

# Kaituna River Re-diversion and Wetland Creation Project

Summary and Analysis of Options and Alternatives



Bay of Plenty Regional Council  
Environmental Publication 2013/09

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NEW ZEALAND

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## Peer review

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Jim Dahm, (Coastal Scientist, Eco Nomos) Project Peer Reviewer reviewed the final draft of this report and his comments have been incorporated.



## **Purpose of report**

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The purpose of this report is to provide councillors with the opportunity to re-consider and provide direction on the various options and alternatives put forward for meeting the objectives of the Kaituna River Re-diversion and Wetland Creation Project. Such consideration is required by Sections 168 and 171 of the Resource Management Act at this stage of the project as staff have identified and recommended a preferred option for further modelling and investigation. The preferred option requires some private land for its implementation. Council direction is sought on the preparation of a Notice of Requirement to designate that land for a public work.





# Scope of report

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This report contains the following sections:

- Part 1 **Project Context** states the project objectives, the problem with the estuary, describes the constraints within which the solution needs to be found and summarises the history of the diversion of the river from the estuary and past steps to re-divert it.
- Part 2 **Investigations to Date** details the studies undertaken pre-2011 (pre-feasibility); those undertaken in early 2012 leading to the decision to pursue the Maximum Flow Partial Re-Diversion option (Feasibility and Consentability stage) and then those presented to the public in early 2013 during pre-consent consultations (Investigation and Preliminary Design stage) and what came out of that consultation.
- Part 3 **Landowner Implications** is a summary of works required on private land and the response from landowners.
- Part 4 **Summary and Analysis of Options** is a review of all the options and their benefits, costs and implications.
- Part 5 contains the **Recommendations**.



## Executive summary

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The Kaituna River Re-diversion and Wetland Creation Project is set up to implement part of the Kaituna River and Ongatoro/Maketū Estuary Strategy (BOPRC 2009) in response to long-standing tangata whenua and community concerns about environmental degradation. The project goal is:

***To significantly increase the volume of water (particularly fresh water) flowing from the Kaituna River into Ongatoro/Maketū Estuary by 2018 in a way that maximises the ecological and cultural benefits (particularly wetlands and kaimoana) while limiting the economic cost and adverse environmental effects to acceptable levels.***

Specific objectives within the goal are to:

- maximise the re-diversion of water, particularly fresh water, from the Kaituna River back through the Ongatoro/Maketū Estuary, while keeping Te Tumu Cut open,
- restore or create at least 20 hectares of new estuarine or freshwater wetland in the estuary or lower river,
- maximise the achievement of tangata whenua, stakeholder and community aspirations for the restoration of the estuary and lower river, and
- avoid, minimise, remedy or mitigate adverse environmental effects, including effects on private land owners.

This report describes the various options considered by Councillors and staff to achieve these objectives. One option (modified option 2) is recommended by staff as the preferred option for detailed modelling, investigation and ongoing dialogue with stakeholders.

The modelling and investigations will detail the risks, benefits and costs of the preferred option. They will also identify potential modifications to the preferred option to either better achieve the desired objectives or to address stakeholder concerns.

At this stage, Councillor approval is sought to proceed with the detailed modelling and investigations. Once the preferred option has been tested and potentially refined through the process of modelling, investigation and dialogue with stakeholders it will be brought back to Council in 2014 for final approval before lodging relevant resource consent applications or proceeding with other implementation work.

Council approval is also sought to prepare a Notice of Requirement to designate land required to implement the preferred option. This Notice of Requirement will also be brought back to Council for approval in 2014 prior to lodgement.

The preferred option for detailed investigation and assessment of environmental effects (including landowners directly affected) are shown in Figures 1a and 1b below.



Figure 1(a) Preferred option



Figure 1(b) Details of preferred option and private land holdings affected.

The key elements of the preferred option as labelled on the above diagram are:

- (a) Replace/extend the existing Ford's Cut Culverts to create a new inlet structure to allow more water from the river into the estuary and disallow return flow.
- (b) Widen Ford's Cut to at least 60 m at the inlet structure widening to at least 100 metres at the estuary and deepen to RL-1.5 m, leaving it with "soft" meandering edges in addition to these widths (these details and the exact shape of the diversion channel to be confirmed/refined by the proposed detailed modelling).
- (c) Shape and restore appropriate wetland ecosystems on low-lying grassland areas of the Brain land north of Ford's Cut. At this stage, indications are that the Brain land is critical to project objectives and that purchase or taking of this land will be required. There is also potential for further wetland restoration on and adjacent to Papahikahawai Island Trust land subject to negotiations with landowners.
- (d) Remove the two causeways between Papahikahawai Island and Maketū Spit, and the one between the Brain Land and Papahikahawai Island to restore hydraulic connections between the restored wetlands and the estuary.
- (e) Block the downstream section of Ford's Loop and convert it to some form of embayment with public boat ramp and parking.
- (f) If additional benefits (particularly greater freshwater content in the re-diversion) are significant and funding permits, the proposed diversion channel will be excavated from from the river at the wetland some 500 m west of Ford Road to meet the existing channel. Alternatively, the diversion will simply involve unblocking the old river loop.
- (g) Consider the option to install a culvert connection from the river at Te Tumu into the upper end of the Papahikahawai Channel – to improve flushing and hydraulic connectivity in this area of the restored estuary.

### **Staged re-diversion**

Staging the increase in re-diversion will be considered to avoid sudden changes in salinity, water quality and flows and sedimentation and erosion patterns. At this time, staging means stepped increments of flow increases at intervals of one to two years from the present 147,000 m<sup>3</sup> per tidal cycle up to approximately 600,000 m<sup>3</sup> per tidal cycle.



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# Part 1: Project context

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## 1.1 Project objectives

In September 2009, following a period of community and stakeholder engagement, the non-statutory Kaituna River and Ongatoro/Maketū Estuary Strategy (“the Strategy”) was published by the Bay of Plenty Regional Council (“BOPRC”) to *“...provide a framework for local authorities, government agencies, tangata whenua, local communities, industry organisations, and non-governmental organisations to co-ordinate and prioritise their actions that will achieve the vision and outcomes of the Strategy by 2018.”*

The Strategy’s vision is that as a wider community our policies and plan, our activities and actions will by 2018: *“Celebrate and honour Kaituna River and Ongatoro/Maketū Estuary life as taonga.”* The key outcomes in the Strategy are:

- 1 Improving water quality.
- 2 Restoring healthy ecosystems.
- 3 Ensuring sustainable resource use.
- 4 Supporting kaitiakitanga and local people’s stewardship.

The Strategy says: *“In practical terms, achieving the vision and outcomes of the Strategy means different things to different people within the community. For some, it will mean that:*

- *The waters of the river and estuary are clean enough to swim in*
- *There is enough water in the river and estuary to support:*
  - *the mauri of the river and estuary,*
  - *good water quality,*
  - *wetland restoration, and*
  - *a range of recreational and non-recreational uses.*
- *Wetlands are restored in the Lower Kaituna Catchment.*
- *There are thriving populations of indigenous flora and fauna, native plants, kōura, eels, fish, whitebait, trout and waterfowl.*
- *Tangata whenua are easily able to get kaimoana, and other kai for themselves and their manuhiri”.*

The two biggest actions in the Strategy are the return of more freshwater from the Kaituna River to Ongatoro/Maketū Estuary, and the creation of 100 hectares of wetlands, both by 2018.

BOPRC through its Ten Year Plan 2012-2022 has agreed to fund certain goals in the Strategy, and to coordinate its overall implementation. To reflect the funding allocation and direction provided by Council, the Kaituna River Re-diversion and Wetland Creation Project is primarily focussed on planning and implementing the re-diversion of water from the Kaituna River back into Ongatoro/Maketū Estuary, and re-creating wetlands as part of and in addition to the re-diversion work.

Achievement of the other objectives of the Strategy, including the majority of wetland creation work, will be planned and implemented through BOPRC’s and partner agencies existing programmes, but reported on through this project.

In 2012 the Kaituna River Re-diversion and Wetland Creation Project was established. This project has the following goals and objectives.

## Goal

***To significantly increase the volume of water (particularly fresh water) flowing from the Kaituna River into Ongatoro/Maketū Estuary by 2018 in a way that maximises the ecological and cultural benefits (particularly wetlands and kaimoana) while limiting the economic cost and adverse environmental effects to acceptable levels.***

## Objectives

Specific objectives within the goal are to:

- maximise the re-diversion of water, particularly fresh water, from the Kaituna River back through the Ongatoro/Maketū Estuary, while keeping Te Tumu Cut open,
- restore or create at least 20 hectares of new estuarine or freshwater wetland in the estuary or lower river,
- maximise the achievement of tangata whenua, stakeholder and community aspirations for the restoration of the estuary and lower river, and
- avoid, minimise, remedy or mitigate adverse environmental effects, including effects on private land owners.

## 1.2 Problem definition

Table 1 (from Commission for the Environment 1984) provides a summary of effects considered to have been created by the removal of the Kaituna River from the estuary. Subsequent detailed investigations from the 1980's to the present are consistent with the Commission for the Environment (CfE) findings. These are:

Significant ecological impacts associated with increased salinity and loss of large freshwater inflows associated with the 1956 Te Tumu diversion, including:

- Significant loss of wetland marsh in upper estuary (about 160 ha or 95%).
- Significant change in habitat of lower estuary.
- Significant changes in estuarine biota, including kaimoana species.
- Alterations in the upper estuary associated with causeways and pastoral farming.
- Problems with nuisance sea lettuce and algae.
- Significant changes in fish populations.

Significant changes in estuarine processes, sedimentation and morphology including:

- Major change in balance between outflows (significantly decreased) and flood tide inflows (significantly increased).
- Decreased tidal prism and some ongoing loss due to sedimentation as system adjusts towards new dynamic equilibrium.
- Significant expansion of flood tide delta in lower estuary – accompanied by changes in bed levels, channels and banks in this area.

- Erosion of landward shorelines associated with expansion of flood tide delta.
- Occasional spit breaching (twice in last 30 years) and associated issues (sediment input, navigation issues, bank and channel changes) with periods of flood tide delta expansion.
- Reduction in entrance and ebb tide delta dimensions and changes to shorelines around the harbour entrance (due to major decrease in outflow tidal prism).
- Decreased flows through upper harbour channels – probably accompanied by slow sedimentation (restricted by sediment supply) and changes in sediment character.

Table 1 Maketū Estuary - Problems and effects created by the removal of the Kaituna River from its natural estuary (CfE 1984).

	Primary	Secondary	Tertiary
<b>1 Lack of river volume causing estuary siltation.</b>	<ul style="list-style-type: none"> <li>(a) Shell-fishing deterioration.</li> <li>(b) Recreational fishing in the estuary (netting, etc.) reduced.</li> <li>(c) Access for commercial fishing and recreational boating impossible.</li> <li>(d) Swimming (including school programmes).</li> <li>(e) Surfing reduced (shallow bay, etc.).</li> <li>(f) Beach scouring, erosion.</li> <li>(g) Decline in wildlife habitat.</li> <li>(h) Duck shooting curtailed.</li> <li>(i) Blocked gravity drains leading to pumping costs.</li> <li>(j) Views, aesthetic outlook deteriorated.</li> </ul>	<ul style="list-style-type: none"> <li>(a) Less business for shops.</li> <li>(b) Stagnation in land values.</li> <li>(c) Increased food expense for working class budgets.</li> <li>(d) Poaching of marine resources.</li> <li>(e) Loss of Māori mana.</li> <li>(f) Increased welfare costs to taxpayer.</li> <li>(g) Difficulty of agar seaweed collection for cash (beach erosion).</li> <li>(h) Walks for elderly restricted (ibid).</li> <li>(i) Decline in use of area as natural classroom for schools.</li> </ul>	<ul style="list-style-type: none"> <li>(a) Emotional stress for leaders dealing with bureaucrats.</li> <li>(b) Widespread feelings of impotence, cynicism toward politicians experts, public servants.</li> <li>(c) Exacerbated community tensions.</li> <li>(d) Family problems.</li> <li>(e) Sense of declining quality of life, viable community future.</li> </ul>
<b>2 Lack of freshwater flow combined with tidal flushing.</b>	<ul style="list-style-type: none"> <li>(a) Shell-fish declining</li> <li>(b) Harm to flax, other plants and mud for dyeing flax.</li> <li>(c) Recreational fishing reduced.</li> <li>(d) Swimming unattractive (stagnant water).</li> <li>(e) Build-up of sea lettuce etc (choking waterways, rotting).</li> <li>(f) Deterioration of wildlife habitats.</li> <li>(g) Saltwater seepage under stopbanks killing pastures, new horticulture plantings.</li> </ul>	<ul style="list-style-type: none"> <li>(a) Less business for shops.</li> <li>(b) Loss of important marine breeding ground.</li> <li>(c) Health problems.</li> </ul>	

	Primary	Secondary	Tertiary
<b>3 Damaging “improvements” in and around estuary, e.g.:</b> <ul style="list-style-type: none"> <li>• Planting spartina grass</li> <li>• Illegal causeways</li> <li>• Illegal dumping, filling</li> <li>• Stopbank dredging causing silting</li> <li>• Filling Ford’s causeway.</li> </ul>	(a) Accelerated silting and less freshwater flows, reinforcing numbers 1 and 2.		
<b>4 Pollution from stream.</b>	Affecting: (a) Shell-fish. (b) Swimming. (c) Fishing. (d) Wildlife.	(a) Family menus impacts. (b) Marae/mana denigration. (c) Health risk increase.	

## 1.3 Critical issues summary

### 1.3.1 Tangata whenua

Tangata whenua have always been the key stakeholder in the Kaituna Ongatoro/Maketū area, the estuary and the river and the cultural and life sustaining values it provides. The success of the Kaituna River Re-diversion and Wetland Creation project is closely tied with the tangata whenua evaluation of the mauri (sometimes defined as “life force”) of the lower Kaituna River and Ongatoro/Maketū Estuary. Tangata whenua have been a major part of the community drive to re-divert some or all of the Kaituna River back through the estuary. The area is highly significant to Māori as the landing place of the Arawa canoe and as a resource-rich location for settlement.

In addition to earlier consultation, project team staff engaged with tangata whenua during pre-consent meetings in May and June of 2013. Responses to date from affected and interested iwi has been generally supportive of the options proposed by the project team. Most of the discussion has been around the details of how to achieve the objectives and maximise the benefits. There remains some wish to re-divert the full flow of the river back through the estuary.

### 1.3.2 Water quality

The poor water quality of the Kaituna River is seen as a major constraint to re-diversion. When the Department of Conservation (DOC) first applied for consent to re-divert water in 1990 its application for 400,000 m<sup>3</sup>/tidal cycle (of an average total river flow of 2,900,000 m<sup>3</sup>/tidal cycle) was reduced to 100,000 m<sup>3</sup>/tidal cycle because it was not legally possible to re-divert more water than this because it would reduce the water classification of the estuary.

Since 1990 there has been a marked reduction in bacterial contamination of the lower Kaituna River, little change in phosphorus but an increase in nitrogen (Park 2007; Park 2010).

DHI Water and Environment (March 2011) modelled a marked reduction in estuarine water quality for full re-diversion (Te Tumu Cut closed and all Kaituna River water re-diverted to the estuary) in terms of requirements for shellfish growing waters and bathing standards. Partial re-diversion (Te Tumu open), although not yet fully modelled, is likely to have an intermediate impact dependant on the amount of water diverted. Any potential reduction in water quality will need to be assessed along with the potential benefits and other environmental effects of the re-diversion.

Proper assessment and management of water quality changes is seen as critical to successfully obtaining consents.

### 1.3.3 Drainage and flood protection

Land along the lower Kaituna River receives benefits from the Kaituna Catchment Control Scheme which provides for drainage and flood protection. Any change to water levels in the river resulting from a re-diversion project will have to be very well understood and managed. Any effects on normal levels and flood protection will need to be avoided, remedied or mitigated.

### 1.3.4 Private land issues

#### Brain land

This land, located between the Kaituna River where it flows due north out through Te Tumu Cut and the estuary, poses a significant constraint on restoration of the Maketū Estuary. The very low-lying land was wetland prior to about 1960, which has since been lost from the upper estuary. In addition, flood protection for the land depends partly on two causeways which cut off the river and tidal flows from a large portion of the former estuary (now referred to as Papahikahawai Lagoon, though originally part of the upper estuary). The habitat and water quality in this area are poor and restoration of this area through reconnection to the estuary is critical to the wider goals of estuarine and wetland restoration (Park 2008).

The land is in four parcels, one of which (four hectares) is owned by Mr Alain Brain and the other three (totalling 69 hectares) are owned by the estate of Oliver and Violet Brain, for which Mr Brain is an Executor along with another Trustee. The land is almost all in pasture (there are minor area of wetland) and leased out for grazing by dairy cows.

The land is drained and is protected from high river and estuary water levels by a series of stopbanks and causeways (see Figure 2). Two of the banks are BOPRC scheme banks – Ford Road and South Side Ford's Cut and no change is proposed to these. The other three banks (North Side Ford's Cut, East Bank and the two causeways) are not scheme assets.



Figure 2 Existing flood protections for the Brain Land.

Ownership of these flood protection assets where they do not occur on the Brain land has not been legally established, although the Brain family have a 1963 agreement with Tauranga County Council outlining where they would be built and who would pay for them, as well as future maintenance responsibilities. The two causeways also provide access to Papahikahawai Island.

Regional Council staff meet regularly with Alain Brain and another Trustee with the objective of negotiating a mutually suitable arrangement for future land use and access for the project.

### Papahikahawai Trust land

The Trust owns a large amount of land in two parcels (Figure 3) bounded by the Papahikahawai Channel to the north and by the edge of the old river channel to the west and south. It therefore owns land within the estuary effectively below the high tide line. A large proportion of the Trust's property was freshwater wetland prior to the 1956 Te Tumu diversion, but increasing salinity in the estuary since that time has killed the vegetation and led to the erosion of the substrate.

The portion of the land located above high tide (Papahikahawai Island) is presently leased and used for grazing dairy cows. Vehicle and stock access to the island is via the causeway built in the early 1960s from the Brain land. There is no legal access arrangement over the Brain land or this causeway. There is a second small causeway from the north side of the island to the spit, used predominantly for foot access.

Regional Council staff are working with Papahikahawai Island Trustees to try and negotiate a mutually suitable arrangement for future land use and access. This may include a Biodiversity Management Plan or other similar agreement.



Figure 3 Papahikahawai Trust land.



## Private land west of Ford Rd

A landowner, referred to in this report as Landowner X, owns a 109 hectare dairy farm at the western end of the Project area, as well as a smaller title for a house and dairy shed (Figure 4). This land spans both the north side of the scheme stopbank (wetland) and the south side (farmed pasture land).

Regional Council staff are working with Landowner X to try and negotiate a mutually suitable arrangement for future land use and access.



Figure 4 Landowner X land and Ford Land Holdings. The solid brown line shows where the scheme stopbank runs through Landowner X's land.

The Ford family own land on the north side of the river and the "island" in the old river loop (Figure 4). This island was created in the early 1980s when the Kaituna River was diverted through the Ford family land cutting the island off from the main property to the north. There is physical access to this island from the west through Landowner X's land but no legal access.

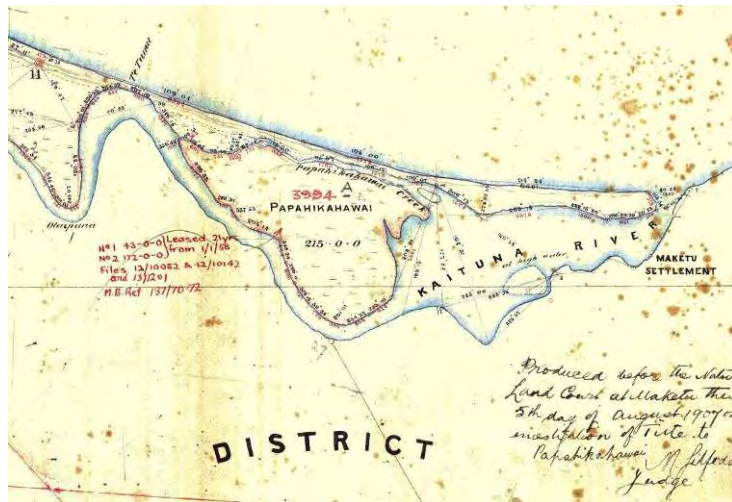
Regional Council staff are working with the Ford family to try and negotiate a mutually suitable arrangement for future land use and access.

## 1.4 History

There are three aspects to the history of the Kaituna River to Maketū Estuary re-diversion proposal: (i) the physical diversions and re-diversions, both natural and man-made, (ii) central government deliberation and (iii) recent Regional Council deliberation.

### 1.4.1 History of Te Tumu diversion and Ford's Cut

- 1877 The main river channel flowed into the estuary along the southern shoreline of Papahikahawai Island with only a minor tidal creek between the island and the spit – as shown in the 1877 Survey Plan below.



- 1907 to 1925 The river broke out to sea at Te Tumu in a major flood and coastal storm in 1907, reducing the estuary to a tidal system and causing extensive sedimentation and disruption of both navigation and local kaimoana. This natural diversion caused significant hardship to local Maori and boat owners and investigations were conducted to assess the situation and possible remedies. Over the period to 1925, the new river entrance slowly migrated eastwards – as can be seen in the following diagram (Drawing BOPCC K4254 from KRTA 1986).

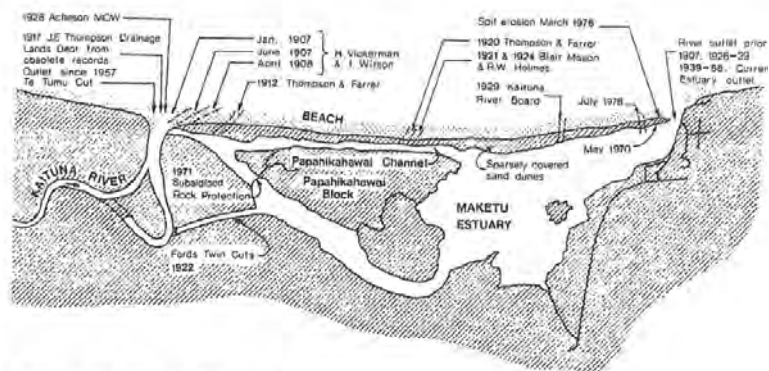


FIG1. KAITUNA RIVER OUTLETS

- 1920 to 1928 Ford's Twin Cuts (also known as Ford's Cut now) and other works constructed to restore the river back through the estuary – with funding provided both by central government and Te Arawa.

- 1956 Schemes for improved flood protection and lower Kaituna were investigated in the 1940's and 50's. Initial proposals from the local drainage board provided for maintenance of river flow through the estuary in recognition of the importance to local Maori and Te Arawa. However, pressure and funding incentives from central government eventually resulted in a revised scheme with diversion of the river at Te Tumu. The Te Tumu diversion was permanently opened in 1956 and Ford's Cut and Papahikahawai Channel blocked.
- 1956 to 1979 Major changes to estuary morphology and ecology following diversion of the Kaituna River from the estuary.
- 1979 Kaituna Catchment Control Scheme started extensive stop-banking work. Stopbank along Ford Road constructed.
- 1981 Ford Island was created by diversion of the river.
- 1990 to 1994 DOC consent application and tribunal for re-diversion through Ford's Cut.
- 1996 Construction of Ford's Cut control structure by DOC to allow 100,000 m<sup>3</sup> per tidal cycle (actually measured at between 120,000 and 150,000 m<sup>3</sup>).

#### 1.4.2 History of deliberations on re-diversion

The adverse effects of the river diversion on the estuary resulted in significant ongoing pressure and lobbying for re-diversion of the Kaituna River water back through the estuary.

In 1984 a Cabinet Paper and Parliamentary Petition resulted in the preparation of a Restoration Strategy in 1989 (DOC 1989). The Cabinet Minute (Clark undated) recommendations were:

*7(e) "Agree that any rediversion of the Kaituna River be undertaken only as part of this management strategy, and only if studies carried out under the strategy justify re-diversions."*

*7(f) "Agree that the scale and nature of any such rediversion be such as to neither lessen water quality in the estuary below classification standards nor impair the integrity of the Kaituna Catchment Control Scheme."*

The optimum re-diversion as recommended in the 1989 Restoration Strategy was (quoted below) very similar to what is being recommended now.

*S.5.6.3 "An optimum rediversion of the Kaituna River in to the Maketū Estuary would entail a significant flow of between ten and twenty cumecs. Constraints on maximum flow include maintaining navigability at Te Tumu, not breaching water quality classification standards of risking public health, not compromising the Kaituna Catchment Control Scheme and maintaining a regular monitoring programme of the effects of rediversion."*

Currently and locally there is still a strong desire to return the waters of the Kaituna River to the estuary. The Kaituna River and Ongatoro/Maketū Estuary Strategy (BOPRC September 2009) was the culmination of many years of discussion around a desire to improve the health of the Maketū Estuary through better ecology, better water quality and improved (increased) flow through the estuary. It was drafted following deliberations by a Joint Council Committee and receipt of numerous submissions from interested parties. Many stakeholders desired full diversion. The Strategy, under the key outcome “Restoring Healthy Ecosystems”, includes the “significant actions”:

- Kaituna River to the Ongatoro/Maketū Estuary re-diversion (exploring options to increase water flow from the river to the estuary).
- Create at least 100 hectares of wetland in the lower Kaituna catchment by 2018.

Bay of Plenty Regional Council’s draft 2012-2022 Ten Year Plan included funding for both of these actions, supported by a number of local submissions. However, the final Plan included funding only for the re-diversion and a statement that wetland creation would be pursued as opportunities arise (such as during the process of re-diverting the river).

### 1.4.3 Resource consent history

The following provides a brief overview of the history of the planning approvals and consents for the rediversion of water from the Kaituna River back into the Maketū Estuary.

- 1990 – As a result of the government ordered Restoration Strategy (1989), an application for planning approval was lodged by the Department of Conservation to undertake a partial rediversion (400,000 m<sup>3</sup> per tidal cycle) of the Kaituna River into the Maketū Estuary (application ref 02 2636). Approval was only granted for up to 100,000 m<sup>3</sup> per tidal cycle due to water quality concerns. The decision was appealed by several parties.
- 1994 – The last of the appeals against consent 02 2636 was dismissed by the Planning Tribunal (Decision A 5/94). A High Court injunction was sought by the Brain family.
- 1996 – High Court appeal dismissed, rediversion was implemented.
- 1997 – Resource consent 02 2636 expired.
- 1998 – Resource consent application 04 0277 was granted to the Department of Conservation. This consent replaced 02 2636 and expired in May 2013. An application for renewal has been lodged.

The rip rap walls along the bank of the Kaituna River and southern side of Ford’s Cut are covered by a comprehensive consent held by BOPRC for coastal structures (65213), which was issued in 2008.

## Part 2: Investigations to date

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The Regional Council investigations to date can be split into three stages:

- 1 Pre-2011 pre-feasibility studies.
- 2 2011 – 2012 feasibility studies.
- 3 2012 to present investigation and preliminary design.



Figure 5 Features of the area.

### 2.1 Pre-feasibility studies up to 2011

#### 2.1.1 Total water flow assessments

A multitude of options have been considered by Council staff for both full re-diversion and partial re-diversion over the period from 2001 to 2011. These are summarised in Table 2 (from Wallace 2001; Wallace June 2007; BOPRC May 2008).

Table 2 Options considered 2001 to 2011.

Option name and early estimate of costs	Option description	Comments
Status quo	Status quo. Leave the river and estuary in their current states with 4% of flow going through Ford's Cut.	No flow increase from 150,000 m <sup>3</sup> . No effect on land owners. Estuary continues to deteriorate. No new wetlands.
B	Remove the culverts and causeway at the inlet to Ford's Cut.	Reduced flow to estuary.
C	Remove the culverts and causeway at the inlet to Ford's Cut and open river to Papahikahawai Channel.	Reduced flow to estuary.
D	Remove block in river channel at upstream of loop.	Very minor increase in flow to 161,000 m <sup>3</sup> .
E	Remove block in river channel at upstream of loop and put a weir across Te Tumu at RL 1.0 m.	Very minor increase in flow to 165,000 m <sup>3</sup> .
F	Remove the culverts at the inlet to Ford's Cut and open river to Papahikahawai Channel and remove the upstream block in the river loop.	Reduced flow to estuary.
G	Remove the culverts and causeway at the inlet to Ford's Cut and open river to Papahikahawai Channel and remove the upstream block in the river loop and construct a weir at Te Tumu at RL 1.5.	Major flow increase to 2,900,000 m <sup>3</sup> . Increased flood levels – costly, technically unreliable to mitigate. Potential for river to break out along spit. Convert the Brain land to wetland.
H - \$8M	Full diversion. Mouth at Te Tumu completely closed off. Ford's Cut structures and causeway removed. Ford's loop block removed. Papahikahawai Channel opened. No bridges included, spit access is cut off.	Major flow increase to 2,900,000 m <sup>3</sup> . Increased flood levels – costly, technically unreliable to mitigate. Potential for river to break out along spit. Convert the Brain land to wetland.
I - \$0.6M	Double the number of culverts between Ford's Cut and estuary including flapgates.	Moderate flow increase to 200-270,000 m <sup>3</sup> . Minimal impact on the Brain land. No new wetland.
J - \$0.5M	Existing culverts at Ford's Cut lowered to be submerged at mid tide (invert level at -1.6 m RL).	Moderate flow increase to 200-260,000 m <sup>3</sup> . Minimal impact on Brain land. No new wetland.
K - \$0.25	Remove culverts and causeway between river and estuary at Ford's Cut, but with the opening defined by two large culverts (as a bridge).	Reduced flow to estuary.
L - \$0.8M	Remove culverts and causeway between river and estuary at Ford's Cut, and replace with large culverts that are floodgated to prevent backflow into the river.	Moderate flow increase to 383,000 m <sup>3</sup> . Minimal impact on the Brain land. No new wetland.

Option name and early estimate of costs	Option description	Comments
M	Open river to Papahikahawai Channel and construct weir at low level.	No results found.
N - \$0.9M	Open Papahikahawai Channel with large floodgated culverts. Remove spit causeways and removal/retention of island causeway.	Significant flow increase to 330-450,000 m <sup>3</sup> but salinity too high If agreed, wetland created on the Brain land; otherwise stopbank needed.
P - \$0.4	Lower the level of Ford's Road to allow high tide flow from river to adjacent farmland (potential nutrient stripping wetlands). Open Papahikahawai Channel.	Very minor increase to 160,000 m <sup>3</sup> . Potential for river break out along spit. Convert the Brain land to wetland.
R - \$6.6M	Full diversion with flood relief. Installation of two mechanically controlled gate structures at Te Tumu and at Ford's Cut. Te Tumu gate closed in normal flow conditions, opened in flood conditions. Ford's Cut gate open in normal conditions and closed in flood conditions.	Major flow increase to 2,900,000 m <sup>3</sup> . Increased flood levels – costly, technically unreliable to mitigate. Convert the Brain land to wetland.

Options B, C, D, E, F, K and M were dismissed (Wallace 2001) because they provided no benefit to the estuary i.e. the flow rate from the river either reduced or increased an insignificant amount (10,000 to 50,000m<sup>3</sup> per tidal cycle). Options G and H were also dismissed because of their cost and the potential to adversely affect flood levels upstream. Options I, J and L were identified as providing reasonable benefit to the estuary at reasonable cost and with potentially manageable environmental affects.

Options N (and 19 variations thereof), P and R were added in 2007 though P and R were dismissed almost immediately due to their low benefits or the unreliability of any type of flood relief system at Te Tumu.

The above work focused simply on technical feasibility of options – i.e. significantly increasing the total flow of water from the river to the estuary without increasing flood levels upstream.

In 2008 Council staff (BOPRC 2008) assessed the hydraulic modelling results considering broader issues and constraints such as cost, likely environmental effects (both positive and negative) and land access/availability for the works. They concluded that Option N be investigated further additionally reporting that this option would allow more extensive re-diversion in the future if appropriate.

### 2.1.2 Salinity assessments

Council scientists and hydraulic engineers were of the view that locating the proposed re-diversion at the Papahikahawai Channel close to the sea could result in the re-diverted river flows being highly saline. This would reduce the benefits of any increased river re-diversion through the estuary.

Accordingly, in 2008 studies were commenced to examine the salinity concentrations that might result. DHI Water and Environment were engaged to model Option N and its variations and to report on the freshwater to saltwater ratios. They reported (DHI Jan 2009 and June 2009) that of the total amount of water coming through any new opening from the river into the estuary at Papahikahawai, only 26%-31% was freshwater (the range of percentages reflects the different configurations modelled). Compared to this the percentage of freshwater entering through Ford's Cut as assessed at that time is 77%.

These results lead Council staff to focus on variations of Option N which propose more water diverted through Ford's Cut and only minor amounts through any new opening near Te Tumu.

### 2.1.3 Wetland creation

While technically possible to create wetlands on a large proportion of the 6,100 hectares formerly part of the large Kawa Swamp in the lower Kaituna Catchment, only a small proportion of that land has attributes that make this practical.

In 2009, the Council commissioned Boffa Miskell to report on the feasibility of wetland creation. Boffa Miskell (2010) identified 5 sites with the highest potential for wetland restoration/creation and worthy of further investigation and investment.

The Brain land was one of these sites (Site C of the five options identified, see Figure 6) and is described by Boffa Miskell (2010) as follows:

#### Option C:

The current land use is grazing, but it is marginal given the high propensity to flood. The coastal/estuarine margins of the site already contain some saltmarsh and dune vegetation. The stop bank within Site 24 may need to be lowered or relocated to the south. The total land identified within this option is approximately 73 ha.

Table12: Option C parcel Information

BML Site ID	Description	Parcel Number	Parcel Area	Appellation
24	Drained, grazing, residential dwelling, Fords Cut	4374653	60.707	Pt Section 1 Blk V Te Tumu SD
25	Drained, grazing, saltmarsh/dunes.	4442416	4.2744	Lot 3 DPS 12129
26	Drained, grazing, saltmarsh/dunes	4309231	4.0847	Lot 2 DPS 12129
27	Drained, grazing, saltmarsh/dunes	4266505	4.11	Lot 1 DPS 1219

The key benefits of Option C include:

- Easy accessibility;
- Freshwater and estuarine biodiversity could be enhanced.
- The land is adjacent to the Kaituna River, Ford's Cut and the Maketu Estuary.
- 73.18 ha, but potential to include more land to the south.
- There is an opportunity to select freshwater and saltmarsh vegetation species that provide habitat for and encourage the spawning and migration of native fish species.
- Critical landscape unit for wetland integration between estuary and river corridor
- Area has the potential to be a key wetland landscape unit in the core area of transition between river to estuary on the south west boundary of the ONFL
- Visual amenity improvement potential high.



- Due to this 'hinge' location between the river and estuary, this area provides substantial and achievable improvement to landscape ecological cohesion and integrity.
- Continuation of connections to Maketu Estuary. Connection to the Kaituna cut and the ocean.
- Kaitiakitanga issues will be strong
- High opportunities for rekindling cultural harvest and practices in the estuary in flora, fauna (fish and bird life).

Option C has a key weaknesses in being privately owned land where it is unlikely that the owners would be willing to sell, lease, MOU.

Boffa concluded that:

The three highest ranking options present fairly consistent levels of benefit and similar levels of implementation cost. Options B and D have no significant weaknesses. Option C may be more difficult to achieve than other Options due to a reasonably high likelihood of difficulty in securing the land.

Further to Boffa's assessment, there are other good reasons to focus on the Brain land north of Ford's Cut (but not all of Area C), as follows:

- It is very low-lying and was freshwater wetland until the early 1960s.
- It is classified by the Kaituna Catchment Control Scheme as category A10 which is defined as "unprotected land in the lower reaches, utilised for grazing purposes, and deriving marginal direct benefits, and limited indirect benefits." See <http://www.boprc.govt.nz/environment/rivers-and-drainage/kaituna-catchment-control-scheme/> for details.
- It is not located behind any scheme stopbanks. This means that wetland creation on the Brain land in question would require only the breaching or removal of existing structures, and would not put other lands at risk of flooding or increased drainage costs. Of the five sites identified by Boffa, it is one of two sites of the five identified by Boffa that is not behind a scheme stopbank. The second site (Site E - Arawa Wetland) is already in the process of negotiations for restoration through a Biodiversity Management Plan with the owners. The other three sites would require both stopbank breaching and the costly construction of new stopbanks to separate the new wetland from adjacent land.
- It is relatively unproductive land from an agricultural perspective, and is not well-suited to residential or other similar land uses due to its exposure to natural hazards.
- It is classified in the Western Bay of Plenty Operative District Plan 2012 as both a Flood Hazard Area and a Significant Ecological Feature (Recommended Area for Protection).

Accordingly, of the five sites identified by Boffa, the current focus is the Brain land and one other (Site E - Arawa Wetland).

The other three sites identified by Boffa (their Areas A, B and D) are not currently being pursued primarily because they are protected by existing scheme stopbanks that would need to be re-constructed elsewhere.

It is envisaged that Council staff will continue to seek and pursue opportunities as they arise, both within and outside the five areas identified in the Boffa Miskell report, consistent with direction from Council's Strategy, Policy and Planning Committee in June 2011 and the subsequent 2012-22 Ten Year Plan.

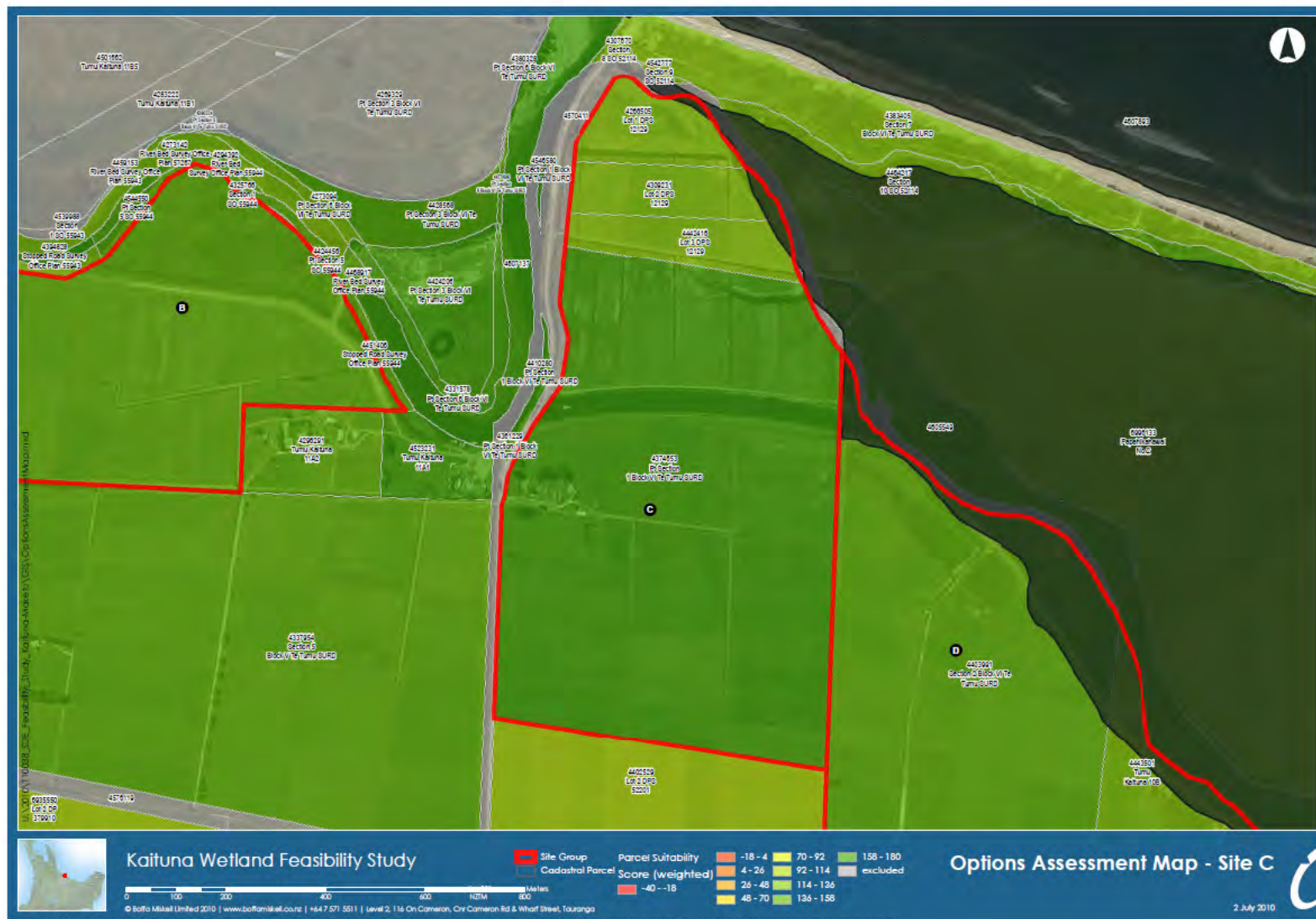


Figure 6 Suitability of Brain family land (marked C) for wetland creation (from Boffa 2010).

#### 2.1.4 **Summary of pre-feasibility studies**

In October 2011 the Council were presented with a staff report that recommended pursuit of Option N as the first stage of a two stage project to achieve full re-diversion. The Council agreed it would support an option that allowed staged re-diversion leading to full closure of Te Tumu Cut. This decision was made on the following assumptions:

- (i) Use of land owned by Mr Alan Brain could be agreed for re-diversion channel improvements and wetland creation.
- (ii) Closing Te Tumu mouth and subsequent loss of access was seen as a minor effect.
- (iii) Modifications to and structures within the Te Tumu mouth could be built and operated reliably to ensure ongoing flood release without adverse effects on upstream flood levels.

These were significant and critical assumptions. There was no evidence at that time that:

- (i) the landowners would agree to use of their land, or
- (ii) the boating community and Te Tumu Landowners Group would agree to closing the Te Tumu entrance, or
- (iii) there were reliable and cost effective gates (or other measures) that could maintain appropriate flood release at Te Tumu.

### 2.2 **Feasibility studies – 2011 to 2012**

During this stage all the options were re-considered and checked against the critical constraints described in Part 2.1. Additional emphasis was placed on fresh to saltwater ratios, wetland creation, land access and consenting risk.

In September 2012 the Council received a report (BPPRC 2012) that narrowed down the range of options available, their feasibility and consentability. In that report three groups of options were compared to the status quo:

- (i) Low flow partial diversion.
- (ii) Maximum flow partial diversion.
- (iii) Full diversion.

These are discussed below.

#### 2.2.1 **Low flow partial diversion**

This option shown in Figure 7 below was that represented in 2008 as Options I and J in which conveyance from the river to the estuary was very similar in concept to that already existing. It is the least technically difficult and the cheapest option with the least potential adverse environmental effects. It has the lowest benefit in that it allows only a small amount of increase in water into the estuary. However it does not preclude increasing this flow in the future subject to gaining subsequent resource consents.



Figure 7 Low flow partial diversion.

It proposes increasing the size or number of culverts at the location of the existing structure between the river and Ford's Cut. If desired the conveyance of Ford's Cut could be improved by minor dredging and earthworks. Some erosion protection and possible flood protection is required along Ford's Cut which is consistent with the landowner's wishes. The exact details of these works are for later definition during public consultation and landowner permission stage.

Re-opening of the old river loop could be considered as a refinement to increase freshwater flows into the estuary.

The inflows into the estuary would increase from the current 150,000 m<sup>3</sup> to between 200,000 m<sup>3</sup> and 270,000 m<sup>3</sup> per tidal cycle (Wallace June 2007, BPPRC 2008).

At the same time the stopbanks (causeways) between the spit and Papahikahawai Island and between the island and the Brain land should either be removed or culverted to reduce the stagnant water that currently exists in this location. However, in doing so it exposes the Brain land to high estuary water levels and the owner's current position is that this will require stopbanking improvements (about 750 m long).

### **Likely advantages**

- (i) There would likely be a small improvement in the ecology in the estuary along with some small reduction in sedimentation.
- (ii) No effect is expected in day-to-day water levels in the river and hence the adjacent wetlands and drainage schemes. No effect is expected in river flood levels and hence no effect on the flood protection scheme works.
- (iii) There is unlikely to be any change to the morphology of the Te Tumu entrance and access is maintained to the Te Tumu mole for fishing and recreation.
- (iv) No erosion is expected between the spit and Papahikahawai Island and no dredging is expected in the estuary.

### **Likely disadvantages**

- (i) The ecological benefits to the estuary would be very minor commensurate with the small increase in water volume and be disproportionately small in relation to the effort and cost.
- (ii) The option would result in only a very minor restoration of the mauri of the river and estuary and is seen by tangata whenua as both inadequate and unacceptable.
- (iii) Possible decrease in water quality.

## **2.2.2 Maximum flow partial diversion**

This option (shown in Figure 8 below) proposed to maximise the flow into the estuary while keeping Te Tumu open.

It proposed significant change to the water conveyance structures (culverts, channels) on the land between the river and the estuary including Ford's Cut and Papahikahawai Channel between the river and the estuary. This could be achieved by more and/or larger culverts at Ford Road and improving the conveyance of Ford's Cut. As Mr Brain currently states he wishes to continue to farm his land, there is no option to construct an additional channel through his land. As in the low flow partial diversion option it is also beneficial to remove or breach the stopbanks (causeways) between the Brain land and the Papahikahawai Trust Island and the island and the spit.

The option provides some optimisation of the previous Options L and N which were assessed to provide 400-450,000 m<sup>3</sup> net inflow per tidal cycle, up from 150,000 m<sup>3</sup> currently.

Council engineers and scientists consider that if Te Tumu is left open it is likely that 600,000 m<sup>3</sup>/tidal cycle would be the maximum volume able to be diverted from the river to the estuary irrespective of the size of the diversion structure. Te Tumu could be constricted by construction of a western training wall to force more water through the estuary but this modification is considered within the full diversion option below because it causes significant upstream effects.

Back in 1990 the Department of Conservation applied to divert 400,000 m<sup>3</sup>/tidal cycle through Ford's Cut by building a structure comprising 10 to 15 box culverts 2.5 m wide and 2.0 m high with flapgates (Works 1989). This proposal was rejected at that time because it was shown likely to breach the water classification and subsequently therefore only 100,000 m<sup>3</sup>/tidal cycle was approved in Consent 22636 and then renewed in Consent 40277. As an aside the consent was appealed (Appeal TCP 637/91) by Mr Don Paterson on the basis that the Papahikahawai Channel should be used in preference to Ford's Cut. The decision went against Mr Paterson.



Figure 8 Maximum flow partial diversion.

Preliminary assessment by Council engineers and scientists indicated that one-way flow from the river to the estuary is required to maximise any benefits. Such one-way flow is achieved by use of flapgates or mechanical gates on culverts or bridges. In this way as the tide falls in the river, water flow is prevented from flowing from the estuary back to the river and out the Te Tumu Cut thus maximising flow through the Maketū entrance.

The exact sizing and location to maximise not only net inflow to the estuary but also freshwater inflow would be the focus of landowner negotiations and consent level investigations. Re-opening of the Ford's Cut river loop could be considered as a refinement to increase freshwater flows into the estuary.

### **Likely advantages**

- (i) The maximum freshwater inflows are reasonably significant relative to the tidal prism and are judged likely to both improve ecological values and decrease sedimentation in the estuary.
- (ii) Partial restoration of mauri of the river
- (iii) Partial restoration of kaimoana to the estuary.
- (iv) Maintained fishing and boating access at Te Tumu with probably no significant change to navigability.
- (v) No rise in flood levels or day-to-day river levels upstream.
- (vi) Restoration of significant areas presently cut off from the estuary by causeways and significant additional restoration/creation of estuarine and freshwater wetland on the Brain land.

### **Likely disadvantages**

- (vii) Reduction in water quality. The diversion will need to be staged with monitoring of effects to ensure adverse impacts on water quality are avoided. .
- (viii) Because the estuary is so full of sand there will be some uncertainty around the path followed by river flows go through the estuary – even though the numerical modelling (using recently re-surveyed bathymetry) will provide a strong indication. Morphological changes to the river channels and sandbars will also be difficult to accurately predict. These uncertainties can be most cost-effectively managed by staging the flow diversion (i.e. increasing flows slowly over time) and monitoring changes to estuary morphology.
- (ix) Significant impacts on the Brain land requiring either acquisition of the property or significant costs associated with extensive stopbanking. Obviously, if the land were protected the wetland creation and restoration benefits would be commensurably reduced.

### **2.2.3 Full diversion**

Full diversion (Figure 9) in which the mouth at Te Tumu is closed and the full river flow is re-diverted into the estuary utilising some combination of Ford's Cut, Papahikahawai Channel and through/over Brain's land (Options H and R in previous reports). Any such combination has to pass the full flow of the river either through some sort of flood relief at Te Tumu or through Brain's land and the estuary then out the estuary mouth. This is a considerable flow (e.g. in the range of 200-350 cumecs) during floods and may increase in the longer term due to climate change.

Re-opening of the Ford's Cut river loop could be considered as a refinement to increase freshwater flows into the estuary.

With the loss of the Te Tumu groyne for fishing, Ford Road in conjunction with any hydraulic conveyance, could be either closed permanently and deconstructed or re-constructed to provide limited access.



Figure 9 Full diversion.

### Likely advantages

- (i) Significantly increased freshwater inflows to the estuary that will eventually improve ecological values and stop and decrease sedimentation in the estuary. But note likely immediate decrease in water quality.
- (ii) Restored mauri of the river.
- (iii) Restored kaimoana to the estuary.
- (iv) Restored boating access from the Maketū estuary to the sea possibly even better than Te Tumu due to increased tidal prism.
- (v) Restored anchorage in the Maketū Estuary (either immediately if the estuary is dredged or over time as the tidal flats erode in response to higher flows).
- (vi) Depending on agreed deconstruction details, no access from Ford Road to the ecological restoration and dotterel breeding areas on the spit. However there would be 4WD access along the beach to these areas with the closure of Te Tumu Cut.
- (vii) Potential creation of wetland on Brain land.



## Likely disadvantages

- (i) Significant rise in day-to-day river water levels that will incur additional capital costs to upgrade pumps in the Kaituna Catchment Control Scheme and cause higher operating costs (maintenance, electrical). Increased seepages under stopbanks causing groundwater levels to rise in pasture lands causing reduced grass growth.
- (ii) Initial reduction in water quality as measured by frequency of exceedance of water quality standards and to a lesser extent bathing standards (DHI March 2011).
- (iii) Rise in flood levels upstream in the Kaituna Catchment Control Scheme. Mitigations considered include – highly efficient channel through Brain land and the estuary (i.e. make the flow paths smooth and large enough to handle the flood flows so as to replicate the head losses that currently exist for flows through Te Tumu – unlikely to be possible); stopbank raising along the flood protection scheme; free overflow spill weir across Te Tumu mouth; gated spillway across Te Tumu mouth; flood storage on low-lying upstream land adjacent to river.
- (iv) Works impacting on Brain land requiring acquisition of property or significant costs associated with extensive stopbanking.
- (v) Because the estuary is so full of sand there will be large uncertainty with the way river flows go through the estuary. Morphological impacts to the river channels and sandbars will be hard to predict especially when high river flows occur i.e. estuary fringe erosion or spit blow-out could readily occur. This effect could be mitigated by dredging the estuary and/or channelising the flow - this will be significant and costly.
- (vi) Loss of boating access through Te Tumu.
- (vii) Loss of fishing access off Te Tumu groyne.
- (viii) Beach access to the restored ecological areas on the Maketū spit and perhaps more likely damage.
- (ix) Potential for river blowout through the spit and scour along the Papahikahawai Channel.
- (x) Potential flooding and erosion of road to Maketū, potential need for flood protection/mitigation of road and other Maketū urban structures.

Table 3 Summary of feasibility study options.

	Status quo	Low flow partial diversion	Maximum flow partial diversion	Full diversion
<b>Volume per tidal cycle</b>	150,000 m <sup>3</sup>	300,000 m <sup>3</sup>	600,000 m <sup>3</sup>	2,900,000 m <sup>3</sup>
<b>Technicalities</b>	None. Ongoing dispute with Alain Brain over erosion along his property.	Solve dispute with Alan Brain over erosion along his property. Modify Ford's Cut and inlet culverts. Provide stopbanks along estuary edge of Brain land.	Solve dispute with Alan Brain over erosion along his property. Significant modification or change to Ford's Cut and its control structure; install culverts under Ford's Road to let water into Papahikahawai Channel and remove stopbanks from channel; stopbank round Brain property or obtain Brain property. Limit peak flow through estuary using the control structure. Leave Te Tumu open.	Solve dispute with Alan Brain over erosion along his property. Block Te Tumu. Significant modification or change to Ford's Cut and its control structure; install culverts under Ford's Road to let water into Papahikahawai Channel and remove stopbanks from channel; stopbank round Brain property or obtain Brain property. Provide flood storage upstream or build risk free control gates. Design for peak flow (500 cumecs) through estuary.
<b>Staging?</b>	N/A	Single – all at once.	Seek consent for 600,000 m <sup>3</sup> /tidal cycle; build structure for full volume incorporating flow control; incrementally increase flow as result of monitoring. Ten years to get to maximum diversion.	Seek consent for 2,900,000 m <sup>3</sup> /tidal cycle including flood rise mitigation and boat entry mitigation; implement Maximum Partial Diversion Scheme; solve upstream flooding and drainage levels; block Te Tumu mouth and remove/modify partial diversion structure.

	<b>Status quo</b>	<b>Low flow partial diversion</b>	<b>Maximum flow partial diversion</b>	<b>Full diversion</b>
<b>Water quality</b>	N/A	Minor decrease.	Decrease – can manage by staging diversion and monitoring effects.	Significant – including increase in upstream water and flood levels, Te Tumu closure, reduced water quality, high flows through estuary (e.g. may affect recreation).
<b>Planning constraints</b>	N/A	Minor.	Moderate.	Major.
<b>Potential adverse environmental effects</b>	Ongoing deterioration of the estuary.	Minor.	Moderate – mitigate against reduced water quality, potential change to Te Tumu navigability.	Significant – mitigate against day-to-day rise in water levels, flood levels, Te Tumu closure, reduced water quality, high flows through estuary.
<b>Cost</b>	\$0	\$500k - \$1M	\$3 - \$4M	\$10 - \$15M
<b>Consenting Risk</b>	N/A	Minor.	Moderate.	Major.
<b>Benefits achieved</b>	Nil	Minor.	Significant improvements likely – including creation/restoration of wetlands and reduced sedimentation.	Significant.

#### 2.2.4 Decision on feasibility studies

Council's Operations, Monitoring and Regulation Committee received a report on these three groups of options in September 2012.

The Low Flow Partial Diversion options were dismissed because the increase in water volume is so low as to be insignificant to the health of the estuary. The Full Diversion options were also dismissed because of significant potential adverse effects, high consenting risk and cost.

The Council agreed (BOPRC Sept 2012) that the Maximum Flow Partial Diversion options were likely to offer significant achievement of project objectives while also carrying lower consenting risk and being more affordable than a full diversion.

This decision was consistent with the conclusions reached and reported in 2008 and 2011. By this time it was obvious there were no feasible solutions to achieve the project objectives without more than minor effects on the land owned by Mr Alan Brain and the Brain Estate.

### 2.3 Preliminary design stage and consultations – 2012 to 2013

During late 2012 and early 2013 further analysis of the Maximum Flow Partial Diversion group of options was undertaken, particularly: the size of the channel required to transfer the maximum amount of water possible from the river to the estuary; its intake location in the river; and its route across the Brain land. Consultation was undertaken with Mr Brain and another Trustee (as executors of the Brain estate) with the objective of a negotiated agreement. These meetings are ongoing.

With respect to the maximum volume that might be hydraulically possible to get from the river to the estuary with Te Tumu open, Wallace (2013) reported this to be approximately 600,000 m<sup>3</sup> per tidal cycle, or 21% of the river's flow over an average tidal cycle. This limit is primarily controlled by the height difference in water levels that exist between the river and the estuary and the duration of time this exists during a tidal cycle. The other controlling factor is the flow area of any channel connecting the river and estuary but this becomes less limiting as channel size increases. A channel width of at least 60m excavated to an invert level of -1.5m RL has been recommended (Wallace 2013; DHI 2013) to carry volumes approaching the maximum hydraulically possible while keeping Te Tumu Cut open.

To further assess the salinity of potential re-diverted flows, DHI Water and Environment were contracted to model a variety of intake and channel positions and sizes. DHI (2013) reported that if the inlet to a new diversion channel was located halfway along Ford Road, the freshwater component would be 31% of the volume re-diverted per tidal cycle. If the inlet were located further south in the vicinity of the existing inlet culverts then the freshwater component would increase to 38%. A further increase to 55% was predicted if modification was made to the old river loop around the south side of Ford Island and the existing channel alongside Ford Road was blocked.

Therefore it was concluded by DHI and Council staff that the inlet of the diversion channel should be located as far upstream as practical to maximise the freshwater component. The optimal location is to be further is to be tested during detailed investigations within the range of other project constraints such as environmental effects and cost.

A Scoping Report for the Assessment of Environmental Affects (BOPRC 2013) was prepared and made available to potentially affected landowners, the public, interested parties and wider audiences and submissions sought.

Two options were presented in this report based on the Maximum Flow Partial Diversion agreed by Council in September 2012. These were referred to as Option 1 and Option 2 and are shown Figures 10 and 11 respectively below. Both options proposed intakes for the re- diversion as far upstream as reasonably possible to maximise freshwater volumes.



Figure 10 Option 1.



Figure 11 Option 2.

The difference between the options was the alignment of the channel across the Brain land – Option 1 was designed to ensure a significant proportion of the re-diverted flow would pass through the channel between Papahikahawai Island and the spit – which appears to have been a significant flow path in the period between 1928 and 1956. Option 2 made the most use of the existing Ford's Cut, with most of the re-diverted flow passing through the estuary along the southern side of Papahikahawai Island similar to the original flow path shown in the 1877 Survey Plan (see section 1.4.1 History earlier in this report).

During consultation it was suggested that the freshwater component of the re-diverted flow might be usefully increased if the intake for the diversion channel could be moved upstream to the next meander loop in the Kaituna River, and a new channel excavated through land owned by Landowner X. This is currently under investigation.

The feedback received during consultation indicated no clear community preference between Options 1 or 2. Overall 74% of respondents gave full or conditional support to the project, 20% were neutral, and 6% were opposed. A summary of consultation responses has been prepared separately.

Option 2, modified to maximise freshwater flows, is recommended by Council staff because it keeps the re-diversion channel well away from the back of the Maketū Spit – reducing the risk of erosion and breaches similar to that which occurred in 1907. It also reduces the extent of additional excavation required and is therefore likely to be significantly cheaper.

Both options require the purchase or taking of the Brain land to realise significant wetland and estuary restoration outcomes. Discussions are continuing with Mr Brain and another Trustee.

## Part 3: Landowner implications

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### 3.1 Brain land

#### 3.1.1 Potential effects

As is apparent from the above information the Brain land is located in a position strategic to the success of the project (Figure 12). This has been previously recognised by the Council. For instance Wallace (2007, page 13) signalled that the effects of Option P will be significant on the Brain land. BOPRC (2008, page 5), having ranked Option N as the most effective option, highlighted that it may lead to some impact on the adjacent Brain land. BOPRC (2008) also stated negotiations will have to be undertaken with landowners whatever option is chosen.



Figure 12 Brain land 1959.



Figure 13 Present day levels (Red is above 0.5 m Moturiki i.e. approx. high tide level; blue is below 0.5 m).

There are two reasons for seeking the whole of the Brain land north of Ford's Cut:

- (a) Project feasibility – the cost of stopbanking the property to the extent required to mitigate effects of the diversion exceed the current market value of the property (discussed further below), and
- (b) Potential for creation of wetlands in an area identified as suitable for this purpose (as discussed in Part 2.1.3 above) – the property is required if significant wetland restoration/creation within the estuary is to be achieved.



Figure 14 Existing stopbanks on the Brain land

Accordingly, this land is of vital importance for the Project to meet its objectives of more water into the estuary and wetland creation/restoration. There are three major reasons for this:

- 1 Removal of the causeways and restoration of estuarine areas upstream of these. The two causeways presently stop any flushing of the water impounded in what was formerly the upper estuary and is now referred to as Papahikahawai Lagoon (Figures 15 and 16). As a result, the water in this area is stagnant and degraded, and its re-connection to the remainder of the estuary and river system has been recommended (Park 2008). This is supported by tangata whenua and other estuary users.





Figure 15 Portion of causeway from the Brain land to Papahikahawai Island (Papahikahawai Lagoon on right).



Figure 16 Causeway from Papahikahawai Island to spit impeding tidal flushing of Papahikahawai Lagoon.

To achieve this objective, the causeways have to be breached and either culverted or removed entirely. The staff recommendation is for the latter as this will facilitate far more effective river and tidal exchange and flushing. Complete removal of the causeways is not a major work and can be readily undertaken at reasonable cost.

The project objectives will not be met if this cannot occur. However, removal of the causeways will expose the Brain land to normal fluctuations in estuary water levels and to potential coastal flooding during storm surge events and in the event of future projected sea level rise.

One solution is to purchase the Brain land and allow it to revert to estuarine and freshwater wetlands. This is the option most consistent with the objectives of the project – providing for significant wetland and estuarine restoration.

The other option is to build stopbanks along the northern and eastern edge of the Brain land with the estuary to protect the land from flooding. This is a length of about 750 metres and the banks would need to be constructed to a height of approximately 2.5 metres. Preliminary costings of stopbanking works are in the range of \$560,000 to \$1,250,000 depending on agreed standards of design. Note: this estimate excludes further stop-banking work that would be required along the northern bank of Ford's Cut.

- 2 Provision of a re-diversion channel of the dimensions required to meet project objectives. The project objective of re-diverting as much freshwater back into the estuary as possible requires the inlet structure to be located in its current location and either the size of Ford's Cut increased in depth and width or a whole new channel constructed. (i.e. Options 1 and 2 used for the pre-consent consultation in May 2013 – as described above).

Where any excavated diversion channel meets the estuary, its depth needs to be gradually reduced and its width increased to match that of the estuary to avoid sudden changes in flow characteristics that cause flow reductions. Accordingly, the geometry of the diversion channel will change from a deeper narrower shape to a wider shallower shape with distance into the estuary. The increase in width impacts further on the Brain land.

- 3 Impact of the re-diversion channel on the stopbank along the north side of Ford's Cut shown in Figure 14. This stopbank is about 570 m long and currently provides protection against high water levels in Ford's Cut arising from higher flows in the Cut and from higher levels in the estuary and a combination of the two. The required widening of the diversion channel will remove this stopbank along much of its length.

The stopbank can be rebuilt at an estimated cost to the project of between \$430,000 and \$710,000. Alternatively, removal of this stopbank would allow the Brain land to revert to wetland achieving the project objectives of new wetland creation.

To summarise, the estimated cost of stopbanking the portion of the Brain property north of Ford's Cut to the extent required to mitigate the effects associated with a maximum flow partial diversion option is at least \$1 million and possible up to \$2 million.

The Council has obtained a valuation for the land of \$XXXX. Accordingly, the cost of all stopbank works to protect the land would be high relative to the value of the land.

Overall, it is clear that purchase of the Brain land and reversion of this area to wetlands is the most appropriate and cost-effective option in terms of project objectives. It also avoids the serious long term complications of projected sea level rise on drainage and flooding of the Brain land that will be encountered if the land is kept in agricultural production and protected with stop-banks.

### 3.1.2 Consultation

Meetings have been held between Council staff and Alan Brain and/or another Trustee regularly since mid-2012. Currently Mr Brain's position is:

- (i) He agrees with the need for restoration of the estuary and wetlands, but questions whether a partial re-diversion is a viable option, and whether it will achieve sufficient ecological restoration.
- (ii) He wants the erosion repaired along the north bank of Ford's Cut that is taking his land. In spite of two reports by BOPRC he is insistent this erosion is being caused by the flows through Ford's Cut allowed by the DOC resource consent to re-divert river water into the estuary through the Ford's Cut culverts. This has been an ongoing dispute.
- (iii) He wants to continue to farm his land and is not interested in converting to wetland although he does have small pockets of existing wetland that he may try and restore independently of BOPRC.
- (iv) He wants his land protected from water levels in Ford's Cut and the estuary

Discussions and negotiations have been on-going with Mr Alan Brain and another Trustee and will continue until all options are exhausted.

### 3.1.3 The Public Works Act

If Council pursues the option of maximum flow partial diversion involving the creation of wetlands on the Brain property and negotiations for purchase of the land are unsuccessful, the land could be taken under the Public Works Act. It is good practice before seeking to take land under the Public Works Act, to seek a designation under the Resource Management Act over the land to signal that it is required for a public work.

Often resource consent applications and designation applications (by way of a Notice of Requirement) are lodged and jointly heard when required for the same project. Both instruments require consideration of alternative routes, sites and methods, as well as their effects on the environment.

### 3.2 Papahikahawai Trust land

The owners of Papahikahawai Island, Papahikahawai Trust, are supportive of the need to get more freshwater back into the estuary and particularly to re-open the lagoon to tidal flows to allow the water and adjacent habitat to improve, and be connected to the river and estuarine system. In doing so they acknowledge their on-going access to the island will be affected and currently considering what type of access they need. Council staff continue to work with the Trust to find a mutually suitable arrangement for the future. Their land is not required for the project.

### 3.3 Private Land West of Ford Road

Landowner X owns land at the western end of the Project (Figure 17) where it is proposed to bring a new channel from the river across his land to the old river loop. The preferred route is through his pastoral land south of the existing stopbank and relocating the stopbank. This avoids destruction of an existing wetland.

Regional Council staff are working with the landowner to try and negotiate a mutually suitable arrangement for future land use and access.

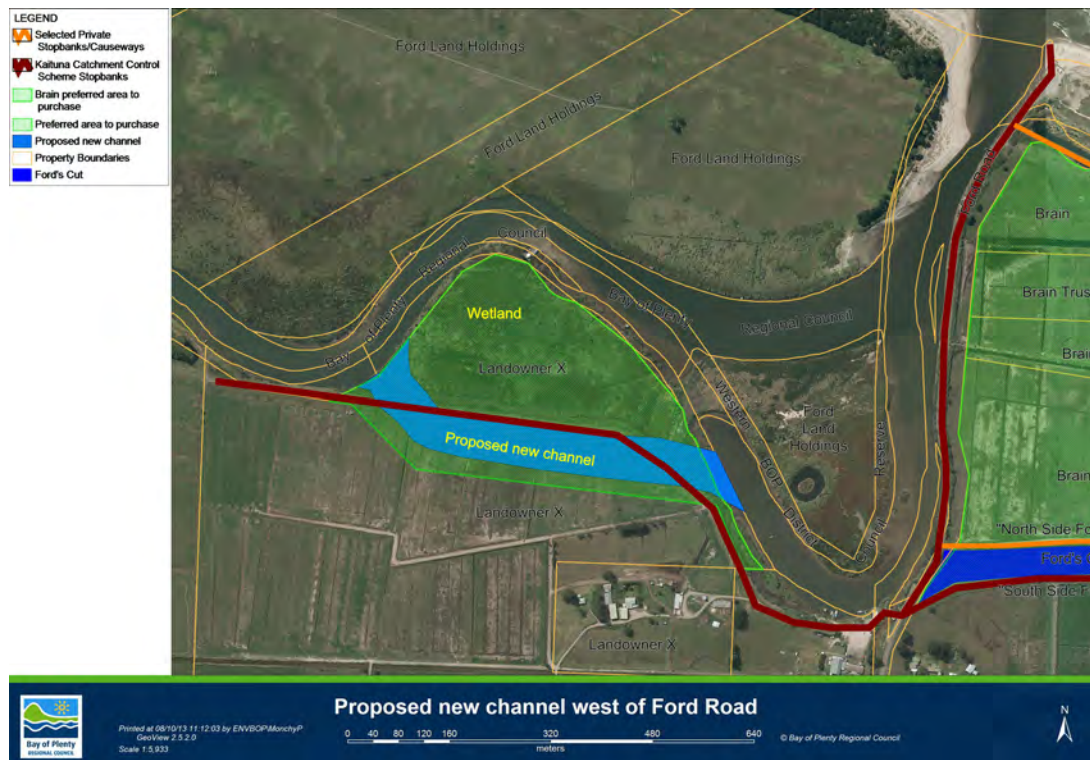


Figure 17 Proposed new channel (blue) and private land required (green).

### 3.4 **Ford Land Holdings**

Ford Land Holdings own the “island” in the old river meander loop (Figure 17). This island was created in 1981 when the Kaituna River was diverted through the north end of this land cutting it off from the main property to the north. There is physical access to this island from the west through Landowner X's land but no legal access.

The options propose to open a channel from the river to the west of the island to feed predominantly freshwater into the meander loop. The options also propose to block the eastern channel with fill. In doing so physical access to the island will be maintained.

Regional Council staff are working with Ford Land Holdings to try and negotiate a mutually suitable arrangement for future land use and access. This land is not required for the project.

## Part 4: Summary and analysis of options

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Each of the options investigated since the early 2000s has been assessed against the criteria that define the project objectives. These are:

- maximise the re-diversion of water, particularly fresh water, from the Kaituna River back through the Ongatoro/Maketū Estuary, while keeping Te Tumu Cut open,
- restore or create at least 20 hectares of new estuarine or freshwater wetland in the estuary or lower river,
- maximise the achievement of tangata whenua, stakeholder and community aspirations for the restoration of the estuary and lower river, and
- avoid, minimise, remedy or mitigate adverse environmental effects, including effects on private land owners.

From a funding perspective this project differs from a more conventional project in that the benefits are very difficult to quantify in traditional dollar terms. Therefore a traditional cost-benefit ratio assessment is not considered appropriate. However, the cost of any solution needs to be realistic to be funded by the various stakeholders and agencies. The process to find this acceptable cost has been facilitated by the Bay of Plenty Regional Council where judgements have been made on the value of the benefits.

Consultation with landowners, stakeholders and the public has had a direct influence on the options. To date consultation has been undertaken at the following stages:

- During the development of the 2009 Kaituna Ongatoro/Maketū Strategy.
- During the development of the 2012 Feasibility and Consentability Report.
- After the preparation of the options in the 2013 Preliminary Design and AEE Scoping Report and before detailed investigations commenced.

Table 4 summarises the options that have been investigated over the past 10 years.

Table 4 Summary of all options considered 2001 to July 2013 (cost doesn't include stopbanking or purchase/acquisition costs).

Option name and estimate cost \$M	Option description	Environmental effects	Comments
A - Status quo	Leave the river and estuary in their current states with 4% of flow going through Fords Cut.	Volume per tidal cycle remains at 150,000 m <sup>3</sup> . No change in salinity in estuary. Estuary continues to deteriorate. No new wetlands. Mauri of river is not re-established.	Not recommended in light of the community expectations and the continuing deterioration in the estuary. Strategy objective not achieved.
B	Remove the culverts and causeway at the inlet to Fords Cut.	Reduced flow to estuary mouth. No change in salinity in estuary. Mauri of river is not re-established. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
C	Remove the culverts and causeway at the inlet to Fords Cut and open river to Papahikahawai Channel Remove spit causeways and removal/retention of island causeway.	Reduced flow to estuary. Increased salinity in estuary. Potential for river to break out along spit. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended due to insignificant benefits Objective not achieved.
D	Remove block in river channel at upstream of loop.	Very minor increase in flow to 161,000 m <sup>3</sup> . Minor reduction in salinity likely in estuary. Mauri of river is not re-established. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
E	Remove block in river channel at upstream of loop and put a weir across Te Tumu at RL 1.0 m (high tide level).	Very minor increase in flow to 165,000 m <sup>3</sup> . Minor reduction in salinity likely in estuary. Mauri of river is not re-established. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
F	Remove the culverts at the inlet to Fords Cut and open river to Papahikahawai Channel and remove the upstream block in the river loop.	Reduced flow to estuary. Increased salinity in estuary. Potential for river to break out along spit. Mauri of river is not re-established. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended – significant adverse environmental effects.

Option name and estimate cost \$M	Option description	Environmental effects	Comments
G	Remove the culverts and causeway at the inlet to Fords Cut and open river to Papahikahawai Channel and remove the upstream block in the river loop and construct a weir at Te Tumu at RL 1.5. Remove spit causeways and removal/retention of island causeway.	Major flow increase to 2,900,000 m <sup>3</sup> . Reduced salinity in estuary. Increased flood levels upstream. Potential for river to break out along spit. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended – significant adverse environmental effects. Flood levels costly and technically unreliable to mitigate.
H - \$8M	Full diversion. Mouth at Te Tumu completely closed off. Ford's Cut structures and causeway removed. Papahikahawai Channel opened. Remove spit causeways and removal/retention of island causeway.	Major flow increase to 2,900,000 m <sup>3</sup> . Increased flood levels upstream. Potential for river to break out along spit. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended – significant adverse environmental effects. Flood levels costly and technically unreliable to mitigate.
I - \$0.6M	Double the number of culverts between Fords Cut and estuary including flapgates. Re-shape Ford's Cut.	Moderate flow increase to 200-270,000 m <sup>3</sup> . No change in salinity in estuary. Mauri of estuary is moderately increased. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
J - \$0.5M	Existing culverts at Fords Cut lowered to be submerged at mid tide (invert level at -1.6 m RL). Re-shape Ford's Cut.	Moderate flow increase to 200-260,000 m <sup>3</sup> . Moderate increase in freshwater. Increase in salinity in estuary. Mauri of estuary is moderately increased. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
K - \$0.25	Remove culverts and causeway between river and estuary at Fords Cut, but with the opening defined by two large culverts (as a bridge).	Reduced flow to estuary. No change in salinity in estuary. Mauri of estuary is not -re-established. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.
L - \$0.8M	Remove culverts and causeway between river and estuary at Fords Cut, and replace with large culverts that are floodgated to prevent backflow into the river. Re-shape Ford's Cut.	Moderate flow increase to 383,000 m <sup>3</sup> . Moderate increase in freshwater. Moderate increase in salinity in estuary. Mauri of estuary is moderately increased. No new wetlands.	Not recommended due to insignificant benefits. Objective not achieved.

Option name and estimate cost \$M	Option description	Environmental effects	Comments
M	Open river to Papahikahawai Channel and construct weir at low level. Remove spit causeways and removal/retention of island causeway.	Reduced flow to estuary. Increased salinity in estuary. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended due to insignificant benefits. Objective not achieved.
P - \$0.4	Lower the level of Fords Rd to allow high tide flow from river across the Brain land. Open Papahikahawai Channel. Remove spit causeways and removal/retention of island causeway.	Very minor increase to 160,000 m <sup>3</sup> . Potential for river break out along spit. No access to spit. Wetland created. Requires purchase or acquisition of property to restore wetland.	Not recommended due to insignificant benefits. Objective not achieved.
R - \$6.6M	Full diversion with flood relief. Installation of two mechanically controlled gate structures at Te Tumu and at Fords Cut. Te Tumu gate closed in normal flow conditions, opened in flood conditions. Fords Cut gate open in normal conditions and closed in flood conditions. Remove spit causeways and removal/retention of island causeway.	Major flow increase to 2,900,000 m <sup>3</sup> . Increased flood levels. Stopbank required or purchase/acquisition of property to restore to wetland.	Not recommended - significant adverse effects. Flood levels costly and technically unreliable to mitigate.
N - \$0.9M+	Open Papahikahawai Channel with large flood-gated culverts. Increase capacity of Ford's Cut and its inlet culverts. Remove spit causeways and removal/retention of island causeway.  Note - many variations were investigated of this basic option.	Significant flow increase to 330-450,000 m <sup>3</sup> but salinity too high. If agreed, wetland created on Alain Brain's land; otherwise stopbank needed. Stopbank required or purchase/acquisition of property to restore to wetland.	Recommended for further investigations and feasibility – has resulted in 2 further variations, Option 1 and Option 2 below, which better meet the objective of maximising freshwater into the estuary (and minimising salinity in estuary). Option of stopbanking property not recommended due to disproportionate estimated cost of stopbanking compared with current market value of property, and objective of creating further wetlands in area.



Option name and estimate cost \$M	Option description	Environmental effects	Comments
Option 1 - \$5M	<p>Remove all causeways in the estuary that prevent river and tidal flushing of Papahikahawai Lagoon and Channel.</p> <p>Allow the Brain land to revert to wetland</p> <p>Excavate a new channel (&gt;60m width, invert level -1.5 m RL) from the Ford's Cut inlet structure across the Brain land and into Papahikahawai lagoon.</p> <p>Increase the size of the inlet structure to Ford's cut and ensure one-way flow.</p> <p>Divert water from the river as far upstream as practical to maximise the freshwater component.</p> <p>Requires purchase or acquisition of Brain land – stopbanking not considered viable due to disproportionate estimated cost of stopbanking compared with current market value of property.</p>	<p>Volume of water is increased to approximately 600,000 m<sup>3</sup>.</p> <p>Moderate reduction in salinity in estuary.</p> <p>Volume of freshwater is increased three-fold into the estuary.</p> <p>Primary flowpath through estuary could develop north of Papahikahawai Island.</p> <p>Mauri of estuary is maximised within the constraint of maintaining Te Tumu open.</p> <p>Flood and drainage levels upstream not affected.</p> <p>Increased risk of spit breach and erosion.</p> <p>Likely reduction in sand deposition rate in estuary.</p> <p>Pasture land reverted to wetland - over 20 hectares of new wetland.</p>	<p>Variation on Option N above - no flow from the river into the estuary at Papahikahawai due to high salinity.</p> <p>Better meets objective but not recommended due to increased risk of spit breach and erosion compared with Option 2 below.</p>
Option 2 - \$4.7M	<p>Remove all causeways in the estuary that prevent river and tidal flushing of Papahikahawai Lagoon and Channel.</p> <p>Allow the Brain land to revert to wetland.</p> <p>Widen and deepen Ford's Cut (&gt;60 m width, invert level - 1.5 m RL) from the Ford's Cut inlet structure and taper it wider at the estuary.</p> <p>Increase the size of the inlet structure to Ford's cut and ensure one-way flow.</p> <p>Divert water from the river as far upstream as practical to maximise the freshwater component.</p> <p>Requires purchase or acquisition of Brain land – stopbanking not considered viable due to disproportionate estimated cost of stopbanking compared with current market value of property.</p>	<p>Volume of water is increased to approximately 600,000 m<sup>3</sup>.</p> <p>Moderate reduction in salinity in estuary.</p> <p>Volume of freshwater is increased three-fold into the estuary.</p> <p>Primary flowpath through estuary is south of Papahikahawai Island.</p> <p>Mauri of estuary is maximised within the constraint of maintaining Te Tumu open.</p> <p>Flood and drainage levels upstream not affected.</p> <p>Risk of spit breach and erosion is not altered.</p> <p>Likely reduction in sand deposition rate in estuary.</p> <p>Pasture land reverted to wetland - over 20 hectares of new wetland.</p>	<p>Variation of Option N above - no flow from the river at Papahikahawai and more diversion capacity in the location of the existing culverts in order to meet the criterion of maximising freshwater (and minimising resultant salinity in estuary).</p> <p>Recommended option – best meets the project objective.</p> <p>Will contribute significantly towards the outcomes sought in Strategy.</p>



## Part 5: Conclusion and recommendations

The feasibility investigations to date together with previous historic work has confirmed the need for the project to re-divert more water, especially fresh water, back into the Maketū Estuary from the Kaituna River.

Various options have been explored in consultation with tangata whenua, the local community, landowners, local and central government agencies and other stakeholders. Option identification and development has included extensive liaison with these parties to ensure that a wide range of environmental effects have been considered while still aiming to achieve the project's desired outcomes.

A preferred overall solution has been identified which will maximise the mauri of the river and the estuary, achieve and promote significant ecological improvements to the estuary and reduce and possibly reverse sedimentation trends and the related issues in the estuary.

### 5.1 Key conclusions

Of all the options considered, Option 2 from the AEE Scoping Report of May 2013 (Figure 18), or minor modifications thereof, best meets the Project's goal and objectives and will contribute significantly toward the outcomes sought in the Strategy. It is considered that Option 2 will maximise the mauri of the river and the estuary, promote ecological improvements to the estuary and reduce and hopefully reverse the sedimentation in the estuary.



Figure 18 Modified Option 2 - Recommended option for further investigation.

A major section of the estuary, Papahikahawai Lagoon, is degraded and stagnant and its rehabilitation requires the removal of the two causeways that block tidal flushing from the estuary. This aspect of the Project is critical to restoring the health of the Estuary in that location. However, removal of these causeways will cause the Brain land to flood due to high sea level in the estuary. Stopbanking around the east and north of the Brain land can be constructed at an estimated cost of between \$0.5 and \$1.2M but this would preclude significant wetland restoration.

Increasing the volume of water diverted from the river through the estuary requires a wider channel than Ford's Cut. The wider channel requires the use of between 5 and 7 hectares of the Mr Brain land. Additionally, the existing stopbank on the north side of Ford's Cut has to be rebuilt to prevent flooding of the Brain land at a cost of between \$0.4 and \$0.7M.

The estimated cost of the project is between \$3M and \$4M (ignoring in the meantime the cost to purchase the land owned by Landowner X – it is not yet clear if this land will be beneficial to the project).

If the Brain land is to be protected from flooding the additional project cost is estimated between \$0.9M and \$1.9M and no wetland is created. These costs far exceed the land value – which has been valued at \$XXXX (plus the area under Ford's Cut).

If the land was to be purchased at its valuation the additional cost to the Project would be \$XXXX and a significant amount of new wetland would be created.

## 5.2 Recommendations

Based on the investigation and assessment completed, it is recommend that:

- 1 *Investigations, including detailed modelling and ecological assessments, continue into Option 2 from the AEE Scoping report including a re-diversion inlet further upstream (as shown in Figure 18) to better quantify the benefits, costs and risks.*
- 2 *Due to disproportionate estimated costs associated with stopbanking the Brain property to the extent required to mitigate effects of the preferred option, negotiations continue with the owners of the Brain land to seek their approval to occupy, use or buy their land (as shown in Figure 19) both to construct a wider and deeper channel to convey more water from the Kaituna River and to create new wetland.*
- 3 *Concurrently, prepare a Notice of Requirement to place a designation over the required land and associated resource consents.*



Figure 19 Land recommended for further negotiation and designation.



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