed path on avifauna in Point England Reserve is considered to be low.

Figure 15: Existing walkway adjacent to Pt England Reserve

4.3 Assessment of Effects on Herpetofauna

Lizard species are not likely to be present within areas that are frequently mown including around public amenity areas and sports fields. Rank grass and coastal scrub bordering these areas are likely to host copper skinks, and it is possible that ornate skink may also be present within these ecological areas. Threatened forest gecko may also be present within coastal vegetation and regenerating native bush.

The construction footprint is largely within the currently mown corridor and potential impacts on lizard habitat are consequently considered to be low.

All native lizard species are afforded absolute protection under the Wildlife Act 1953 and consequently, mitigation of potential direct harm to lizards is required.

4.4 Assessment of Effects on Coastal Receiving Environment

The Tāmaki Estuary adjacent to Point England Reserve is a SEA, provides habitat for high value shorebirds. If construction works are not managed appropriately, short-term discharges of sediment may enter the coastal marine area (CMA) as a result of earthworks or ground disturbance activities. Construction debris and litter may also be washed into the CMA. The release of sediment and debris/litter into the Tāmaki Estuary can potentially impact benthic fauna, and indirectly affect the high value shorebirds that utilise the estuary as a food resource. Fuel spills or oil leaks from machinery could also have adverse ecological effects on the values of the SEA.

The potential level of effect of discharges to the Tāmaki Estuary is considered to be high. The staged construction of coffer dams on either side of Omaru Creek will seal off the work area preventing disturbed sediment from being discharged outside of the area. Additional sediment and erosion control measures are required to mitigate the risk of discharges to the marine receiving environment from other stages of the construction of the path.

The staged construction of coffer dams on either side of Omaru Creek to allow for bridge construction will alter channel flows temporarily and could potentially entrain fish during the dewatering process. It is recommended that a fish management plan is prepared to provide for the rescue and relocation of any native fish during the dewatering phase.

Direct mortality of benthic invertebrates that are within the construction footprint of the Omaru Creek bridge, or are exposed due to diversion of water during installation of piles are expected. All benthic invertebrates are expected to be common and widely distributed and only a small area within the footprint of the piles (<1m^2) will permanently displace fauna. The overall level of effect on benthic fauna within the Omaru Creek bridge footprint is considered to be very low.

It is proposed that construction will be undertaken from the banks to avoid tracking machinery to the coastal marine area where feasible. Where this is not feasible, additional controls will be required to minimise potential impacts of the movement of machinery on benthic fauna and mudflat habitats.

5.0 Ecological Impact Assessment - Southern Section

Potential and actual impacts on the vegetation, herpetological, freshwater, avian, coastal and freshwater values in the southern section of the proposed path are discussed below. Impacts are summarised in Table 20.

5.1.1 Assessment of Effects on Avifauna

Shorebirds have been observed to utilise public reserves along the southern section of the proposed path as high-tide roosting habitat (Riverside, Dunkirk and Mount Wellington War Memorial Reserves). As discussed in 4.2.2, disturbance is a critical factor for roosting shorebirds. During construction of the proposed path and bridge, noise and vibration from machinery may cause temporary disturbance of coastal birds in these locations or reduce movement between coastal feeding grounds and high tide roosting sites. The proposed construction period near Mount Wellington War Memorial Reserve is the summer earthworks season, January to April whilst the construction period for Riverside and Dunkirk Reserves falls within winter.

Long-term effects from increased human access and on-going use of the proposed path, including potential disturbance of roosting sites and permanent displacement of individuals are considered to be negligible given the existing use of these reserves for informal recreation, off-leash dog exercise, and the sports fields in Mount Wellington War Memorial Reserve.

The magnitude of effect from the construction of the proposed path in this location is considered to be low as the footprint of works is located along existing public reserves, and effects associated with noise and disturbance during the construction period will be short term and temporary. Overall, the level of effect from the construction of the proposed path on avifauna in public reserves located along the southern section of the proposed path is considered to be very low.

5.2 Assessment of Effects on Herpetofauna

Lizard species are not likely to be present within areas that are frequently mown including around public amenity areas and sports fields. Rank grass and coastal scrub on the coastal fringes are likely to host copper skink. Ornate skink and threatened forest gecko may also be present within these areas.

The construction footprint is largely within currently mown reserves and sports fields and potential impacts on lizard habitat are consequently considered to be low through this section of the proposed path.All native lizard species are afforded absolute protection under the Wildlife Act 1953 and consequently, mitigation of potential direct harm to lizards is required.

5.3 Assessment of Effects on Coastal Receiving Environment

The Tāmaki Estuary adjacent to the southern extent of the proposed path is a marine SEA, providing habitat for high value shorebirds. If construction works are not managed appropriately, short-term discharges of sediment may enter the CMA as a result of earthworks or ground disturbance activities. Construction debris and litter may also be washed into the CMA. The release of sediment and debris/litter into the Tāmaki Estuary can potentially impact benthic fauna, and indirectly affect the high value shorebirds that utilise the estuary as a food resource. Fuel spills or oil leaks from machinery could also have adverse ecological effects on the values of the SEA.

The potential level of effect of discharges to the Tāmaki Estuary is considered to be high and appropriate sediment and erosion controls are required to minimise the likelihood of this occurring.

6.0 Impact Management – Northern Path Section

The hierarchy of impact management should be adhered to, whereby impacts are to be avoided where practicable; remedied or mitigated on site if adverse effects cannot be avoided; any residual adverse impacts following appropriate mitigation should be offset with an aim of achieving no net loss of biodiversity with respect to species composition, habitat structure, and ecosystem function.

6.1 Avoidance

Environmental constraints and opportunities mapping was undertaken at the commencement of the project following initial site investigations. Environmental constraints and opportunities identified from initial site investigations were mapped against the proposed path alignment as set out in the FrameGroup feasibility reports. The Mauri Model was used as a framework to document potential impacts and opportunities of the proposed alignment on the Environmental, Cultural, Social and Economic wellbeings. A total of 219 items, 180 which constitute the baseline assessment with 29 supplementary alternative consideration were documented during the constraints mapping process. This process was essential to avoiding environmental impacts wherever possible. The documentation of the environmental constraints and opportunities process is included in Appendix 4.

This design process was employed to achieve outcomes that meet the definition of Green Infrastructure, which manage risks of negative impacts and maximise enhancement of social and environmental values.

Avoidance measures associated with the northern section of the revised path alignment are detailed in Table 15 below.

Table 15: Summary of avoidance measures taken to avoid environmental impacts (northern section)

Potential Impact Area	Method of Avoidance	Environmental Impacts avoided
Removal of vegetation between C1 and C2 Pt England Reserve North	The Frame Group preferred option bridge would have resulted in the removal of approximately 210 m^2 of the highest ecological value vegetation within the project site by widening 70 m of the existing path to 3 m. The lower impacts option was considered to build a longer spanning bridge across the mouth of Omaru Creek to avoid the vegetation loss.	Loss of biodiversity Loss of avian habitat and roost sites Potential loss in bank stability
Works in the root zone of individual trees	Relocation of path alignment to avoid root zones of scheduled trees. Further detail is provided in arboricultural assessment (Greenscene, 2017).	Adverse effects on condition of mature trees.

6.2 Mitigation

Mitigation measures proposed and recommendations to reduce impacts from the construction and long-term use of the proposed Tāmaki Path in the northern section of the project area are detailed in Table 16 and summarised in Table 19.

Table 16: Mitigation measures and recommendations to reduce impacts (northern path section)

Impact type and location	Proposed mitigation measures and recommendations
Vegetation removal at Omaru Creek	Prior to removal of any flora and fauna the site engineer will be notified and await confirmation/approval of any works. Reinstating vegetation within the construction footprint (approximately 283 m^2), providing formal protection for remaining vegetation, and weed control.
Mangrove removal at Omaru Creek	Mangrove roots will be left in place to avoid unnecessary disturbance of marine mud. Low impact mangrove removal methods including: • Minimising proposed area of clearance • Non mechanical removal (via hand clearance) • Minimising disturbance of fauna (clearing outside of breeding season); • Minimising movement footprint to reduce trampling; and Disposing of cut vegetation outside the CMA Mangrove removal should be carried out during autumn or winter to minimise impacts on potential banded rail breeding sites.
Impacts on avifauna from bridge construction through Omaru Creek	Where practicable, vegetation removal is undertaken outside of peak bird breeding season (September to December inclusive). Prior to removal of vegetation, large trees and vegetation should be checked by an avian specialist for any roosting or nesting birds.
Impacts from bridge construction on fish, channel flows, and erosion in Omaru Creek mouth.	Bank will be reinstated following construction of the bridge. Staged construction to allow for continual flows through the Omaru Creek Preparation of Fish Management Plan to be developed to minimise potential harm to fish from staged cofferdams.
Disturbance to coastal birds in Point England Reserve from construction	Construction of the proposed path will be staged, this will allow coastal birds that are temporarily disturbed or displaced to relocate to reserves along the proposed alignment. Omaru Creek bridge and section through Point England Reserve timed for construction in January – April, outside of peak breeding season. Species selected for proposed offset planting through Point England Reserve should consider potential impacts on shorebirds, in regards to reducing visibility of predators.
Impacts on lizards from vegetation removal in Omaru Creek and construction of path in Point England Reserve.	It is recommended that a rapid lizard survey be undertaken by a suitably qualified herpetologist to determine whether lizards are likely to exceed 20 individuals per species along the proposed path. This will in turn determine whether the project can proceed without a project-specific Wildlife Permit.
Discharges into the Tāmaki Estuary from construction work in Point England Reserve.	Construction will occur during earthworks season to reduce sediment discharges. Vehicle access suspended if ground conditions too wet. Stabilised access ways built up to construction area. Erosion and sediment control measures will be implemented including: • Minimising the area of open ground at any one time • Silt fencing • Filter socks

- Stablishing topsoil stock piles.
- Cofferdams

Detailed sediment and erosion control plans are to be developed and implemented. Erosion and sediment control measures will be implemented including:

- Minimising the area of open ground at any one time
- Silt fencing
- Filter socks
- Stablishing topsoil stock piles.
- Cofferdams

Detailed sediment and erosion control plans are to be developed and implemented.

6.3 Residual Adverse Effects

Ecological impacts associated with the clearance of approximately 155 m^2 of regenerating native bush of moderate-high value in the construction footprint through the north bank of Omaru Creek are unable to be sufficiently avoided or mitigated. This residual adverse effect is proposed to be addressed through biodiversity offsetting.

A ratio of 3:1 has been applied to proposed offset planting areas, given the high ecological value of the regenerating native bush and replacement planting is typically of pioneer species that does not provide like-for-like offsetting for the removal of established vegetation. Locations proposed for offset planting have been selected which contain similar ecological zones to those locations being removed, and with the overall goal of achieving a net biodiversity gain, in terms of species composition, habitat structure and ecosystem function.

The proposed area for offset planting includes margins of the ephemeral watercourse at Pt England Reserve(Figure 9), located along the coastal fringes of Point England Reserve, covering a total area of approximately 465 m^2. It is recommended that three large grade (e.g. 60 L) pōhutukawa trees be included in the species mix for offset planting. It is noted that there is a small remnant of midden in the lower ephemeral channel, placement of deep rooting species (such as pōhutukawa) should be under further advice from the project archaeologist as part of a general authority from Heritage New Zealand. Areas for additional, optional, enhancement planting have also been recommended along the proposed Tāmaki path. It is noted that this enhancement planting is not part of the resource consent application for the construction of the Tāmaki Path. It is indicative only, and illustrates Council's future aspirations for enhancement of the coastal environment

Locations of vegetation removal and proposed off-set planting areas, in addition to optional enhancement areas are provided in Map 5A of Appendix 1.

7.0 Impact Management - Southern Path Section

7.1 Avoidance

Environmental constraints and opportunities mapping was undertaken at the commencement of the project following initial site investigations, for the original path alignment. Environmental constraints and opportunities identified from initial site investigations were mapped against the proposed path alignment as set out in the FrameGroup feasibility reports. The Maui Model was used as a framework to document potential impacts and opportunities of the proposed alignment on the Environmental, Cultural, Social and Economic wellbeings. A total of 219 items, 180 which constitute the baseline assessment with 29 supplementary alternative consideration were documented during the constraints mapping process. This process was essential to avoiding environmental impacts wherever possible. The documentation of the environmental constraints and opportunities process is included in Appendix 4.

This design process was employed to achieve outcomes that meet the definition of Green Infrastructure, which manage risks of negative impacts and maximise enhancement of social and environmental values.

Avoidance measures associated with the southern section of the revised path alignment are detailed in Table 17 below.

Table 17: Summary of avoidance measures taken to avoid environmental impacts (southern section)

Potential Impact Area	Method of Avoidance	Environmental Impacts avoided
Removal of mature gum trees and pine trees adjacent to the Tāmaki Rugby Football Club and Tennis Club)	Mature tree removal has been avoided by moving the path alignment further west to allow adequate space for the construction of the path in these pinch points. Selective pruning of karo under the gum trees has been allowed for to meet CPTED principles whilst protecting the gum trees.	Loss of mature trees Loss of avian habitat and roost sites Loss of potential bat habitat Potential bank stability issues
Works in permanent and intermittent watercourses	Bridges have been provided at each stream crossing point on permanent streams.	Loss of connection between hyporheic zone
Works in the root zone of individual trees	Relocation of path alignment to avoid root zones of scheduled trees. Further detail is provided in the arboricultural assessment report (Greenscene).	Adverse effects on condition of mature trees.

7.2 Mitigation

Mitigation measures proposed and recommendations to reduce impacts from the construction and use of the Tāmaki Path in the southern section of the project area are detailed in Table 18 below and summarised in Table 20.

Table 18: Mitigation measures and recommendations to reduce impacts (southern section)

Impact type and location	Proposed mitigation measures
Disturbance or displacement of shorebird roosting sites during construction works in the	Construction of the proposed path will be staged, this will allow coastal birds that are temporarily disturbed or displaced to relocate to reserves

southern reserves	along the proposed alignment. Works undertaken in accordance with the requirements of NZS 6803: 1999 'Acoustic – Construction Noise' and any relevant resource consent conditions. Construction works undertaken during agreed working hours.
Direct mortality of lizards during path construction	It is recommended that a rapid lizard survey be undertaken by a suitably qualified herpetologist to determine whether lizards are likely to exceed 20 individuals per species along the proposed path. This will in turn determine whether the project can proceed without a project-specific Wildlife Permit.
Discharges from construction activities (sediment, construction debris, litter, or fuel spills) into the CMA	Erosion and sediment control measures will be implemented including: • Minimising the area of open ground at any one time • Silt fencing • Filter socks • Stablishing topsoil stock piles. • Cofferdams Detailed sediment and erosion control plans are to be developed and implemented.

7.3 Residual Adverse Effects

No residual effects have been identified along the southern section of the path. It is considered that all identified impacts can be addressed through avoidance, remediation or mitigation.

8.0 Adaptive Management and Monitoring

In the event that adverse effects on ecological values are greater than predicted or mitigation offsets do not achieve the mitigation outcomes an adaptive management approach is recommended.

In accordance with EIANZ recommendations, where practical it is recommended that an adaptive management plan is established within the EMP. Staged construction works should be programmed to allow roosting and nesting birds to relocate to alternative suitable habitat.

It is recommended that monitoring of avifauna be undertaken before, during and after the construction process as follows:

- Prior to construction, baseline surveys should be undertaken along the entire length of the proposed construction footprint. These surveys should include visual counts of roosting shorebirds and ten-minute bird counts for terrestrial avian species in the area of mature vegetation along Omaru Creek. Footprint and playback surveys for banded rail should be undertaken before mangrove removal operations are carried out in the vicinity of Omaru Creek bridge.
- During the construction process, an avian specialist should monitor removal of mature pōhutukawa along Omaru Creek to ensure nesting avifauna are not affected, if undertaken during breeding season.
- Follow up bird surveys should be undertaken during construction to monitor effects on avian roost sites.
- Post-construction monitoring should be undertaken to assess the success of mitigation and offset plantings and bird counts undertaken to compare effects of construction.

It is recommended that all planting sites are maintained for at least three years. Maintenance includes releasing of plants from any colonising exotic species and replacement of dead plants.

A bi-annual survey of the vegetation clearance footprint should be conducted within a year following completion of construction to assess the extent, if any, of:

- Additional die back of indigenous vegetation beyond the clearance footprint from edge disturbances;
- An increase in weeds (abundance or diversity) in the retained area; and,
- The survival rate of buffer enhancement planting.

9.0 Summary of Assessment of Ecological Effects

9.1 Northern Section of Proposed Path

Ecological impacts in the northern section of the proposed path are greatest in the vicinity of Omaru Creek. The vegetation on the northern banks of Omaru Creek is of moderate to high ecological value, and the permanent loss of this vegetation (including three mature pōhutukawa trees) through the 8 m wide bridge construction footprint is likely to result in a moderate magnitude of effect. Consequently, the overall effect on ecological values from this activity is considered to be high, and further mitigation actions are warranted.

The potential effects of the construction of the pathway on avifauna include disturbance or displacement of individuals, and reduced movement between feeding grounds and roosting sites. This is mitigated through the staged progression of works including ensuring works in the vicinity of Point England Reserve are timed to avoid the peak breeding season of NZ dotterels (August to December).

It is possible that the cryptic banded rail may be present within the mangroves to be removed during the Omaru Creek bridge construction and vegetation clearance should also be timed to avoid peak breeding season.

The construction footprint is largely within the currently mown corridor and potential impacts on lizard habitat are consequently considered to be low. However all indigenous lizards are absolutely protected and a lizard management plan is recommended to be prepared to rescue and relocate lizards during vegetation clearance. A survey may be required to confirm whether this may proceed without a project specific Wildlife Permit.

The potential level of effect of discharges (sediment, spills or construction debris) into the Tāmaki Estuary during construction works is considered to be high and sediment and erosion controls, consistent with TP90, or GD05, as appropriate.

The construction of the bridge at Omaru Creek will result in the direct mortality of benthic fauna and permanent loss of benthic habitat within the footprint of the timber piles. This is collectively estimated at $<1m^2$ and is consequently considered to be of low impact to the existing values of the stream mouth or wider SEA. The proposed staged construction of cofferdams around the work area will provide a dry work site and seal off the area to reduce the risk of discharge of suspended sediments or other contaminant to the coastal marine area. However, the construction of the dams may result in the entrainment of fish and an appropriate fish management plan is recommended to rescue and relocate fish during dewatering.

Following avoidance, remediation, and mitigation of the potential ecological effects of the proposed pathway, the overall level of effect of the construction of the proposed path is considered to be low. Note that if the recommended mitigation measures are not implemented, the impact is considered the 'without mitigation' level. It is recommended that this impact assessment is revised following any alterations to the proposed design or construction methodology.

Table 19: Summary of impacts and recommendations for northern path section (refer to Appendix 3 for interpretation)

Impact area	Details	Ecological value	Magnitude of impact	Level of effect (without mitigation)	Remediation and mitigation measures	Level of effect (with mitigation)
Omaru Creek Riparian Vegetation (North)	Clearance of 155 m^2 of regenerating native bush and intrinsic loss of habitat	Moderate-High	Moderate	High	Reinstating vegetation within the construction footprint (approximately 283 m^2)	High (off set planting required)
	Fragmentation and edge effects	Moderate-High	Low	Low	Bank will be reinstated following construction of the bridge. Weed control is recommended along edges	Low
	Noise and vibration disturbance to avifauna from bridge construction	Low	Low	Low	Works undertaken in accordance with the requirements of NZS 6803: 1999 'Acoustic – Construction Noise' and any relevant resource consent conditions. Construction works undertaken during agreed working hours.	Low
	Direct mortality of eggs and juvenile birds if vegetation is cleared during breeding season	Low	Low	Low	Avoid vegetation clearance August to December.	Very low
	Direct mortality of lizards during vegetation clearance and construction.	Moderate - High	Low	Low	Rapid lizard survey recommended to determine lizard abundance in project area and in turn whether the project can proceed without a project-specific Wildlife Permit.	Very low
Omaru Creek Riparian Vegetation (South)	Clearance of 128 m^2 of mixed coastal vegetation and general loss of habitat	Low	Low	Low		Low
	Direct mortality of eggs and juvenile birds if vegetation is cleared during breeding season	Low	Low	Low	Avoid vegetation clearance August to December.	Very Low

Impact area	Details	Ecological value	Magnitude of impact	Level of effect (without mitigation)	Remediation and mitigation measures	Level of effect (with mitigation)
Mangroves	Clearance of 116 m^2 of mangrove vegetation	Moderate	Low	Low		Low
	Changes to benthic communities from mangrove removal	Low	Low	Low	Mangrove roots will be left in place to avoid unnecessary disturbance of marine mud. Low impact mangrove removal methods including: • Minimising proposed area of clearance • Non mechanical removal (via hand clearance) • Minimising disturbance of fauna (clearing outside of breeding season); • Minimising movement footprint to reduce trampling; and • Disposing of cut vegetation outside the CMA	Very Low
Point England Reserve	Disturbance or displacement of shorebird roosting and nesting sites and life-cycle stages	High	Low	Low	Construction of path to occur outside of breeding season of NZ dotterel (August to December). Adaptive management approach to staged construction works (stage 1). Consider effects of proposed coastal planting species on shorebirds, in regards to increasing predation.	Low

Impact area	Details	Ecological value	Magnitude of impact	Level of effect (without mitigation)	Remediation and mitigation measures	Level of effect (with mitigation)
Coastal Receiving Environment (Tāmaki Estuary)	Discharges of from construction activities (sediment, construction debris, litter, or fuel spills)	High	Moderate	High	Construction will occur during earthworks season to reduce sediment discharges. Vehicle access suspended if ground conditions too wet. Stabilised access ways built up to construction area. Sediment and erosion control measures implemented through EMP. Works in accordance with Construction Methodology Management Plan	Low
Omaru Creek Mouth	Bank instability and erosion, and reduced filtration of surface sheet flow	High	Moderate	High	Bank will be reinstated following construction of the bridge. Sediment and erosion control measures during construction implemented through EMP.	Low
	Direct mortality of benthic invertebrates	Low	Low	Low	Minimise area of disturbance where possible.	Low
	Alteration of channel flow	High	Moderate	High	Staged construction to allow for continual flows through the Omaru Creek.	Low
	Entrainment of fish during dewatering of cofferdam	Low	Low	Low	Preparation of Fish Management Plan recommended.	Low

9.2 Southern Section of Proposed Path

Shorebirds are known to also utilise the public reserves in the southern section of the path (Riverside, Dunkirk and Mt Wellington War Memorial Reserves) for roosting sites, although no records of threatened bird species have been found here. Overall, the level of effect from the construction of the proposed path on avifauna in these reserves is considered to be low, given the short-term duration of effects and the existing level of activity within the reserves.

The construction footprint is largely within the currently mown corridor and potential impacts on lizard habitat are consequently considered to be low. However all indigenous lizards are absolutely protected and a lizard management plan is recommended to be prepared to rescue and relocate lizards during vegetation clearance.

Discharges into watercourses (Riverside Reserve Stream and Tāmaki Estuary) associated with construction activities (sediment, construction debris, litter or minor fuel spills from machinery) have the potential to reduce water quality if not managed appropriately. The potential level of effect of construction discharges to the Tāmaki Estuary is considered to be high and sediment and erosion controls, consistent with TP90, or GD05, as appropriate.

Following avoidance, remediation, and mitigation of the potential ecological effects of the proposed pathway, the overall level of effect is considered to be very low given the smaller scale of proposed works and less available habitat for native fauna. Note that if the recommended mitigation measures are not implemented, the impact is considered the 'without mitigation' level.

Table 20: Summary of impacts and recommendations for southern path section (refer to Appendix 3 for interpretation)

Impact area	Details	Ecological value	Magnitude of impact	Level of effect without mitigation	Remediation and mitigation measures	Significance of effect after recommended mitigation
Southern Public Reserves	Disturbance or displacement of shorebird roosting sites and life-cycle stages during construction works	Low	Low	Very low	Staged construction works. Avoidance of peak breeding season.	Very low
	Direct mortality of lizards during path construction	Moderate and High	Low	Low	Relocation of lizards on site during construction in accordance with a Lizard Management Plan.	Very low
Coastal Receiving Environment (Tāmaki Estuary)	Discharges from construction activities (sediment, construction debris, litter, or fuel spills)	High	Moderate	High	Construction will occur during earthworks season to reduce sediment discharges. Vehicle access suspended if ground conditions too wet. Stabilised access ways built up to construction area. Sediment and erosion control measures implemented through EMP. Works in accordance with Construction Methodology Management Plan	Low
Riverside Reserve Stream	Discharge of sediment	Low	Moderate	Low	Construction will occur during earthworks season to reduce sediment discharges. Sediment and erosion control measures implemented through EMP. Works in accordance with Construction Methodology Management Plan.	Very low

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Appendix 1 Maps

MAP 1 - WATERCOURSES LOCATED WITHIN PROJECT AREA

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Proposed Tamaki Path Alignment

Stormwater Inlet/Outlet

Stormwater Drain

Open Watercourse

Stormwater Treatment Wetland

Stormwater Catchments

Client GHD

Project **TAMAKI GREENWAYS**

0 300 600 m

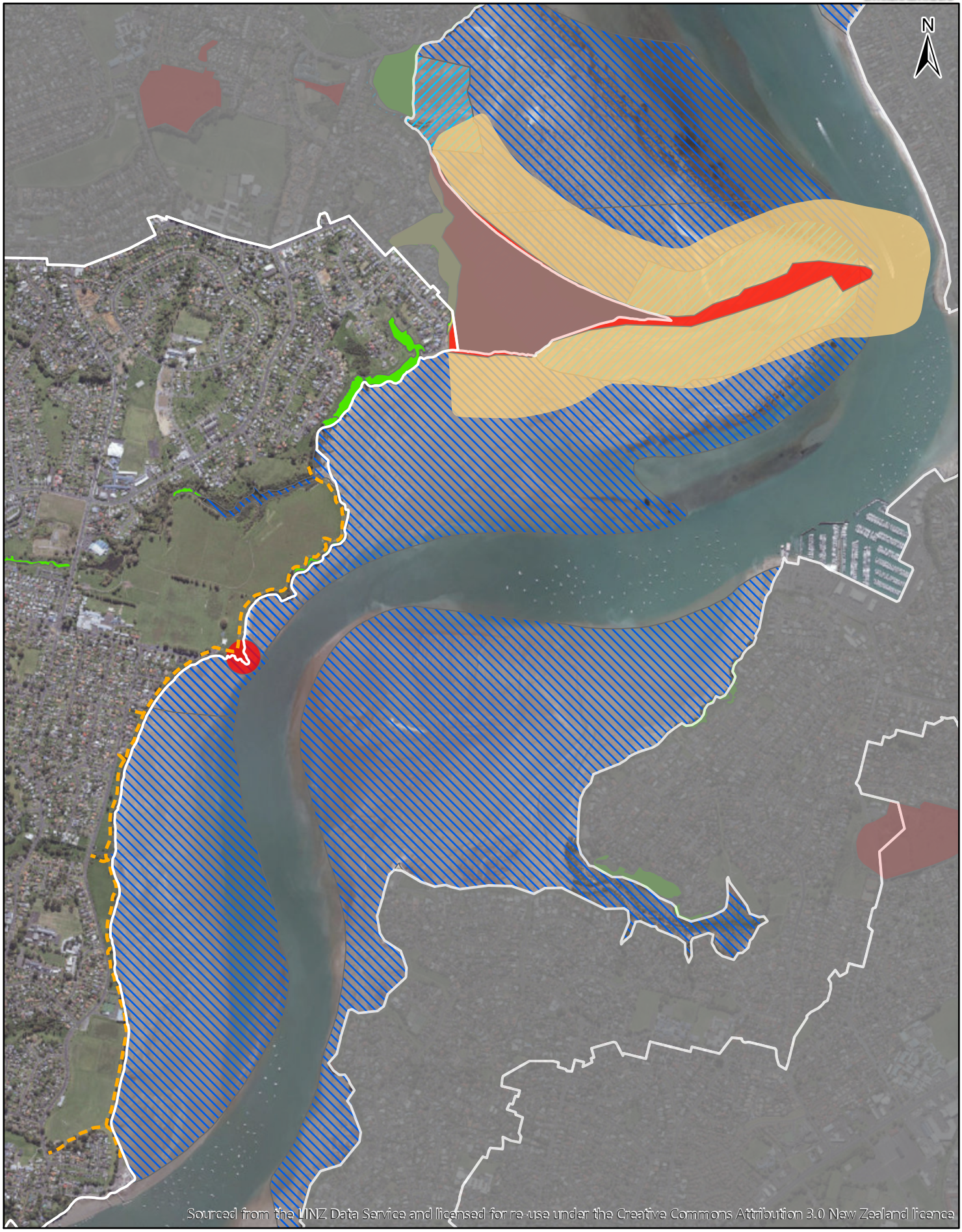
Project no. P00974

Date 13 Jul 17

Drawn SM

Approved CC

MAP 2 - SIGNIFICANT ECOLOGICAL AREAS



Significant Ecological Areas

- Marine 1
- Marine 2
- Terrestrial
- High Natural Character Area
- Outstanding Natural Features
- Proposed Tamaki Path Alignment
- Stormwater Catchments

Client GHD
Project **TAMAKI GREENWAYS**

0 450 900 m

Project no. P00974
Date 13 Jul 17

Drawn SM
Approved CC

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MAP 3 - ECOLOGICAL ZONES

Ecological Zoning

- Coastal
- Coastal exotic
- Grazed grass
- Mangrove
- Mown grass
- Regenerating Native Bush
- Rank grass

Client GHD

Project **TAMAKI GREENWAYS**

0 250 500 m

Project no. P00974
Date 13 Jul 17

Drawn SM
Approved CC

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MAP 4 - STREAM ECOLOGICAL VALUES

NZFFDB (2005 - 2010)

- Other
- Banded Kokopu
- Common Bully
- Mosquitofish
- Shortfin Eel
- Unidentified Eel
- Yellow Eyed Mullet

MCI Score (Clapcott et al. 2011)

- ≤80.0

- Stormwater Catchments
- Proposed Tamaki Path Alignment

0 300 600 m

Client GHD
Project **TAMAKI GREENWAYS**
Project no. P00974
Date 13 Jul 17
Drawn SM
Approved CC

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MAP 5A - AREAS OF VEGETATION REMOVAL AND PROPOSED PLANTING

Proposed Planting

- Optional Enhancement Planting
- Offset Planting (Riparian)
- Proposed Tamaki Path Alignment
- Vegetation Removal

Client GHD

Project **TAMAKI GREENWAYS**

0 75 150 m

Project no. P00974
Date 25 Jul 17

Drawn SM
Approved CC

This plan may contain errors or omissions or may not have the spatial accuracy required for some purposes. There may be other information relating to the area shown on this map which is unknown to Morphum Environmental Ltd. This map may contain Crown copyright data. Please consult Morphum Environmental Ltd if you have any queries.

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MAP 5B - AREAS OF PROPOSED PLANTING

Proposed Planting

- Enhancement,Coastal
- Enhancement,Coastal low growing
- Enhancement,Low lying amenity
- Enhancement,Riparian
- Proposed Tamaki Path Alignment

Client GHD

Project **TAMAKI GREENWAYS**

0 175 350 m

Project no. P00974

Date 13 Jul 17

Drawn SM

Approved CC

W:\Morphum_GIS\Projects\Organisations\GHD\P00974 Tamaki Greenways\MXDs\Tamaki Greenways.aprx Layout: Map 5B Vegetation Removal

Appendix 2 Plant Species Identified in Project Area

Table 21: Plant Species Identified in Project Area

Species	Common name
Acacia mearnsii	Black wattle
Adiantum aethiopicim	
Adiantum hispidulum	
Agapanthus praecox	Agapanthus
Alectryon excelsus	Titoki
Alocasia brisbanensis	Elephant ear
Asparagus scandens	Climbing asparagus
Asplenium flaccidum	Hanging spleenwort
Asplenium oblongifolium	Shining spleenwort
Bambusa sp.	Bamboo
Blechnum parrisiae	
Carex lessoniana	Spreading swamp sedge
Cirsium vulgare	Thistle
Convolvulus arvensis	Field bindweed
Coprosma grandifolia	Kanono
Coprosma robusta	Karamu
Coprosma rotundifolia	Round-leaved coprosma
Cordyline australis	Cabbage tree
Cortaderia selloana	Pampas
Corynocarpus laevigatus	Karaka
Crataegus monogyna	Hawthorn
Crocosmia x crocosmiliflora	Montbretia
Cyathea dealbata	Silver fern
Dicksonia squarosa	Wheki
Doodia sp.	Pukupuku
Euonymus japonicus	Japanese spindle
Geniostoma ligustrifolium	Hangehange
Gomphocarpus physocarpus	Swan plant
Hedychium gardneriunum	Kahili ginger
Hydrangea sp.	Hydrangea
Ipomoea indica	Blue Morning Glory
Jasminium polyanthum	Jasmine
Knightia excelsa	Rewarewa
Kunzea ericoides	Kanuka
Ligustrum lucidum	Tree privet
Ligustrum sinense	Chinese privet
Lonicera japonica	Japanese honeysuckle
Melicytus ramiflorus	Mahoe

Microsorum pustulatum	Hound's tounge
Monstera deliciosa	Fruit salad plant
Myrsine australis	Mapou
Nephrolepis cordifolia	Ladder fern
Paraserianthes lophantha	Bush wattle
Pennisetum clandestinum	Kikuyu
Phytolacca octandra	Inkweed
Pinus radiata	Monterey pine
Pittisporum crassifolium	Karo
Polystichum neozelandicum	
Rubus sp.	Blackberry
Rumex obtusifolius	Dock
Rumex sagittatus	Climbing dock
Salix fragilis	Crack willow
Schleffera digitata	Pate
Selaginella kraussiana	African club moss
Solanum mauritanum	Woolly nightshade
Solanum sp.	Black nightshade
Sophora microphylla	Kowhai
Tradescantia flumensis	Wandering jew
Tropaeolum majus	Nasturtium
Veronica stricta	Hebe
Weinmannia silvicola	Towai
Zantedeschia aethiopica	Arum lily

Appendix 3 Key Criteria Used in Assessment of Effects

Table 23: Assigning value to species, vegetation, and habitats (summarised from EIANZ, 2015)

Value	Species Values	Vegetation/Habitat Values
Very High	Nationally threatened – critical or vulnerable	Supporting more than one national priority type. Nationally threatened species found or likely to occur there, either permanently or occasionally.
High	Nationally at risk – declining	Supporting one national priority type or naturally uncommon ecosystem. At risk, declining species found or likely to occur there, either permanently or occasionally.
Moderate - High	Nationally at risk – recovering, relict, or naturally uncommon	Other at risk species found or likely to occur there, either permanently or occasionally.
Moderate	Locally uncommon. rare, not nationally threatened or at risk	Locally rare or threatened, supporting no threatened or at risk species
Low	Not threatened nationally, common locally	Nationally and locally common, supporting no threatened or at risk species

Table 24: Criteria for describing magnitude of effect (summarised from EIANZ, 2015)

Magnitude	Description
Very High	Total loss of or major alteration to key features of the baseline condition causing a fundamental change or complete loss of the character, composition, or attributes of the site.
High	Major loss or major alteration to key features of the baseline condition causing a fundamental change of the character, composition, or attributes of the site.
Moderate	Loss or alteration of one or more key features of the baseline condition causing a partial change to the character, composition, or attributes of the site.
Low	Minor shift away from baseline conditions. Change may be discernible but underling character, composition, or attributes of the site will be similar to pre-development.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable.

Table 25: Criteria for describing level of effects (from EIANZ, 2015)

Ecological Value / Magnitude	Very High	High	Moderate	Low
Very High	Very High	Very High	High	Moderate
High	Very High	Very High	Moderate	Low
Moderate	Very High	High	Low	Very Low
Low	Moderate	Low	Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low

Table 26: Interpretation of effects against standard terms (modified from EIANZ, 2015)

Level of effect	Interpretation	
Very High	Unacceptable adverse effects	Extensive adverse effects that cannot be avoided, remedied, or mitigated
High	Significant adverse effects	An effect that is noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied
Moderate	More than minor	Adverse effects that are noticeable and may cause an adverse impact but could be potentially mitigated or remedied
Low	Minor adverse effects	Adverse effects that are noticeable but that will not cause any significant adverse impacts
Very Low	Less than minor adverse effects	Adverse effects that are discernible day to day effects but too small to adversely affect the environment or other persons
Nil	Nil effects	No effects at all

Appendix 4 Constraints and Opportunities Memo

MORPHUM ENVIRONMENTAL LTD

Engineers & Consultants

Memorandum

Date:	23rd August 2016
To:	Ryan Orr
From:	Caleb Clarke
CC:	Kate Macintosh, Gary Marshall, Ray Johnston

Subject: Tamaki Path Constraints and Opportunities Framework

Hi Ryan,

This memo is to document the methodology and results of the framework used for the constraints and opportunities workshop for the Tamaki Path held on the 12th July.

In order to fulfil the environmental design process we put forward in the Project Methodology, the constraints and opportunities workshop is critical to provide an open transparent process to table constraints and opportunities for design as well as communication or incorporation of any particular ideas and perspectives from stakeholders going forward.

This is a particularly important design process to achieve outcomes that meet the definition of Green Infrastructure, which manage risks of negative impacts and maximise enhancement of social and environmental values.

Therefore we proposed the structure of Multi-criteria assessment based loosely on the Mauri Model to provide a framework that would provide clarity and constructive input and that can be considered down the track to close the loop on outcomes through the design.

Mauri Model

Mauri is a concept that permeates Māori thinking; it is the binding force that holds together the physical and spiritual components of a being or thing (Morgan 2006). When actions impact negatively upon the mauri of something this essential bond is weakened (or broken), potentially resulting in the separation of the physical and spiritual elements leading to the death of a living thing or alternatively the loss of its capacity to support other life (Morgan 2006).

The Mauri model was developed as an assessment tool that allows for consideration against the four wellbeing's of Environmental, Cultural, Social and Economic objective in terms of the enhancement or denigration of mauri with a rating of outcomes between -2 and +2 as demonstrated in Figure 1 below.

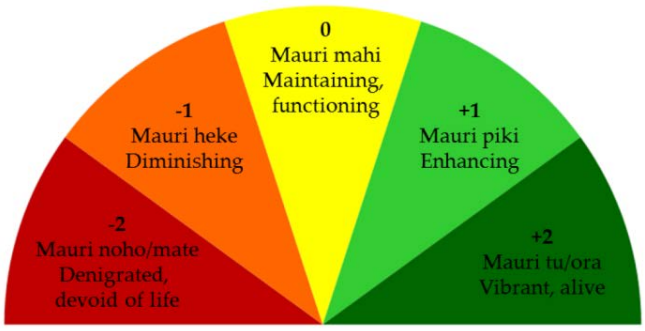


Figure 1: "Mauri-o-metre" demonstrating the ratings that result from the Mauri Assessment (recreated after Morgan, 2008).

Methodology

Mauri Model Framework

The Mauri model framework was loosely adapted to the Tamaki Path Project. Table 1 includes summary description of the range of scores from -2 to +2 applied to the Tamaki Path.

Under the four wellbeings a range of indicators can be identified that contribute to the overall status of the factor. Each of these indicators can be rated on an integer scale from +2 to -2, Table 2 includes a summary of the indicators used for each of the four wellbeings that are considered relevant to the Tamaki Path.

Table 1: Mauri Model Scoring

Constraints		**Opportunities**	
Score	**Description**	**Score**	**Description**
0	Neutral or of little consequence for special consideration.	0	Neutral or of little consequence for special consideration
-1	Risk of diminishing outcomes, with a need for consideration in design – Specific comment recorded	+1	Potential for enhancement to be considered for accentuation in design – specific comment recorded
-2	Risk of denigrating the environment or successful outcomes, with specific measures proposed to avoid remedy or mitigate the risk.	+2	Potential for contribution to the project having remarkable outcomes and key measures proposed.

Table 2: Indicators for Mauri Model Assessment of Tamaki Path Alignment Options

Mauri Focus Area	**Consideration/ indicator**	**Primary Assessor**
Environmental	General Consentability	Kim Hardy
	Freshwater and Marine Ecology	Kate Macintosh
	Terrestrial Ecology	Kate Macintosh
	Arboriculture	Craig Webb
	Contaminated Land	Laura Bell
Cultural	Archaeology	Don Prince/Caleb Clarke
	Te Aranga Design	Gary Marshall
	Character/Amenity	Gary Marshall

Mauri Focus Area	Consideration/ indicator	Primary Assessor
Social	Accessibility	Gary Marshall
	Safety	Gary Marshall/ Jason Chow
	Bicycle Horizontal/ Vertical alignment	Jason Chow
Economics/Engineering	Geotechnical	Nick Burke
	Structural	Tadeas Mejdr
	Resilience and Futureproofing	All
	Cost	Ryan Orr/ Ray Johnstone

Node and Zone Identification

Nodes and Character zones act as a reporting structure for capturing constraints and opportunities along path segments across the different disciplines within the project team. A Character Zone is defined as having a typical character along a section of path and a Node is defined as a key entry exit point/ discrete point of interest or particular design challenge.

A list of Character zones and Nodes were identified by the Landscape Architects and are included in Table 3 below.

Table 3: Tamaki Path Character Zones and Nodes

Number	Item	Type
1	Northern Entrance	Node
2	Wai o Taki Bay	Character Zone
3	Pt England Internal	Character Zone
4	Oamaru Creek Mouth	Node
5	Omaru Creek	Character Zone
6	Pt England Coastal	Character Zone
7	Pt England Reserve Carpark	Node
8	Riverside Residential	Character Zone
9	Dunkirk/Riverside Reserve Riverside Residential	Character Zone
10	Marist Rugby Club	Node
11	Mt Wellington War Memorial Reserve	Character Zone
12	Panmure Wharf and Boat Ramp	Node

Workshop Preparation

Each discipline received the Mauri model score descriptions, Mauri Model indicators and character zone and node list prior to the workshop in order to assign a rating against their relevant indicator for each node and character zone with comments on the key constraint/opportunities.

This approach was taken to focus discussions at the workshop on key nodes which require multi-disciplinary input to optimise avoidance of impacts and maximise opportunities for benefit.

Constraints and Opportunities Workshop

A 2.5 hour workshop was held on Tuesday 12th July with all disciplines represented. Facilitated discussion was held where each discipline allocated a score to each indicator for each zone / node with a brief description of the key constraint or opportunity that resulted in each respective score.

All discussion and scores were recorded in a spreadsheet. The primary assessment was undertaken for the preferred Frame Group alignment, comprising of Option 1. Some consideration was made to rating alternatives or residual risk/opportunity post mitigation, which was also recorded.

Post Workshop Analysis

The spreadsheet was disseminated to each discipline to make any changes or amendments. All changes were amalgamated into a master spreadsheet for analysis. Weightings for calculation of overall scores were based on equal weighting of the 15 different indicators listed in Table 2.

Results

The master spreadsheet contains a database format with a total of 219 items 180 which constitute the baseline assessment with 29 supplementary alternative consideration. These can be queried or summarised in various configurations. Table 4 and Table 5 provide a summary of the findings for the baseline assessment.

Table 4: Summary of Constraints and Opportunities Scores By Character Zone/Node

#	Item	Type	Environmental	Hapu / Cultural	Community / Social	Whanau / Economic	Overall
1	Northern Entrance	Node	-1.00	0.67	-0.33	-0.50	-0.40
2	Wai o Taki Bay	Character Zone	-1.00	0.33	-0.67	-1.00	-0.67
3	Pt England Internal	Character Zone	0.00	0.33	1.00	-0.50	0.13
4	Oamaru Creek Mouth	Node	-1.00	-1.00	1.00	-0.50	-0.47
5	Omaru Creek	Character Zone	-1.60	-0.33	-0.67	-0.75	-0.93
6	Pt England Coastal	Character Zone	-0.20	0.33	0.00	0.25	0.07
7	Pt England Reserve Carpark	Node	-0.20	0.67	0.00	0.00	0.07
8	Riverside Residential	Character Zone	-0.20	0.33	-0.33	-0.25	-0.13
9	Dunkirk/Riverside Reserve Riverside Residential	Character Zone	0.40	0.33	0.00	-0.25	0.13
10	Marist Rugby Club	Node	-0.80	0.33	-0.33	-0.50	-0.40
11	Mt Wellington War Memorial Reserve	Character Zone	-0.40	0.33	-0.33	0.00	-0.13
12	Panmure Wharf and Boat Ramp	Node	0.00	0.33	0.33	0.00	0.13

The colour range spanning the summary scores from -1.6 (red) to positive 1.0 (green) reflects the pattern with greater constraints in the north of the route where steeper topography, streams and proximity to other uses provide greater complexity and therefore cost to address. The most significant challenges come from the Section along Omaru Creek. An exception is the Marist Rugby Club site which brings tight constraints to the south of the alignment.

Table 5: Number of Constraints/Opportunities by Score

Constraints			**Opportunities**		
Score	**Description**	**No.**	**Score**	**Description**	**No.**
0	Neutral or of little consequence for special consideration.	90	0	Neutral or of little consequence for special consideration	90
-1	Risk of diminishing outcomes, with a need for consideration in design – Specific comment recorded	41	+1	Potential for enhancement to be considered for accentuation in design – specific comment recorded	32
-2	Risk of denigrating the environment or successful outcomes, with specific measures proposed to avoid remedy or mitigate the risk.	16	+2	Potential for contribution to the project having remarkable outcomes and key measures proposed.	1

This Table 5 shows a skew towards detail on constraints associated with the path over specific opportunities for consideration. This is consistent with the selection of the implementation of the base Tamaki Path as the status quo, whereby significant benefit opportunity is wrapped up in the associated with the neutral maintaining score of 0.

A list of the Key high risk -2 constraints are included in Appendix 1. A list of all the Raw Scores is provided by Character Zone/ Node in Appendix 2.

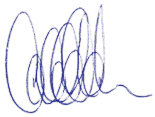
Conclusion

The Mauri model was used as an agile, robust and transparent mechanism to facilitate and record the communication of constraints and opportunities to feed into the feasibility and final alignment processes of the Tamaki Path.

The initial benefit of having the constraints and opportunities recorded holistically will be in defining the preferred alignment. The selection of alignment is the primary opportunity to avoid potential effects on the environment. This resource will also be useful to the preferred alignment or any staging considerations, and can also provide a mechanism to include further inputs and perspectives that may arise from consultation.

Once design is underway the Constraints and Opportunities can also be utilised to guide the objectives for each character zone and nodes for implementation of the developed design and incorporation of a diversity of consideration in the design process with a minimum of confusion and iteration.

Best regards,



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Appendix 1 – Key Constraints for Option 1 alignment

Zone #	Zone Name	Factor	Indicator	Raw Score, RS	Justification
1	Northern Entrance	Environmental	Arboriculture	-2	Potential to avoid effects on Pohutakawa however at least several species of native trees will require removal.
2	Wai o Taki Bay	Environmental	Arboriculture	-2	Won't get support for removal of pine trees. Difficult to establish mature trees on coastal edge. Future longer term issues with loss of limbs. Likely to fall seaward side so unlikely to pose safety hazard. Be aware of trees root plate. Can't lower the ground. Privately owned trees on boundary. Pine tree area path narrows quite a bit.
2	Wai o Taki Bay	Community / Social	Bicycle Horizontal/ Vertical alignment	-2	Major earthworks for both options at Pine trees. Short steep sections may by achievable. Option 1 C3 -B8 preferred to avoid steep section out of gully.
2	Wai o Taki Bay	Whanau / Economic	Geotechnical	-2	Complex issues along coast. Longer retaining Option 1 C6 - C7, Normal risk of coastal erosion (only looking where great risk). Option 1 will need grading down contours on gully.
3	Pt England Internal	Whanau / Economic	Resilience and Futureproofing	-2	Unknown future land use of Point England Reserve.
4	Omaru Creek Mouth Node	Environmental	General Consentability	-2	Option 2 bridge - new structure in the CMA and an SEA provided difficulties for consenting.
4	Omaru Creek Mouth Node	Hapu / Cultural	Archaeology	-2	Option 2 bridge - less length of impact through major settlement site, but disturbance still likely.
4	Omaru Creek Mouth Node	Hapu/Cultural	Character/ Amenity	-2	Visual impact assessment required but significant opportunity. Bridge more visible from coast. Alignment of the bridge needs to not obscure landform.

Zone #	Zone Name	Factor	Indicator	Raw Score, RS	Justification
4	Omaru Creek Mouth Node	Whanu/Economic	Cost	-2	Option 2 bridge more expensive
5	Omaru Creek	Hapu / Cultural	Archaeology	-2	2 sites along alignment, partial disturbance required. Several minor middens. 1 site on ridge – can't avoid if path here.
5	Omaru Creek	Environmental	Freshwater and Marine Ecology	-2	Culvert B4 - B5. Widening existing path along north stream bank - reduce shade, risk bank stability, works within the floodplain impacts. SEA receiving environment. Option 1 preferred to reduce path length along floodplain
5	Omaru Creek	Environmental	Terrestrial Ecology	-2	Significant amount of vegetation removal to upgrade path to 3m wide. Prefer option 1 to reduce length of vegetation removal along floodplain
5	Omaru Creek	Environmental	Arboriculture	-2	Prefer option 1 to reduce length of vegetation removal along floodplain. Approximately 40 large mature (exotics) and multiple natives will require removal.
5	Omaru Creek	Community / Social	Safety	-2	CPTED - no passive surveillance, entrapment spots. Possibility to improve daylight amenity at Bridge and with Option 1. Need to provide linkage to coastal route where surveillance higher.
10	Marist Rugby Club Node	Environmental	Arboriculture	-2	Uphill battle to remove gums and pine trees. Seawall remediation will remove vegetation and view shaft. Pinch point and earthworks.
10	Marist Rugby Club Node	Community / Social	Safety	-2	CPTED poor visibility, possible light, no alternatives. Need to provide alternative path through Rugby club carpark where there is more surveillance.

Appendix 2 – Raw Scores per Character Zone/ Node

Appendix 2 - Raw Score Assessment for each Node

Northern Entrance

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	-1	Little justified need, close to residential and 3m from properties.
	Freshwater and Marine Ecology	-1	Works in the floodplain and associated effects on stream. Area in coastal inundation zone.
	Terrestrial Ecology	-1	Native vegetation removal in an SEA.
	Arboriculture	-2	Potential to avoid effects on Pohutakawa however at least several species of native trees will require removal.
	Contaminated Land	0	
Hapu / Cultural	Archaeology	0	No sites present.
	Te Aranga Design	1	Could be a key node for entry.
	Character/Amenity	1	Connect coastal path along coast. No amenities. Tahaki Road is an ideal location for a start/finish for the Path.
Community / Social	Accessibility	1	Coastal walkway having a node on the coast would be of benefit, there could be some advantage in connecting to St Heliers around the coast although competes with objectives for Tahuna Torea. Entry space unique – could make it a formal start / finish for path.
	Safety	-1	Steep and CPTED issues due to isolation form adjacent uses.
	Bicycle Horizontal/ Vertical alignment	-1	Sudden drop required by Pine Trees. Steep at entrance.
Whanau / Economic	Geotechnical	-1	Poor ground conditions in gulley slope stability and stream erosion
	Structural	0	
	Resilience and Futureproofing	-1	TRC Fernwood Place plans unknown and uncertainty with AT and coastal inundation zone.
	Cost	0	

Wai o Taki Bay

Factor	Indicator	Raw Score, RS	Justification	Alternative Option: Raw Score	Alternative Option: Justification	If Constraints avoided: Residual Score	If Constraints avoided: Justification
Environmental	General Consentability	-1	Lots of issues - Coastal Protection Yard, 3 m from private property rule, Mana Whenua.				
	Freshwater and Marine Ecology	-1	Impacts on minor gulley stream and boardwalk design impacts on watercourse. Option 1 preferred	-1	Option 2 C2 - C4 Replacement of bridge - works within floodplain impacts	2	Plant stream with native species
	Terrestrial Ecology	-1	B6 - C3 Option 1 preferred no vegetation removal. Option 2 will require vegetation removal. Removal of pine trees C6 - C7 - loss of roost habitat.	0	Option 2 C2 - C4 native veg removal adjacent to bridge.	2	keep pine trees and plant along watercourse.
	Arboriculture	-2	Wont get support for removal of pine trees. Difficult to establish mature trees on coastal edge. Future longer term issues with loss of limbs. Likely to fall seaward side so unlikely to pose safety hazard. Be aware of trees root plate. Can't lower the ground. Privately owned trees on boundary. Pine tree area path narrows quite a bit.			-1	Leaving pine trees and going with Option 2 C6 - C7 - will still have a lesser negative effect on roots.
	Contaminated Land	0					
Hapu / Cultural	Archaeology	-1	Option 1 C3 - B8 preferred stream crossing to avoid R11/2750. Tweaking alignment from C2 - B6 required to avoid R11/1878.	-2	Option 2 C2 - C4 will likely require earth works and disturbance of site R11/2750.	2	Connection to Kaino Place entrance will help to avoid archaeological sites on ridgeline / knoll.
	Te Aranga Design	1	Entrance Node on Fernwood has opportunity.				
	Character/Amenity	1	Views to harbour. Entrance node has limited amenity. Development of Path entrance along with playground upgrade could increase amenity. View shaft near pines to highlight amenity. Option 1 preferred - not visible from coast.	-1	Option 2 C2 - C4 Visual Assessment required of bridge upgrade.		
Community / Social	Accessibility	1	Real need to upgrade and create entrance at Fernwood Pl.			2	Connection to Kaino Place entrance will increase accessibility and connect more residents to Path.
	Safety	-1	CPTED back of fences. Steep alignment.			1	Possible to improve Fernwood Place safety through creating a node.
	Bicycle Horizontal/ Vertical alignment	-2	Major earthworks for both options at Pine trees. Short steep sections may by achievable. Option 1 C3 -B8 preferred to avoid steep section out of gully.				
Whanau / Economic	Geotechnical	-2	Complex issues along coast. Longer retaining Option 1 C6 - C7, Normal risk of coastal erosion (only looking where great risk). Option 1 will need grading down contours on gully.	-1	C6 - C7 Option 2 less risk from Geotech. Option 2 will need fill or retaining.		
	Structural	-1	Option 1 C6 - C7 structure an option to cover longitudinal grade. Both bridge crossing options present no structural issues. Bridges okay. Boardwalks will have least impact.	-1	Option 2 C6 - C7 potential structure an option to cover longitudinal grade but issues with views into private property. Tricky to put boardwalk around pine trees. If can't cut down trees will need to reduce grade.		
	Resilience and Futureproofing	0	Option 1 C3 - B8 further from coastal inundation zone.	-1	Option 2 within coastal inundation zone.		
	Cost	-1	Key cost at pines, piles around roots of pines possible.	-1	Option 2 C6 - C7 presents high cost also.		

Pt England Internal

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	0	
	Freshwater and Marine Ecology	0	
	Terrestrial Ecology	0	
	Arboriculture	0	
	Contaminated Land	0	
Hapu / Cultural	Archaeology	0	
	Te Aranga Design	1	Could be of high interest to Mana Whenua.
	Character/Amenity	0	
Community / Social	Accessibility	2	Internal concreate paths (or same as rest of internal paths) connecting Path to create effective links with Point England Road and Elstree Ave and Maybury Reserve. Increase access to North and Southern path sections.
	Safety	1	Need to provide safer options through Pt England Reserve. Possible issues with cyclist speeds along flat straight path.
	Bicycle Horizontal/ Vertical alignment	0	
Whanau / Economic	Geotechnical	0	
	Structural	0	
	Resilience and Futureproofing	-2	Unknown future land use of Point England Reserve.
	Cost	0	

Omaru Creek Mouth Node (Option 2 in the Frame Group Report is the preferred Option).

				Alternative Option		If Constraints avoided?	
Factor	**Indicator**	**Raw Score, RS**	**Justification**	**Raw Score**	**Justification**	**Residual Score**	**Justification**
Environmental	General Consentability	-2	Option 2 bridge - new structure in the CMA and an SEA provided difficulties for consenting.	-1	Option 1 bridge preferred - replacement of existing structure easier consenting path.		
	Freshwater and Marine Ecology	-1	Option 2 bridge - new structure in the CMA + SEA significant wading bird habitat. Possible discharge of contaminated sediment during bridge construction.	-1	Option 1 bridge - works in the SEA and CMA. SEA, wading bird habitat Possible mangrove removal before 1996. Possible discharge of contaminated sediment during bridge construction. Replacing existing bridge and constructing a new bridge have the same level of effects on the receiving environment.		
	Terrestrial Ecology	-1	less native vegetation removal if Option 2 bridge lands closer to headland (approx. 10 m).	-2	Option 1 greater area of native vegetation removal as a result of a longer length of track upgrade (50 m).		
	Arboriculture	-1	less vegetation removal (approx. 10 m length).	-2	Option 1 longer length of native vegetation removal to upgrade 50 m of existing track.		
	Contaminated Land	0		0			
Hapu / Cultural	Archaeology	-2	Less length of impact through major settlement site, but disturbance still likely.	-2	Option 1 replace existing bridge - approx. 50 m length of impact through major settlement site on North bank. Sites on both sides of bridge. Evidence of terraces, disturbances to existing walkway – want to avoid. Southern side 2 sites disturbed by original pathway.		
	Te Aranga Design	1	Likely to be of high interest to Mana Whenua.			2	Likely to be of high interest to Mana Whenua.
	Character/Amenity	-2	Visual impact assessment required but significant opportunity. Option 2 bridge more visible from coast. Alignment of the bridge needs to not obscure landform.	-1	Option 1 Visual impact assessment required for upgrade of existing bridge. Being less visible from coast could reduce risk of a visual assessment. Bridge needs to not obscure headland landform.	2	Significant opportunity for a bridge with artistic value added.
Community / Social	Accessibility	1	Option 2 bridge resolves issues of steep approach.	-1	Steep slopes to entrance of existing bridge.		
	Safety	1	CPTED with Bridge view shaft, Option 2 bridge has less slope and more visible entry and exit points	0	CPTED with Bridge.		
	Bicycle Horizontal/ Vertical alignment	1	Option 2 presents easier bridge approaches and is the preferred option from a cycle perspective	-1	Option 1 bridge - difficult bridge approach with tight corners and steep stream bank on northern side.		
Whanau / Economic	Geotechnical	-1	Option 2 preferred - less earth works. Foundations design with slope issues.	-2	Large amount of earth works required to upgrade existing track to 3 m. Retaining walls required within midden sites.		
	Structural	1	Prefer option 2, great opportunity to stand out. Length of bridge is feasible.	-1	Width of existing bridge is an issue. Potential to make new structure stand out. Length of bridge is feasible.		
	Resilience and Futureproofing	0		0			
	Cost	-2	Option 2 new bridge more expensive.	-1	Retain existing bridge cheaper option but earth works and path upgrades at bridge approaches expensive.		

Omaru Creek

Factor	Indicator	Raw Score, RS	Justification	Alternative Option: Raw Score	Alternative Option: Justification	If Constraints avoided?: Residual Score	If Constraints avoided?: Justification
Environmental	General Consentability	-1	Proximity to Private boundaries watercare designation, Archaeology, veg removal. However mitigation options available				
	Freshwater and Marine Ecology	-2	Culvert B4 - B5. Widening existing path along north stream bank - reduce shade, risk bank stability, works within the floodplain impacts. SEA receiving environment. Option 1 preferred to reduce path length along floodplain			2	Possible to enhance inanga spawning sites and floodplain engagement.
	Terrestrial Ecology	-2	Significant amount of vegetation removal to upgrade path to 3m wide. Prefer option 1 to reduce length of vegetation removal along floodplain			1	Reduce path width to 1.5 or 2 m to reduce vegetation removal. Mitigation planting to increase ecological integrity of veg remnant.
	Arboriculture	-2	Prefer option 1 to reduce length of vegetation removal along floodplain. Approximately 40 large mature (exotics) and multiple natives will require removal.			-1	Reduce path width to 1.5 or 2 m to reduce vegetation removal.
	Contaminated Land	-1	Potentially contaminated, NES disturbance volumes. Residential dumping around boundary where houses are. Probably will not need consent.				
Hapu / Cultural	Archaeology	-2	2 sites along alignment, partial disturbance required. Several minor middens. 1 site on ridge – can't avoid if path here.				
	Te Aranga Design	0	Likely cultural significance associated with Omaru Creek and heritage sites.				
	Character/Amenity	1	Could make path 1.5 or 2m wide through here. Logical approach to constructability. Interesting opportunities to improve character. Node design opportunity at confluence of paths at eastern edge of Omaru Pond (ideally coordinated with this project).			1	Internal concreate paths (or same as rest of internal paths) required to create alternative route to that along the stream for those that find this path either unsafe and/or non accessible.
Community / Social	Accessibility	1	Option 1 will provide better connections to upgraded SW pond. Need to integrate with SW to future proof design. Site is currently densely vegetated and there is opportunity to improve the connectivity along the route.				
	Safety	-2	CPTED - no passive surveillance, entrapment spots. Possibility to improve daylight amenity at Bridge and with Option 1. Need to provide linkage to coastal route where surveillance higher.				
	Bicycle Horizontal/ Vertical alignment	-1	Probably needs to be 2m and therefore some compromise.			-1	Decreasing path width - possibility to be pedestrian only - no/less usability for cyclists.
Whanau / Economic	Geotechnical	-1	Alignment along stream and close to boundaries. Nothing prohibitive, localised soil removal and drainage. Minimise retaining. Need buried large piles. Alignment to move away from slope and stream bank where possible.				
	Structural	0	Longer spans to minimise excavation. 1 x 25 m bridge along route.				
	Resilience and Futureproofing	-1	Sea level inundation issues, Floodplain work, Some issues with future proofing with residential development and future connections. Council has tried to move path onto TRB through Pt England Reserve but Mana Whenua have opposed. Need to integrate with SW to future proof design.				
	Cost	-1	High cost for number of bridges, vegetation and mature tree removal. Path width may need to be reduced to 2.2 m.			0	Decreasing width of path will improve constructability and cost.

Pt England Coastal

Factor	Indicator	Raw Score, RS	Justification	Alternative Option: Raw Score	Alternative Option: Justification	If Constraints avoided?: Residual Score	If Constraints avoided?: Justification
Environmental	General Consentability	0	No perceived issues.				
	Freshwater and Marine Ecology	-1	Three OLFP culverts may be some impacts mitigated by oversized culverts to create stream bed ecology.				
	Terrestrial Ecology	0	No issues.			1	Opportunity for weed removal through SEA to improve ecological integrity.
	Arboriculture	0	No issues as it is anticipated there is sufficient room to avoid excavations close to the base of coastal vegetation.			1	Opportunity for weed removal through SEA to improve ecological integrity.
	Contaminated Land	0	No issues.				
Hapu / Cultural	Archaeology	-1	Several known sites along alignment but path upgrade unlikely to disturb.				
	Te Aranga Design	1	Node opportunity on point to beach. View shaft opportunities along coast.				
	Character/Amenity	1	Frame views to harbour and create resting areas along path.				
Community / Social	Accessibility	0	No issues.				
	Safety	0	Important CPTED linkage where more surveillance than through northern section of Omaru Stream. Possible issues with cyclist speeds along flat straight path.				
	Bicycle Horizontal/ Vertical alignment	0	Need to design for low speed.				
Whanau / Economic	Geotechnical	0	Connection to preferred crossing retaining on bends.				
	Structural	0					
	Resilience and Futureproofing	1	Urban design opportunities.				
	Cost	0					

Pt England Reserve Carpark Node

Factor	Indicator	Raw Score, RS	Justification	Alternative Option: Raw Score	Alternative Option: Justification	If Constraints avoided?: Residual Score	If Constraints avoided?: Justification
Environmental	General Consentability	0	Ensure doesn't disturb scheduled site on headland.				
	Freshwater and Marine Ecology	0	no issues SEA and scheduled site in close proximity to path but alignment won't disturb.				
	Terrestrial Ecology	0	No issues.				
	Arboriculture	-1	Potential works within the dripline of trees adjacent to existing footpath.			-1	Potential works within the dripline of trees adjacent to existing footpath.
	Contaminated Land	0	Earth disturbance - not an issue.				
Hapu / Cultural	Archaeology	0					
	Te Aranga Design	1	Possible area of interest.				
	Character/Amenity	1	Possible entry node (minor node).				
Community / Social	Accessibility	0	Potential conflict with car park use. Need a treatment for crossing car park.				
	Safety	0	Need a treatment for crossing carpark. Need to put in formalised path to cross road (removal of 2 car parks can be swapped with garden area).			1	Create single crossing opportunity across Point England Road.
	Bicycle Horizontal/ Vertical alignment	0					
Whanau / Economic	Geotechnical	0	Ensure alignment keeps clear of culvert and coastal erosion.				
	Structural	0	No issues.				
	Resilience and Futureproofing	0	No issues.				
	Cost	0	Remove two carparks - swap existing garden beds for carparks if necessary.				

Riverside Residential

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	-1	Private neighbours Coastal protection Yard, less than 3m from residential houses. Existing use as an informal walkway.
	Freshwater and Marine Ecology	0	No issues.
	Terrestrial Ecology	1	Increased planting with some augmenting existing sections of planting.
	Arboriculture	-1	Scheduled Pohutukawa. Low branches and roots. Roots more important so boardwalk over roots and trim limbs. Heritage arborist confirmed pruning possible. Liaison with private resident required. Path may need to be narrowed in this pinch point.
	Contaminated Land	0	
Hapu / Cultural	Archaeology	0	
	Te Aranga Design	0	
	Character/Amenity	1	utilise ecological restoration to frame views to harbour.
Community / Social	Accessibility	0	
	Safety	-1	Possible issues with cyclist speeds along flat straight path.
	Bicycle Horizontal/ Vertical alignment	0	
Whanau / Economic	Geotechnical	-1	Generally fine, close to CMA so increase in erosion risk, however generally sufficient width to implement minimum setback on path. Main concern is x2 'pinch' points that will likely require retaining or underpinning of the path – 1 location between B8-B9, 1 location between B7-B8.
	Structural	0	
	Resilience and Futureproofing	0	
	Cost	0	

Dunkirk/Riverside Reserve Riverside Residential

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	0	
	Freshwater and Marine Ecology	1	Watercourse can be planted (between B4 - B5). Provide shade, increased habitat, filtration, organic matter input.
	Terrestrial Ecology	1	Planting watercourse to provide connectivity to coast.
	Arboriculture	0	No issues.
	Contaminated Land	-1	Soil testing required Old landfill minimise disturbance for cuts required for 10 m long bridge.
Hapu / Cultural	Archaeology	0	No identified sites.
	Te Aranga Design	0	
	Character/Amenity	1	Create connections to coastal path by aligning links to street with road alignments. Possible additional 1 - 3 connections required to make effective connections. Create resting/viewing nodes along coast and adjacent to replanted waterway.
Community / Social	Accessibility	0	
	Safety	-1	Possible issues with cyclist speeds along flat straight path.
	Bicycle Horizontal/ Vertical alignment	1	Possible tweak of alignment.
Whanau / Economic	Geotechnical	-1	There is a proposed bridge within riverside reserve crossing small stream, otherwise 0 all other areas.
	Structural	0	
	Resilience and Futureproofing	0	OLFPs across site.
	Cost	0	

Marist Rugby Club Node

				Alternative Option			If Constraints avoided?
Factor	**Indicator**	**Raw Score, RS**	**Justification**	**Raw Score**	**Justification**	**Residual Score**	**Justification**
Environmental	General Consentability	0					
	Freshwater and Marine Ecology	0					
	Terrestrial Ecology	-1	Removal of gum trees and pines will remove roost habitat.	0	If removal of gums avoided.		
	Arboriculture	-2	Uphill battle to remove gums and pine trees. Seawall remediation will remove vegetation and view shaft. Pinch point and earthworks.	-1	Removal of gums avoided.		
	Contaminated Land						
Hapu / Cultural	Archaeology	0	No issues.				
	Te Aranga Design	0					
	Character/Amenity	1	Artistic opportunities for path through carpark and connection to footpath adjacent to road.				
Community / Social	Accessibility	1	Possible alternative on path.				
	Safety	-2	CPTED poor visibility, possible light, no alternatives. Need to provide alternative path through Rugby club carpark where there is more surveillance.				
	Bicycle Horizontal/ Vertical alignment	0	Short steep area, need to explore options.				
Whanau / Economic	Geotechnical	-1	Generally 0, however several areas of increased risk; 1. 'Pinch' point in front of Rugby club, - suggest decreasing proposed 3m width here if possible, however regardless will still require some form of retaining and/or underpinning of path. Must also consider risk of damaging/effecting existing building during construction of path. 2.Where path follows the northern and western boundary of the Reserve given it will be on a slope. Cut and uphill retaining will likely be the cheapest solution and easiest solution, otherwise downslope retaining. Do not recommend placement of fill to create level platform.				
	Structural	0					
	Resilience and Futureproofing	-1	Rugby club footprint rationalisation potential.				
	Cost	0					

Mt Wellington War Memorial Reserve

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	-1	Trees - works within the drip line.
	Freshwater and Marine Ecology	0	
	Terrestrial Ecology	1	Opportunity to increase connectivity between estuary and terrestrial through planting.
	Arboriculture	-1	Excavation too deep within dripline. Specimen Pohutukawas along coast - Keep as far as possible from trees. No constraints as long as not too much excavation.
	Contaminated Land	-1	Soil testing required Old landfill minimise disturbance.
Hapu / Cultural	Archaeology	0	No issues.
	Te Aranga Design	0	
	Character/Amenity	1	Frame views to harbour and create resting areas along path.
Community / Social	Accessibility	0	
	Safety	-1	Possible issues with cyclist speeds along flat straight path.
	Bicycle Horizontal/ Vertical alignment	0	
Whanau / Economic	Geotechnical	0	Generally fine, may require some attention along western boundary where path is located on slope, and possible soft ground at proposed new starting location of route – paleo gully runs through this area and continues west into the reserve on other side of Dunkirk Road. These items not likely to be significant however, therefore score of 0.
	Structural	0	
	Resilience and Futureproofing	0	
	Cost	0	

Panmure Wharf and Boat Ramp Node

Factor	Indicator	Raw Score, RS	Justification
Environmental	General Consentability	0	
	Freshwater and Marine Ecology	0	
	Terrestrial Ecology	0	
	Arboriculture	0	1 scheduled tree.
	Contaminated Land	0	
Hapu / Cultural	Archaeology	0	
	Te Aranga Design	0	
	Character/Amenity	1	New Node for southern entrance. Need to incorporate in our design for TRC to construct. Important linkage. Playground important entry point and node.
Community / Social	Accessibility	1	Painted finish to link through Panmure Wharf area and possibly along Dunkirk Road to create connection to broader Greenway Network.
	Safety	0	
	Bicycle Horizontal/ Vertical alignment	0	
Whanau / Economic	Geotechnical	0	No issues.
	Structural	0	No issues.
	Resilience and Futureproofing	0	Within coastal inundation zone.
	Cost	0	