



**Waihi Beach to Athenree
Shared Pathway Connection**

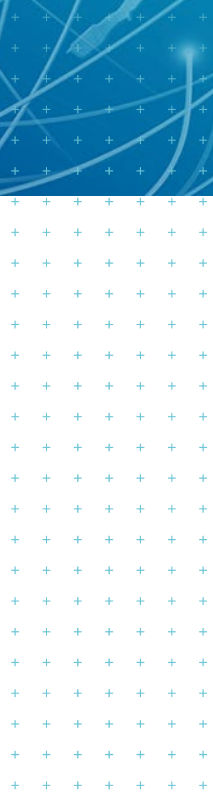
Preliminary Feasibility Report

Prepared for
Western Bay of Plenty District Council

Prepared by
Tonkin & Taylor Ltd

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Appendix A : **Figures 1 and 2 – Potential Crossing Locations**

1 Introduction and background

The proposed Waihi Beach to Athenree Shared Pathway Connection (“crossing”) forms part of the “Tauranga Moana Cycle Trail” (“TMCT”). The crossing is the subject of this preliminary feasibility report.

The crossing is identified within Section 4 of the *Katikati – Waihi Ward Reserve Management Plan 2018* as a “priority trail”. The crossing is also identified within Sections 2.2 and 3 of the *Waihi Beach Ward Community Plan 2020* as a measure required to “support a connected and safe community”.

To commence the process of developing a concept for the connection, Western Bay of Plenty District Council (“WBOPDC”) has undertaken the following:

- Attended an onsite hui with Te Whanau a Tauwhao ki Otawhiwhi, Community Board and Ratepayer Association representatives, and Archaeological/Heritage experts relating to potential locations for the connection;
- Commissioned a statutory assessment report¹ for the Waihi Beach Walkway/Cycleway.

Subsequently, WBOPDC engaged Tonkin & Taylor Limited (“T+T”) to prepare this preliminary feasibility report (“report”) which considers the environmental and engineering constraints and opportunities relating to the three locations identified by WBOPDC for the crossing.

WBOPDC has also engaged Mishmish Heritage to prepare an archaeological and heritage report (“archaeological report”) relating to the crossing locations identified by WBOPDC. It is intended that the archaeological report is a companion document to this feasibility report.

The feasibility and archaeological reports will assist WBOPDC with its future processes relating to community engagement, designing, consenting, and funding of the connection.

2 Scope of report

WBOPDC developed a “job brief” for T+T which, in an abbreviated form, requires this report to address:

- The advantages and disadvantages of three locations for the crossing as nominated by WBOPDC;
- The potential types of structures for the crossing;
- Rough order cost estimates for the potential types of structures for the crossing.

3 Crossing concept assumptions

Section 4 of the Reserve Management Plan² states:

Our [WBOPDC] focus is on developing off-road cycle trails through existing reserves, along roadsides and on road where traffic volumes are low. Cycle ways are also available for walking, pushchairs and E –Bikes on a “share with care” basis.

In developing this report, T+T has assumed the crossing shall, wherever possible, be located on WBOPDC reserves and that its width, grade and surface material is based on a “share with care” philosophy.

¹ Statutory Assessment for Western Bay of Plenty District Council – Waihi Beach Cycleway/Walkway Statutory, Archaeological and Ecological Investigating and Consenting Assessment, Fiona Low Consulting, January 2017.

² Page 61 Katikati – Waihi Ward Reserve Management Plan 2018, WBOPDC 2018.

The WBOPDC job brief to T+T further clarifies assumptions relating to the crossing concept where it states the crossing shall be:

- 2.5 m wide;
- Mobility scooter and wheelchair accessible;
- Elevated above the highest astronomical tide level (current sea level) in the Waiau Estuary;
- Compliant with the New Zealand Building Code;
- Constructed of materials which are highly durable in a dynamic and corrosive marine environment;
- Constructed in a manner that allows for continued access by small watercraft upstream of it;
- Able to have cultural and artistic elements/features incorporated into/fixed to it.

4 Site visit and client interview

4.1 Initial site visit and client interview

T+T visited the three locations identified by WBOPDC for the crossing on 10 December 2020 between 9 am and 12 pm. The Land Information New Zealand prediction was for low tide to occur at 0922 hours with a tidal level of 0.4 m above Lowest Astronomical Tide (representing a neap tidal state).

In addition to the three locations identified by WBOPDC for the crossing, T+T viewed other potential locations to ensure other potential crossing sites had not been unintentionally overlooked.

T+T also discussed with WBOPDC their understanding of the location and extent of the culturally sensitive areas identified by Te Whanau a Tauwhao Ki Otawhiwhi in the vicinity of the Koutunui Pa. T+T was specifically interested in the proximity of these culturally sensitive sites to Crossing 3 and the unformed portion of Koutunui Road that would require relatively substantial earthworks to form the shared pathway to Crossing 3.

T+T and WBOPDC discussed the design life requirement for the crossing. WBOPDC confirmed this report could consider structures with shorter design lives (i.e. 20-30 years) and higher maintenance costs. This shorter design allowance would have the benefit of the structure being able to be constructed with a smaller allowance made for future sea level rise in the nearer term, rather than a large allowance for future sea rise which has greater uncertainty regarding the timing and magnitude of the sea level change.

T+T and WBOPDC also discussed what type of “small” watercraft would need to be able to access the estuary upstream of the crossing. WBOPDC confirmed the craft should be kayaks and small dinghies with tiller steer outboard motors. This meant that T+T determined there would need to be approximately 1 m of clearance under the crossing in the sub-tidal portion at a highest astronomical tide (equivalent to approximately RL 3 m MVD) to provide for passage of these small watercraft upstream. The intertidal portion of the crossing will be set an elevation of approximately RL 2 m MVD.

4.2 Additional site visit and hui with Te Whanau a Tauwhao Ki Otawhiwhi

Following the receipt of T+T’s draft report, WBOPDC identified a potential fourth crossing location (“Option 4”). WBOPDC then requested that T+T attend a site visit and hui with WBOPDC, Te Whanau a Tauwhao Ki Otawhiwhi and Mishmish Heritage on 13 April 2021 at 11.30 am to view the Option 4 potential crossing location. The Land Information New Zealand prediction was for low tide to occur at 1417 hours with a tidal level of 0.4 m above Lowest Astronomical Tide (representing a neap tidal state).

The purpose of the site visit and hui was to view and discuss the Option 4 crossing location from a cultural, archaeological, environmental, and engineering perspective.

Following the site visit and hui, WBOPDC requested that T+T update this report to include Option 4.

5 Crossing structure options

5.1 The options

Considering the matters set out in Sections 3 and 4, T+T considers the following options could be suitable for formation of the crossing:

- Rock lined fill causeway with culverts to pass tidal water underneath the intertidal component of the estuary and an elevated segment of timber boardwalk constructed over the sub-tidal channel to provide watercraft access;
- Timber piled boardwalk over the intertidal component of the estuary with an elevated segment constructed over the sub-tidal channel to provide watercraft access;
- Floating pontoon secured with piles over the intertidal component of the estuary and an elevated segment of timber boardwalk constructed over the sub-tidal channel to provide watercraft access.

A hybrid of the above options could also be suitable. T+T discounted the consideration of bridges which could be lifted or retracted from the sub-tidal channel portion of the crossing due to the watercraft assumptions in Section 3 and 4 and cost of such structures.

5.2 Other options

T+T conducted web-based research of other potential non-conventional structure options.

T+T found that floating boardwalks (no piles required) have been constructed in British Columbia³ which has a similar tidal range to the subject site. These structures have benefits of minimal disruption to the estuary bed as no piles are required. This lack of piles potentially reduces costs also when compared to the conventional pontoon structure identified above. Further work would need to be undertaken as to the potential suitability of these structures at the site where wave and wind activity and tidal currents may be different to that present at the sites they have been installed overseas.

T+T also found that large pre-cast concrete and steel boardwalks have been constructed in Austin⁴. However, due to the scale and the cost of materials used for these boardwalks T+T discounted them from further consideration.

T+T discounted a suspension bridge option due to scale and cost.

5.3 Advantages and disadvantage of options

Table 5.1 below contains an assessment of the advantages and disadvantages of the crossing structure options set out in Section 5.1. The following items/matters have been excluded from the matrix for the accompanying reasons:

- Cost has not been considered as this is addressed in the location assessment provided under Section 6.

³ <https://www.cbc.ca/news/canada/prince-edward-island/pei-greenwich-boardwalk-1.4170689>

⁴ <http://structurestx.com/portfolio/lady-bird-lake-boardwalk/>

- All three options are considered prominent engineered structures at the site which are likely to create a large visual impact irrespective of the materiality. Therefore, the perceived aesthetic qualities of materials have not been considered.
- Whether the legal requirement for a handrail is considered an advantage or disadvantage. If wheelchairs are likely to use the crossing, then a handrail is recommended.

Table 5.1: Advantages and disadvantages of crossing structure options

Option	Advantages	Disadvantages
Rock lined fill causeway	<ul style="list-style-type: none"> • Long term design life (50 + years). Crest can be designed to be topped up in future to account for long-term sea level rise • Low maintenance • Can be finished with an aggregate surface to make the shared pathway a non-slip surface • Rock armour layer can provide new habitat opportunities for estuary fauna. These opportunities can be optimised through products such as eco⁵ armour units 	<ul style="list-style-type: none"> • Large (tall and wide due to sloped sides) structure which makes it visually prominent • Will cover the estuary bed and smother plants and animals living on/within the bed • Will affect the movement of sediment and water within the estuary and change the shape and composition of the estuary bed and shoreline with resulting effects on ecology • Tall structure which makes it visually prominent
Timber piled boardwalk	<ul style="list-style-type: none"> • Tidal water and sediment can pass under the structure and so is unlikely to change the shape and composition of the estuary bed and shoreline thereby largely avoiding effects on ecology • Will not cover the estuary bed and smother plants and animals living within/on the bed. May result in reduced sunlight reaching plants located directly underneath structure resulting in impacts on their health/survival • Non-slip surface (such as geogrid) can be affixed easily to wooden planks 	<ul style="list-style-type: none"> • Shorter term design life than rock lined fill causeway • Higher maintenance than rock lined causeway • Tall structure which makes it visually prominent
Floating pontoon	<ul style="list-style-type: none"> • Tidal water and sediment can pass under the structure and so is unlikely to change the shape and composition of the estuary bed and shoreline thereby largely avoiding effects on ecology • Will cover the estuary bed when not floating on tidal water and smother plants and animals living within/on the bed. • The lowest of all options and therefore less visually prominent • Requires less piles than timber boardwalk so less impacts on plants and 	<ul style="list-style-type: none"> • Shorter term design life than rock lined fill causeway • Surface finish is not fully non slip. This could be an issue for cyclists. This issue could likely be overcome by affixing a grid or similar to the surface or requiring the supplier address in the moulding stage of production • Stability issues could arise for users due to wave forces action on them and weight being transferred as people move across individual pontoon segments

⁵ <https://econcretetech.com/>

Option	Advantages	Disadvantages
	<p>animals living within/on estuary bed from construction and use</p> <ul style="list-style-type: none"> When not floating will be approximately 400 mm high and so can be stepped onto and over for pedestrians walking shore parallel if a handrail was not fitted 	<ul style="list-style-type: none"> The pontoon segments may require regular maintenance at joints, pile fastening points etc due to constant movement

6 Crossing location assessment

The matrix below (Sections 7 to 10) contains an assessment of the advantages and disadvantages of the crossing locations identified by WBOPDC and one crossing location identified by T+T using all criteria required by WBOPDC and other criteria developed by T+T. The assessment excludes geotechnical considerations as no site investigations have been undertaken to date.

Figures 1 and 2 provided in Appendix A show the features described in the matrix.

7 Crossing 1 – Roretana Drive (WBOPDC nominated location)

7.1 General description

This crossing is approximately 330 m long.

7.1.1 Western side

This side of the crossing site comprises a WBOPDC recreation reserve which is maintained in mown grass for walking and other recreational activities. The land gently grades towards the harbour across the width of the reserve (approximately 3 m of elevation difference over 20 m). The reserve has direct access to Roretana Drive through an approximately 15 m wide frontage.

7.1.2 Eastern side

This side comprises a WBOPDC recreation reserve which is maintained in an aggregate surface for the shared pathway connecting Waihi Beach to Bowentown. Indigenous riparian and backshore vegetation and unmown grass surround the pathway corridor. The land on this side is flat for the first 15 m inland of the top of the bank above the shoreline. A WBOPDC watermain linking Waihi Beach to Athenree is located under the estuary bed and joins another watermain near the location where the proposed crossing ties into the land.

7.1.3 The Estuary

The estuary where the crossing would traverse comprises predominantly intertidal sand flats with seagrass beds and shellfish visible in the surface. There is a subtidal channel located nearer the eastern side which conveys flows between the Waihi River and Tauranga Harbour. There are several informal swing mooring blocks located on the intertidal sand flats in the vicinity of the site. The most upstream navigation marker (starboard) is located approximately 200 m southeast of the mid-point of the crossing across the estuary.



7.2 Crossing assessment

Criteria	Advantages	Disadvantages	General comments
Cultural and archaeological	There are no registered archaeological sites at the site ⁶ . Based on the notes taken by WBOPDC following the on-site hui with Te Whanau a Tauwhao Ki Otawhiwhi, there are no particular cultural matters/sensitivities relating to this site.	Nil	
Historic crossings	Nil	Nil	During the site visit, T+T observed members of the public crossing the estuary in the general location of this proposed crossing. The water depth on a neap low tide in the sub-tidal change was observed to be approximately 600 mm to 1 m. In some of the historic aerials T+T reviewed there were vehicle tracks evident on the estuary bed in the location of the crossing.
Resource Management Act considerations	Nil	Nil	Pages 64-74 of the Fiona Lowe Consulting report ⁷ supplied to T+T sets out an assessment of the statutory approvals likely required for "Crossing 3". T+T considers that a lot of the comments made in the Lowe report, except for those relating to the DOC Reserve located within the salt marsh located at Crossing 3, are generally relevant and applicable to Crossing 1. In summary, resource consents will be required from WBOPDC and the BOPRC as well as an Archaeological Authority from Heritage New Zealand.

⁶ Based on a review of the New Zealand Archaeological Association's Arch Site GIS Viewer. Registered Archaeological Site U13/1308 located at 50 and 52 Roretana Drive is the closest site to the crossing tie into the reserve.

⁷ Statutory Assessment for Western Bay of Plenty District Council – Waihi Beach Cycleway/Walkway Statutory, Archaeological and Ecological Investigating and Consenting Assessment, Fiona Low Consulting, January 2017.

Criteria	Advantages	Disadvantages	General comments
			T+T considers that the crossing will require several technical assessments to be undertaken to support the resource consent applications including coastal processes, landscape and visual, ecological and cultural. The coastal processes assessment will likely require numerical modelling to be undertaken to understand the effects of the crossing on tidal currents, sediment transport and seagrass and shellfish. The resource consent applications are likely to be publicly notified, submissions received, and a formal hearing held.
Existing services	Nil	Based on WBOPDC's Mapi GIS a 250 mm PE watermain linking Waihi Beach to Athenree is located under the estuary bed and joins another watermain near the location where the proposed crossing ties into the land on the eastern side. Intrusive ground investigations required for design, earthworks and piling works in this location to tie the crossing into the land will require careful management and location of services on site.	Nil
Recreational amenity	Depending on the type of structure used, the crossing would potentially provide enhanced access to the estuary itself (perpendicular from the shoreline) as at present some of the surficial sediments on the estuary bed are soft making access for swimming, shellfish gathering etc challenging. At low tide the crossing would provide easier access to the subtidal	The crossing will create a physical barrier to pedestrian access either side of it where people are walking shore parallel (unless the pontoon with no handrail option is selected).	

Criteria	Advantages	Disadvantages	General comments
	<p>channel for swimming, fishing etc. However, due to the height of the structure and the requirement for a handrail for the wooden boardwalk option, this access may be quite challenging.</p> <p>For the rock fill embankment option, there is potential to use the landward segment of the structure as a control structure (same function as a rock groyne) to trap sediments either naturally suspended in the coastal water column or placed on the foreshore when the area is not inundated with tidal water. These sediments would assist with the formation and retention of a high tide beach between the structure and the adjacent shoreline. There would be visual and recreational amenity benefits associated with this new beach.</p>		
Navigation	Nil	The crossing will create a physical barrier effectively closing the upper estuary to navigation by craft other than kayaks and small dinghies.	There is an opportunity to mitigate some this impact, if funding permits, by designing the sub-tidal portion of the crossing to be higher, thereby providing greater clearance for larger craft to pass underneath the structure. However, due to the elevation of the majority of the crossing being set at around RL 2, there is a limit as to how high the subtidal component could be and still allow a transition in grade (1V:12H) between the intertidal and sub-tidal components.
Private landowners	Nil	The tie in between the crossing and the reserve on the western side could affect the adjacent landowners whose properties are located at 32-36 and 40-44 Roretana	There are large pohutukawa trees located along the shoreline of the reserve which provide a degree of softening and screening of segments of the crossing as

Criteria	Advantages	Disadvantages	General comments
		Drive from a privacy perspective. However, the reserve is already public land used for walking, picnicking, swimming, cycling etc for the purpose it was created and so this potential disadvantage is not significant.	viewed from some properties located at 32-36 and 40-44 Roretana Drive.
Landscape and visual	Nil	The crossing will result in a new and visually prominent engineered structure when viewed from Tauranga Harbour and the Athenree and Bowentown peninsulas. There is limited mitigation that can be designed and constructed into the crossing to minimise this effect.	Early involvement from a landscape architect to the concept design process will assist with mitigating this effect to the extent practicable.
Ecology	If the rock lined fill causeway option is selected for the crossing, or a portion of it, then the armour layer could potentially provide new habitat for fauna. This crossing site does not traverse the main seagrass beds located up and downstream of it.	The construction and occupation of the estuary bed by the structure will smother benthic organisms and prevent sunlight reaching plants such as seagrass. The rock lined fill embankment option creates the greatest impact with the pontoon and timber boardwalk options having lesser and the least effects respectively.	Early involvement from a marine ecologist to the concept design process and construction methodology will assist with mitigating this effect to the extent practicable.
Hydrodynamics	Nil	The crossing will result in a new engineered structure which will affect the tidal currents, sediment deposition and potentially benthic organisms and seagrass that inhabit the estuary surrounding the structure. The wooden boardwalk and pontoon options will have lesser effects than the rock lined fill causeway option, as tidal currents can still pass underneath these structures. The rock lined fill causeway option's effects on hydrodynamics can be lessened using multiple culverts through the structure at regular intervals.	Early involvement from a coastal engineer to the concept design process will assist with mitigating this effect to the extent practicable. Numerical modelling would be used to predict effects from different structures and combinations of structures with the results informing a design which has the least impact. There is a risk that actual effects are slightly different to those predicted by the numerical model. If significant effects were to result, then they may be difficult to mitigate or remediate. These significant effects could include re-positioning of the sub-tidal channel, loss of

Criteria	Advantages	Disadvantages	General comments
			seagrass due to sediment smothering it, changes to sediment type/depth etc in areas currently inhabited by shellfish making those areas unsuitable. There is a relationship between hydrodynamic effects and ecological effects, so these assessments and inputs to the concept design would need to be undertaken in parallel.
Traffic safety	The crossing ties into land on both the eastern and western sides that is located off the road, within recreation reserves which are either flat or gently sloping. Connection of the crossing tie ins to the current and future shared pathway at Athenree and Bowentown can be achieved without creating safety issues to pedestrians, mobility scooters or motor vehicles.	Nil	
Earthworks and landform modification	Minor earthworks will be required where the crossing ties into land on both the eastern and western side due to the land being either flat or gently sloping. It is unlikely that any mitigation or remediation works, such as planting, will be required following the completion of the earthworks due to their likely nature and scale.	Nil	It has been assumed cultural monitoring of all earthworks on land will be undertaken by Te Whanau a Tauwhao Ki Otawhiwhi.

7.3 Rough order cost estimate

Rock lined fill causeway option: \$2,900,000 + GST

Timber boardwalk option: \$1,700,000 + GST

Pontoon option: \$2,800,000 + GST

8 Crossing 1A – Marina Way (T+T nominated location)

This crossing is approximately 300 m long.

8.1 General description

The description provided for the eastern side of Crossing 1 and the Estuary is also applicable to this crossing site. There is an additional seagrass bed located immediately adjacent to Crossing 1A.

8.1.1 Western side

This side comprises an unformed road that WBOPDC maintain as a mown grass area for walking and other recreational activities. Several large pohutukawa trees are located along the shoreline. The land on this side comprises an erodible cliff shoreline with top of the bank approximately 5 m above the foreshore below. The land behind the top of the bank grades gently (approximately 3.5 m of elevation difference over a 40 m width) towards the top of bank shoreline. There is an existing wooden step structure from the top of the bank down to a small sandy embayment located on the foreshore where kayaks are stored.



8.2 Crossing assessment

The crossing assessment for Crossing 1 is also applicable to this crossing site.

The differences between the two sites are that the Site 1A has additional advantages to Site 1 which are as follows:

- Site 1A is approximately 30 m shorter.
- Site 1A is further upstream from the informal swing mooring and “main” seagrass bed, so is less likely to impact on them in so far as hydrodynamics and navigation of watercraft are concerned.

The additional disadvantages to Site 1 are as follows:

- The sub-tidal channel at Site 1A is less confined (it is the main channel but also a smaller feeder channel) and appears to be more prone to migration historically. This means the localised higher portion of the crossing would need to be wider (and more costly). This is not considered a significant disadvantage because localised dredging of the sub-tidal channel at the site could be undertaken to ensure it is confined to the localised higher portion of the crossing, should it be subject to future migration.
- The existing wooden steps are not suitable for wheelchairs, mobility scooters or bicycles and a new timber or concrete ramp or earthworks to create a suitable grade (1V:12H) would be costly and/or technically challenging.

8.3 Rough order cost estimate

Rock lined fill causeway option: \$2,600,000 + GST

Timber boardwalk option: \$1,600,000 + GST

Pontoon option: \$2,500,000 + GST

9 Crossing 2 – Roretana Drive (WBOPDC nominated location)

This crossing is approximately 230 m long.

9.1 General description

9.1.1 Western side

This side of the crossing site comprises a WBOPDC recreation reserve which is maintained in mown grass for walking and other recreational activities. The land gently grades towards the harbour across the width of the reserve (approximately 2 m of elevation difference over a 20 m width). There is an existing pedestrian walkway (approximately 3 m wide) connecting the reserve to Roretana Drive located approximately 30 m southeast of the crossing site.

9.1.2 Eastern side

This side comprises a WBOPDC recreation reserve which is maintained in an aggregate surface for the shared pathway connecting Waihi Beach to Bowentown. Indigenous riparian and backshore vegetation and unmown grass surround the pathway corridor. The land on this side is flat for the first 15 m inland of the top of the bank above the shoreline.

9.1.3 The Estuary

The estuary where the crossing would traverse comprises predominantly intertidal sand flats with seagrass beds and shellfish visible in the surface. The crossing would go through the middle of the large seagrass bed. There is a subtidal channel located nearer the centre of the estuary which conveys flows between the Waiiau River and Tauranga Harbour. There are several informal swing mooring blocks located on the intertidal sand flats upstream of the crossing site and the most upstream navigation marker (starboard) is located approximately 30 m upstream of the crossing.



9.2 Crossing assessment

Criteria	Advantages	Disadvantages	General comments
Cultural and archaeological	There are no registered archaeological sites at the site ⁸ . Based on the notes taken by WBOPDC following the on-site hui with Te Whanau a Tauwhao Ki Otawhiwhi, there are no particular cultural matters/sensitivities relating to this site.	Nil	
Historic crossings	Nil	Nil	Nil
Resource Management Act considerations	Nil	Nil	<p>Pages 64-74 of the Fiona Lowe Consulting report⁷ supplied to T+T sets out an assessment of the statutory approvals likely required for "Crossing 3". T+T considers a lot of the comments made in the Lowe report, except for those relating to the DOC Reserve located within the salt marsh located at Crossing 3, are generally relevant and applicable to Crossing 2. In summary, resource consents will be required from WBOPDC and the BOPRC, as well as an Archaeological Authority from Heritage New Zealand.</p> <p>T+T considers that the crossing will require several technical assessments to be undertaken to support the resource consent applications including coastal processes, landscape and visual, ecological and cultural. The coastal processes assessment will likely require numerical modelling to be undertaken to understand the effects of the crossing on tidal currents,</p>

⁸ Based on a review of the New Zealand Archaeological Association's Arch Site GIS Viewer. Registered Archaeological Sites U13/1302, U13/1303 and U13/1304 located at 3, 4 and 11 Roretana Drive respectively are the closest sites to the crossing tie into the reserve.

Criteria	Advantages	Disadvantages	General comments
			sediment transport and seagrass and shellfish. The resource consent applications are likely to be publicly notified, submissions received, and a formal hearing held.
Existing services	Nil	Nil	Nil
Recreational amenity	<p>Depending on the type of structure used, the crossing would potentially provide enhanced access to the estuary itself (perpendicular from the shoreline) as at present some of the surficial sediments on the estuary bed are soft, making access for swimming, shellfish gathering etc challenging. At low tide the crossing would provide easier access to the subtidal channel for swimming, fishing etc. However, due to the height of the structure and the requirement for a handrail for the wooden boardwalk option, this access may be quite challenging.</p> <p>For the rock fill embankment option, there is potential to use the landward segment of the structure as a control structure (same function as a rock groyne) to trap sediments either naturally suspended in the coastal water column or placed on the foreshore when the area is not inundated with tidal water. These sediments would assist with the formation and retention of a high tide beach between the structure and the adjacent shoreline. There would be visual and recreational amenity benefits associated with this new beach.</p>	The crossing will create a physical barrier to pedestrian access either side of it where people are walking shore parallel (unless the pontoon with no handrail option is selected)	

Criteria	Advantages	Disadvantages	General comments
Navigation	Nil	The crossing will create a physical barrier effectively closing the upper estuary to navigation by craft other than kayaks and small dinghies. The location for this crossing is likely to have the greatest impact on navigation because it is the near the outlet of the estuary to Tauranga Harbour.	There is an opportunity to mitigate some this impact, if funding permits, by designing the sub-tidal portion of the crossing to be higher, thereby providing greater clearance for larger craft to pass underneath the structure. However, due to the elevation of the majority of the crossing being set at around RL 2, there is a limit as to how high the subtidal component could be and still allow a transition in grade (1V:12H) between the intertidal and sub-tidal components. The options of retractable or lifting mechanism for the sub-tidal component of the structure has been discounted purely on cost to benefit basis.
Private landowners	Nil	The tie in between the crossing and the reserve on the western side could affect the adjacent landowners whose properties are located at 32-36 and 40-44 Roretana Drive from a privacy perspective. However, the reserve is already public land used for walking, picnicking, swimming, cycling etc for the purpose it was created and so this potential disadvantage is not significant.	There are large pohutukawa trees located along the shoreline of the reserve, which provide a degree of softening and screening of segments of the crossing as viewed from some properties located at 2-12 Roretana Drive.
Landscape and visual	Nil	The crossing will result in a new and visually prominent engineered structure when viewed from Tauranga Harbour and the Athenree and Bowentown peninsulas. There is limited mitigation that can be designed and constructed into the crossing to minimise this effect.	Early involvement from a landscape architect to the concept design process will assist with mitigating this effect to the extent practicable.

Criteria	Advantages	Disadvantages	General comments
Ecology	If the rock lined filled causeway option is selected for the crossing, or a portion of it, then the armour layer could potentially provide new habitat for fauna.	The construction and occupation of the estuary bed by the structure will smother benthic organisms and prevent sunlight reaching plants such as seagrass. The rock lined fill causeway option creates the greatest impact with the pontoon and timber boardwalk option having lesser and the least effects respectively. This location is likely to have the greatest impact because the alignment is through the middle of the large seagrass bed.	Early involvement from a marine ecologist to the concept design process and construction methodology will assist with mitigating this effect to the extent practicable.
Hydrodynamics	Nil	<p>The crossing will result in a new engineered structure which will affect the tidal currents, sediment deposition and potentially benthic organisms and seagrass that inhabit the estuary surrounding the structure. The wooden boardwalk and pontoon options will have lesser effects than the rock lined fill causeway option as tidal currents can still pass underneath these structures. This location is likely to have the greatest impact because:</p> <ol style="list-style-type: none"> 1 the estuary is the narrowest at this location meaning tidal flows are constricted more than at Sites 1 and 1A, and 2 the location is near the estuary outlet where deeper water is located, meaning a larger volume of tidal water passes through the area. 	Early involvement from a coastal engineer to the concept design process will assist with mitigating this effect to the extent practicable. Numerical modelling would be used to predict effects from different structures and combinations of structures with the results informing a design which has the least impact. There is a risk that actual effects are slightly different to those predicted by the numerical model. If significant effects were to result, then they may be difficult to mitigate or remediate. These significant effects could include re-positioning of the sub-tidal channel, loss of seagrass due to sediment smothering it, changes to sediment type/depth etc in areas currently inhabited by shellfish making those areas unsuitable. There is a relationship between hydrodynamic effects and ecological effects so these assessments and inputs to the concept design would need to be undertaken in parallel.

Criteria	Advantages	Disadvantages	General comments
Traffic safety	The crossing ties into land on both the eastern and western sides that is located off the road, within recreation reserves which are either flat or gently sloping. Connection of the crossing tie ins to the current and future shared pathway at Athenree and Bowentown can be achieved without creating safety issues to pedestrians, mobility scooters or motor vehicles.	Nil	
Earthworks and landform modification	Minor earthworks will be required where the crossing ties into land on both the eastern and western side due to the land being either flat or gently sloping. It is unlikely that any mitigation or remediation works such as planting will be required following the completion of the earthworks due to their likely nature and scale.	Nil	It has been assumed cultural monitoring of all earthworks on land will be undertaken by Te Whanau a Tauwhao Ki Otawhiwhi.

9.3 Rough order cost estimate

Rock lined fill causeway option: \$2,200,000 + GST

Timber boardwalk option: \$1,300,000 + GST

Pontoon option: \$2,000,000 + GST

10 Crossing 3 – Koutunui Road (WBODPC nominated location)

This crossing is approximately 325 m long.

10.1 General description

The unformed portion of Koutunui Road comprises steep topography (there is 18 m of elevation difference over a length of approximately 180 m). Consequently, to achieve a suitable grade (1V:12H) for the shared pathway would require a large volume of earthworks and the construction of retaining structures on steep land which is geotechnically challenging. In addition, the formation of the shared pathway on land would require the clearance of indigenous vegetation and the construction of stormwater collection and discharge structures. The stormwater discharge may require resource consent and easements from the adjoining private landowners.

These technical challenges, in combination with the advice received from Te Whanau a Tauwhao Ki Otawhiwhi relating to the site being culturally sensitive, meant that T+T did not inspect the crossing location because it was discounted from further assessment. T+T notes that the crossing itself is located in a highly sensitive salt marsh area which extends across the full width of the Waiau River Estuary from the distal end of the Athenree Peninsula to Emerton Road.



11 Crossing 4 – Pohutukawa Drive (WBOPDC nominated location)

This crossing is approximately 370 m long. This length assumes the shared pathway segment located on WBOPDC recreation and esplanade reserves (Lot 73 DPS 27596 and Lot 32 DPS 10394) comprises a 2.5 m wide aggregate surface formed on the existing ground i.e. the segment located on the reserves is not part of the “crossing” or associated rough order cost estimates.

11.1 General description

11.1.1 Western side

This side of the crossing site comprises a WBOPDC recreation reserve and esplanade reserve which do not appear to be maintained by mowing. There is a mix of indigenous vegetation including mature pohutukawa at the northern end and oi oi and other sedges along the estuary/land interface. The landform comprises an approximately 10 m wide bench located between the landward edge of the riparian vegetation and the toe of slope located beneath the houses on Pohutukawa Drive. At the northern end, the bench terminates by tying into the escarpment that the mature pohutukawa are located on. At the southern end, the bench terminates at a small sandy embayment accessed from timber steps located on an unformed public road. The unformed public road is maintained in mown grass for walking and other recreational activities. The unformed public road connects to Pohutukawa Drive approximately 250 m southwest of the timber access steps.



11.1.2 Eastern side

This side comprises a WBOPDC recreation reserve which is maintained in an aggregate surface for the shared pathway connecting Waihi Beach to Bowentown. Indigenous riparian and backshore vegetation and unmown grass surround the pathway corridor. The land on this side is flat for the first 15 m inland of the top of the bank above the shoreline.

11.1.3 The Estuary

The estuary where the crossing would traverse comprises a mixture of small/secondary intertidal channels located between mature mangroves growing on intertidal sand flats, the subtidal estuary channel/Waiiau River channel and estuarine mud flats located at the toe of the escarpment under the WBOPDC historic reserve and private land parcels at 26-28 Pohutukawa Drive. The crossing would be constructed within the existing “gaps” in the mangroves where currently mangrove roots and sporadic juvenile mangroves are evident. There is a subtidal channel located nearer the Pohutukawa Drive side of the estuary which conveys flows between the Waiiau River and Tauranga Harbour.

11.2 Crossing assessment

Criteria	Advantages	Disadvantages	General comments
Cultural and archaeological	There are no registered archaeological sites at the site ⁹ . Based on the on-site hui with Te Whanau a Tauwhao Ki Otawhiwhi and advice from Mishmish Heritage, there are no particular cultural matters/sensitivities relating to this site.	Nil	At the on-site hui WBOPDC, Te Whanau a Tauwhao Ki Otawhiwhi and Mishmish Heritage collectively identified a cultural and archaeological landscape opportunity. In broad terms, the opportunity is for the crossing to restore a connection between the Koutunui Pa complex, the open coast, the estuary, and land located along the estuary margin (Pohutukawa Drive and Roretana Drive) as traditional places of occupation, food gathering, and recreation.
Historic crossings	Nil	Nil	Nil
Resource Management Act considerations	Nil	Nil	Pages 64-74 of the Fiona Lowe Consulting report ⁷ supplied to T+T sets out an assessment of the statutory approvals likely required for "Crossing 4". T+T considers a lot of the comments made in the Lowe report are generally relevant and applicable to Crossing 4. In summary, resource consents will be required from WBOPDC and the BOPRC, as well as an Archaeological Authority from Heritage New Zealand. T+T considers that the crossing will require several technical assessments to be undertaken to support the resource consent applications including coastal processes, landscape and visual, ecological and cultural. The coastal processes

⁹ Based on a review of the New Zealand Archaeological Association's Arch Site GIS Viewer. Registered Archaeological Sites U13/50 and U13/1559 located on the WBOPDC historic reserve at the end of Pohutukawa Drive and in the backdune landward of the existing cycleway respectively are the closest sites to the crossing tie into the reserves.

Criteria	Advantages	Disadvantages	General comments
			assessment will likely require numerical modelling to be undertaken to understand the effects of the crossing on tidal currents, sediment transport, mangroves, seagrass and shellfish. The resource consent applications are likely to be publicly notified, submissions received, and a formal hearing held.
Existing services	Nil	Nil	Nil
Recreational amenity	<p>Depending on the type of structure used, the crossing would potentially provide enhanced access to the estuary itself (perpendicular from the shoreline) as at present some of the surficial sediments on the estuary bed are soft, making access for swimming, shellfish gathering etc challenging. At low tide the crossing would provide easier access to the subtidal channel for swimming, fishing etc. However, due to the height of the structure and the requirement for a handrail for the wooden boardwalk option, this access may be quite challenging. It is more likely that people will use the lower estuary (in the vicinity of Crossings 1, 1A and 2 for swimming, shellfish gathering etc. The crossing is unlikely to create a physical barrier to pedestrian access either side of it where people are walking shore parallel. This is because the mangroves currently prevent pedestrian access through the estuary on the eastern side and on the western side the sub-tidal channel and estuarine muds located under the</p>		

Criteria	Advantages	Disadvantages	General comments
	escarpment currently impede pedestrian access.		
Navigation	Nil	The crossing will create a physical barrier effectively closing the upper estuary to navigation by craft other than kayaks and small dinghies. The location for this crossing is likely to have the least comparative impact on navigation because it is the most upstream site.	There is an opportunity to mitigate some of this impact, if funding permits, by designing the sub-tidal portion of the crossing to be higher, thereby providing greater clearance for larger craft to pass underneath the structure. However, due to the elevation of the majority of the crossing being set at around RL 2, there is a limit as to how high the subtidal component could be and still allow a transition in grade (1V:12H) between the intertidal and sub-tidal components. The options of retractable or lifting mechanism for the sub-tidal component of the structure has been discounted purely on cost to benefit basis.
Private landowners	The tie in between the crossing and the reserve on the western side is unlikely to affect the adjacent landowners whose properties are located at 5, 7, 9 and 13 Marina Way and 16, 18, 20, 22, 24, 26 and Pohutukawa Drive from a privacy perspective. This is because the tie in and shared pathway itself would be located on a bench located between approximately 10 m at the northern end transitioning to 6 m at the southern end lower than the crest of the slope the dwellings are located behind. The tie in and shared pathway would also be near the toe of the slope, making it difficult to view from the dwellings.	Nil	There are large pohutukawa trees located along the shoreline of the reserve, which provide a degree of softening and screening of segments of the crossing as viewed from some properties located at 2-12 Roretana Drive.

Criteria	Advantages	Disadvantages	General comments
Landscape and visual	In a general sense, the crossing will result in a new and visually prominent engineered structure when viewed from Tauranga Harbour and the Athenree and Bowentown peninsulas. However, relative to Crossing Options 1, 1A and 2, this option is likely to create the least impact. This is because strategically locating the crossing within the mangrove “gaps” and under the pohutukawa limbs in a shore parallel orientation will mitigate the effects through partial screening and working with nature to utilise meandering characteristics of the intertidal channels between the mangroves. This represents mitigation that can be designed and constructed into the crossing to minimise this effect.	Nil	Early involvement from a landscape architect and ecologist to the concept design process will assist with mitigating this effect to the extent practicable.
Ecology	If the rock lined filled causeway option is selected for the crossing, or a portion of it, then the armour layer could potentially provide new habitat for fauna.	The construction and occupation of the estuary bed by the structure will smother benthic organisms and prevent sunlight reaching plants such as mangroves and seagrass. The rock lined fill causeway option creates the greatest impact with the pontoon and timber boardwalk option having lesser and the least effects respectively. This location is likely to have the least impact because the alignment utilises “gaps” in the mangroves, and west of the extent of the mangroves the estuary is largely comprised of the sub-tidal channel i.e. there are no large intertidal sand flats where seagrass etc colonise.	Early involvement from a marine ecologist to the concept design process and construction methodology will assist with mitigating this effect to the extent practicable.

Criteria	Advantages	Disadvantages	General comments
Hydrodynamics	Nil	<p>The crossing will result in a new engineered structure which will affect the tidal currents, sediment deposition and potentially benthic organisms, mangroves, and seagrass that inhabit the estuary surrounding the structure. The wooden boardwalk and pontoon options will have lesser effects than the rock lined fill causeway option as tidal currents can still pass underneath these structures. This location is likely to have the comparatively least impact because:</p> <ul style="list-style-type: none"> • A large segment of the structure will be located within the mangroves which are already impacting on hydrodynamics. • The location is near the top of the estuary where base flows from the Waiau River are likely to be more dominant than tidal flows. 	<p>Early involvement from a coastal engineer to the concept design process will assist with mitigating this effect to the extent practicable. Numerical modelling would be used to predict effects from different structures and combinations of structures with the results informing a design which has the least impact. There is a risk that actual effects are slightly different to those predicted by the numerical model. If significant effects were to result, then they may be difficult to mitigate or remediate. These significant effects could include re-positioning of the sub-tidal channel, loss of seagrass due to sediment smothering it, changes to sediment type/depth etc in areas currently inhabited by shellfish making those areas unsuitable. There is a relationship between hydrodynamic effects and ecological effects so these assessments and inputs to the concept design would need to be undertaken in parallel.</p>
Traffic safety	<p>The crossing ties into land on both the eastern and western sides that is located off the road, within esplanade and recreation reserves which are either flat or gently sloping. Connection of the crossing tie ins to the current and future shared pathway at Athenree and Bowentown can be achieved without creating safety issues to pedestrians, mobility scooters or motor vehicles.</p>	Nil	

Criteria	Advantages	Disadvantages	General comments
Earthworks and landform modification	Minor earthworks will be required where the crossing ties into land on both the eastern and western side due to the land being either flat or gently sloping. It is unlikely that any mitigation or remediation works such as planting will be required following the completion of the earthworks due to their likely nature and scale.	Nil	It has been assumed cultural monitoring of all earthworks on land will be undertaken by Te Whanau a Tauwhao Ki Otawhiwhi.

11.3 Rough order cost estimate

Rock lined fill causeway option: \$3,300,000 + GST

Timber boardwalk option: \$1,900,000 + GST

Pontoon option: \$3,100,000 + GST

12 Assumptions and exclusions

The rough order cost estimates provided in the matrix for each crossing location and structure type relate to construction, design and resource consenting.

The rough order cost estimates have been developed based on the following assumptions and exclusions:

- They are for the purpose of assessing options against one another i.e. they should be considered as being relative rather than absolute.
- They include items of a 25% allowance and 50% allowance respectively of the construction cost for preliminary and general and contingency.
- They have been developed using
 - Recent and historic tendered prices for comparable works undertaken within Tauranga Harbour
 - QV Cost Builder rates
 - Engineering judgment and experience
- The resource consenting allowances are up to the point of lodgement of the application i.e. no allowances have been made for further information requests, hearing evidence etc.
- The resource consenting allowances provide for some engagement with tangata whenua and potentially affected parties.
- The resource consenting allowances provide for a landscape and visual assessment to be provided by a sub-consultant and an assumed fee value for that sub-consultant has been incorporated into the allowances.
- They exclude geotechnical considerations as no site investigations have been undertaken to date.
- They exclude any consideration of seismic performance requirements pertaining to the structures that make up the crossing under the Building Act.

13 Summary and conclusion

This report has assessed the advantages and disadvantages of four proposed locations for the crossing as nominated by WBOPDC, the potential types of structures for the crossing, and rough order cost estimates for the potential types of structures for the crossing.

Option 3 has been discounted from further consideration based on engineering and cultural considerations.

As to Options 1, 1A, 2 and 4, some of the advantages and disadvantages identified in this report are relatively consistent at all locations. Conversely, other advantages and disadvantages are specific to individual locations. All options have different rough order cost estimates, but that is determined by their respective lengths.

Overall, and based on site observations and feedback received to date from Te Whanau a Tauwhao Ki Otawhiwhi and Mishmish Heritage, T+T considers that the Option 4 location utilising a timber boardwalk should be considered the preferred option by WBOPDC, if it decides to advance the project to the next stages of community engagement and preparation of technical assessments required to support future resource consent applications.

The reasons that Option 4 using a timber boardwalk should be considered the preferred option by WBOPDC are:

- No particular cultural and archaeological matters/sensitivities relating to this site have been identified.
- There is an opportunity for the crossing to create a narrative and restore a connection between the Koutunui Pa complex, the open coast, the estuary, and land located along the estuary margin (Pohutukawa Drive and Roretana Drive) as traditional places of occupation, food gathering and recreation.
- Compared to the other potential crossing locations and types there are likely to be less environmental impacts. These are summarised as follows:
 - **Recreational amenity:** The crossing is unlikely to create a physical barrier to pedestrian access either side of it due to the presence of the mangroves on the eastern side and the sub-tidal channel on the western side.
 - **Navigation:** The location for this crossing is likely to have the least comparative impact on navigation because it is the most upstream site. Small watercraft such as dinghies and kayaks will still be able to pass underneath the structure between the piles.
 - **Private landowners:** The tie in between the crossing and the reserve on the western side is unlikely to affect the adjacent landowners' privacy due to the height differential of the landform the dwellings are sited on.
 - **Landscape and visual:** The crossing will utilise existing "gaps" in the mangroves on the eastern side of the estuary and will sit within a backdrop of pohutukawa limbs on the western side, thereby partially screening the structure and/or providing a natural vegetated backdrop. The alignment represents working with nature.
 - **Ecology:** The crossing site utilises "gaps" in the mangroves and the boardwalk is the least invasive/disruptive to benthic organisms and sunlight for plants adjacent to and under the structure. The Waikareao Estuary Walkway is a good local example of where timber boardwalks can be constructed within salt marsh and mangrove habitat with little ongoing impact.
 - **Hydrodynamics:** The location for this crossing is likely to have the least comparative impact on tidal currents, sediment deposition etc because a large segment of the structure will be located within the mangroves, which are already impacting on hydrodynamics. Further, the location is near the top of the estuary where base flows from the Waiau River are likely to be more dominant than tidal flows. Lastly, tidal currents and river flows can still pass underneath the boardwalk through the significant voids between the piles.

As to the rough order cost estimates relating to Option 4, we note that the existing timber steps at the southern end of the WBOPDC esplanade reserve¹⁰ are currently unsuitable for the shared pathway. There are a few potential options that could be suitable for replacement of the existing timber steps that would be suitable for the shared pathway. We have not undertaken an options assessment and prepared rough order cost estimates for the replacement structure/solution as part of this report. We note that the structure/solution could be relatively costly. Similarly, we have not prepared rough order cost estimates for the shared pathway itself where it traverses WBOPDC esplanade and recreation reserves and unformed public roads prior to connecting to Pohutukawa Drive.

¹⁰ Lot 32 DPS 10394

14 Applicability

This report has been prepared for the exclusive use of our client Western Bay of Plenty District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

The construction rates utilised for this high-level cost estimate are based on assumed design concepts, estimated quantities and a combination of recently submitted tender rates for similar projects within the regional area along with the latest available rates from QV Cost Builder database (formerly Rawlinsons). Consequently, a significant margin of uncertainty exists on the cost estimate and the contingency we have allowed should be considered as part of the cost rather than a potential add on.

No allowance has been included for cost escalation beyond 2021.

COVID-19 impacts: The derived rates are based on information and data obtained prior to COVID-19 being declared a pandemic by the World Health Organisation. New Zealand subsequently entering COVID-19 Alert Level 4 “lockdown” plus the global economic impacts of COVID-19 will have an impact on the construction industry in at least the immediate and medium-term future. The significance and extent of COVID-19 impacts is uncertain at this time but likely to impact both labour and materials rates.

We have not made any attempt to allow for the impact of COVID-19 in this estimate and recommend you seek specialist economic advice on what budgetary allowances you should make for escalation and changed construction costs post COVID-19.

Tonkin & Taylor Ltd

Report prepared by:


Authorised for Tonkin & Taylor Ltd by:



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Reuben Hansen

Principal Environmental Consultant



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Dave Taylor

Project Director









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Appendix A: Figures 1 and 2 – Potential Crossing Locations



LEGEND

-  Property Boundary
-  Parcel Boundary
-  Most Northern Starboard Navigation Marker
-  Crossing
-  Informal Mooring Area
-  Seagrass Bed
-  Timber Steps
-  WBOPDC Water Main

A3 SCALE: 1:2,500

0 25 50 75 100 125 (m)



1. Parcel Boundary, Property Boundary, Street Name, Street Number sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
2. World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**WBOPDC
 WAIHI BEACH TO ATHENREE
 Proposed Shared Pathway
 Potential Crossing Locations**

FIGURE No.
 Figure 1



LEGEND

-  Property Boundary
-  Parcel Boundary
-  Crossing
-  Timber Steps

A3 SCALE: 1:2,500

0 25 50 75 100 125 (m)

1. Parcel Boundary,Property Boundary,Street Name,Street Number sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
2. World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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**WBOPDC
 WAIHI BEACH TO ATHENREE
 Proposed Shared Pathway
 Potential Option 4 Crossing Location**

FIGURE No.
 Figure 2

