Peer review of annual reporting for the Kaituna River Re-Diversion and Te Awa o Ngātoroirangi/Maketu Estuary Enhancement Project

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Contents

1 About the Project

In 2017, a suite of resource consents were approved for the Kaituna River Re-Diversion and Te Awa o Ngātoroirangi/Maketu Estuary Enhancement Project. These resource consents authorise the following:

a) Construction of a new channel from the Kaituna River to Ford's Cut.
b) Widening of Ford's Cut including associated erosion protection works.
c) Diversion of water from the Kaituna River into Maketu Estuary.
d) Reclamation of land to create a salinity block.
e) Installation of an additional culvert and diversion of water to the Lower Kaituna Wildlife Management Reserve.
f) Provision of public and commercial boat and parking facilities adjoining and within the Coastal Marine Area.
g) Wetland creation and estuary enhancement.
h) Sediment mobilisation in the lower Kaituna River as well as temporary discharge of contaminants and taking, damming and diverting of water, associated with construction activities.

Construction commenced the following year and its completion celebrated with a publicly celebrated karakia and ribbon-cutting ceremony in February 2020 to mark the opening of the first nine control gates (a.k.a. Stage 1 Commissioning).

The remaining three control gates were opened a year later (a.k.a. Full Commissioning).

2 Peer review overview

2.1 Requirement for annual reporting

Condition 29 of Resource Consent 67958 requires the preparation of an annual monitoring report. This is to outline and discuss matters including, but not limited to:

- Results, analysis and interpretation of specific monitoring parameters (e.g. water levels and flows; ecology; mauri; water quality and shellfish).
- Measures or responses to identified issues following analysis of monitoring results.
- Ways in which opportunities for tāngata whenua involvement were provided for (i.e. to meet other consent conditions).

The full wording of Condition 29 is provided in Appendix 1 to this report. To date, five annual reports have been prepared.

2.2 Report Purpose and scope

This report provides an integrated and independent peer review of the **technical and cultural aspects of the annual reports** associated with the resource consent. It is guided by the requirements of Condition 29A of the consent (refer Appendix 1), which includes:

- Appointment, composition and skillset of the peer review panel (refer Section 2.5)
- Provision of all annual reports to the peer review panel.
- Scope, based on the role of the peer review panel, namely the technical and cultural aspects of the annual reports.
- Consultation directly with the consent holder and tāngata whenua, if necessary.
- Recommendations to the consent holder and/or consent authority to address any identified adverse effects attributable to the Project.

Such a review must occur following the commissioning of the first set of control gates (i.e. Stage 1 commissioning) and again every five years thereafter.

2.3 Review methodology

This peer review is informed by technical documents provided by, and correspondence with, the consent holder (Bay of Plenty Regional Council). A briefing meeting was also held on 5 October 2021. Refer to Appendix 2 of this report for a list of documents provided to the peer review panel.

A number of aspects have been considered for each respective topic area. This includes expected effects vs monitored effects; whether annual reporting is sufficient to meet the conditions of the consent; and/or whether there is missing data to confirm or clarify the scale of effect.

2.4 Report structure

The following sections outline the outcomes of the peer review of the technical and cultural aspects of the annual reports:

Section 3 First impressions of the annual reports	Section 4 Ecological and water quality matters	Section 5 Cultural matters	Section 6 Hydrological and engineering matters

Section 8 of this report outlines our recommendations to the consent holder and consent authority based on the outcomes of this peer review.

2.5 About the peer review panel

Condition 29A.1 and 29A.2 outlines the requirements for the appointment, composition and skillset of the review panel:

29A.2 The peer review panel must comprise three independent experts each suitably qualified and experienced in at least one of ecological, cultural or hydrological, engineering or coastal matters of relevance to the Project, except that there must at all times be an expert in cultural matters.

The peer review panel is follows:

Hamish Dean	Hamish is a Principal Ecological Consultant for 4Sight Consulting. He has a wide range of experience in ecology and resource management gained from 18 years working in ecological consultancy, not-for-profit environmental organisations, and Regional Council. Hamish has worked in a wide range of habitats across Aotearoa on projects involving significance assessment; vegetation survey and classification; wetland survey and management; ecological restoration and re-creation; fauna survey; catchment management; and impact assessment. Hamish's ecological and resource management experience is backed by an MSc in Biological Sciences which is focussed on ecological restoration.
Elva Conroy	Elva (Tapuika, Tuhourangi) is a planning consultant and director for Conroy and Donald Consultants Ltd. She has over 19 years' experience in resource management planning, policy analysis, strategic planning and cultural frameworks. Elva also has won numerous NZ Planning Institute Awards for iwi management plan development. Elva has an Applied Science degree (Natural Resource Management; Forestry) and is a certified hearing commissioner and full member of the NZ Planning Institute.

Roger Waugh	Roger is director and principal engineer for RiverSpace Ltd. He has over 35 years' experience in hydrology, river and hydraulic engineering, water resources and asset management with various roles across Hawkes Bay, Wellington and Bay of Plenty Regional Councils. Roger has been director of RiverSpace Ltd and consulting since October 2018. He has been involved with projects that include engineering design and construction; hydrological and hydraulic technical reviews; resource consent planning; hearings evidence and compliance. Roger is a Registered Engineering Associate, holds a New Certificate in Engineering (Civil) and is a member of Australian River Basin Management Society.

3 First impressions of the annual reports

This section outlines our first impressions of the annual reports.

To date, five annual reports have been prepared. The early reports (2017-2019) were relatively light, as monitoring was not required for many of the parameters in the first couple of years. For example, the 2017 report only included a summary of work completed as well as the results of erosion and bed level monitoring. No other Condition 29.1(b) parameters were mentioned or discussed within this report, even if monitoring had not occurred that year. It is notable that the cultural matters were not introduced until the 2020 report (discussed further in Section 5 of this report).

The consent conditions require that results are interpreted. In some cases, this has not been done, nor is there insight into the 'why' has been provided. The monitoring requirements for this resource consent rely heavily on the interpretation of results by the consent holder and their interpretation of what constitutes an unexpected adverse effect. For example, Condition 28.2(c) of the resource consent states that the monitoring should "*be capable of testing and verifying the performance measures listed in these resource consent conditions*" but there are no performance measures within the conditions for ecological or water quality parameters. This puts the onus on the Regional Council's Regulatory Compliance team to ensure that monitoring and reporting is done well, and that unexpected changes are being detected. This includes any positive effects that were expected to take place but are not being realised.

The annual reports to date do not really explain what the expected effects of the re-diversion were in relation to the monitored parameters, so it was very difficult in reviewing them to work out what changes were expected and what were not, and the application material and technical reports had to be constantly referred to during the peer review process. This is further confounded by the fact that the project was expected to have various positive effects and consent was granted on that basis. So, when monitoring results are reported as being, for example, 'no change detected' or 'there was a slight improvement' the reader asks, 'so what?'.

In our view, monitoring results should be better linked to expected effects for these reports to be meaningful and for the consent authority to understand the actual effects of the project. These matters could be addressed, where applicable, in future annual reports.

Finally, while the annual reports are produced to meet the requirements of a consent condition, there was information of interest or significance that was missing. For example:

- Feedback from those living in the area and/or raised at tāngata whenua and community meetings (i.e. observations, concerns, complaints).
- Notable activities or events over the year. This could include community planting days, education programmes with schools and tāngata whenua as well as awards won, which has been the case for this project.

Some consideration could be given to wider project communication. For example, an information sheet summarising the key points from the annual report along with notable activities or events over the year. It is acknowledged that the consent holder already carries hold annual briefings with tangata whenua and the community.

4 Ecological and water quality matters

This section of our report deals with ecological matters covered by Condition 29.1 (ii), (v), (vi), (vii) and (viii). Table 1 outlines the monitoring requirements for each of these matters. No ecological monitoring was included in the 2017-2019 annual reports as it was not required until Stage 1 commissioning, but a range of attributes were reported in the 2019-20 and 2020-21 reports.

Table 1 : Ecological and Water Quality Monitoring Requirements

Parameter	Requirement	Condition	Required by end of 2021?	Supplied to date?
Water quality	Once within 2 yrs of commissioning, and once at 5 years from commissioning.	Condition 32.1 – dissolved oxygen, temperature, salinity *Not required but data has been collected*	No	Yes (2021)
Water Quality & Shellfish	From Stage 1 commissioning, 3x annually during December – March (at high and low tide for water chemistry and bacteria but not specified for shellfish).	Condition 32.4 – TN, NNN, NH4N, TP, DRP, salinity, faecal coliform bacteria & enterococci bacteria. Condition 32.5 – Enterococci and Faecal Coliforms from shellfish flesh and associated water samples.	Yes – 3 sets of samples	Yes (2021)
Shellfish	From Stage 1 commissioning, annually for a period of 5 years. December – March.	Condition 32.8 – Pipi survey along transect in the lower estuary. Condition 32.9 – Shellfish survey along transects at three sites in mid estuary.	Yes	Yes (2021)

Parameter	Requirement	Condition	Required by end of 2021?	Supplied to date?
Algal Distribution	From Stage 1 commissioning annually for 5 years.	Condition 33.1 – Broad-scale mapping of algal distribution	Yes	No (technical constraint)
Ecology (Fauna)	Once within 2 years of commissioning, once 5 years from commissioning.	Condition 33.2 – Survey of benthic macrofauna at 8 sites identified on plan RC67958/12 and one site at Papahikahawai Creek. Condition 33.3 – At same locations as fauna survey and consistent with methods used for 35.3: Algal cover and type, % cover of mud/silt, depth of mud/silt, and anoxic depth (RPD depth).	No	No
Ecology (Flora)	Transect 9, 10 and 11: No less than 1 month prior to Stage 1, within 6 months of Stage 1, then annually for 5 years. Transect 1-6: within 6 months of Stage 1, then annually for 5 years.	Condition 34.1 – terrestrial and wetland vegetation	Yes – one measurement	Yes (2020 & 21)
Ecology (Flora)	Annually from Stage 1 Commissioning for 5 years	Condition 34.4 – Photo monitoring of salt marsh remnant and Sarcocornia.	Yes	No
Ecology (Flora)	Prior to Stage 1, then 6 monthly for 2 years after Stage 1 commissioning.	Condition 34.5 – vegetation composition and spatial extent along true left bank of diversion channel.	Yes – 2 measurements (prior + August 2021)	No
Sediment & algae	Once prior to Stage 1 commissioning, once within 1 yr of Stage 1 commissioning, once within 2 years of commissioning, once within 5 years of commissioning.	Condition 35 – survey of algae & sediment	Yes (once prior, once by February 2021)	Yes

4.1 Water Quality & Shellfish

4.1.1 EXPECTATIONS AND PREDICTIONS

Salinity

The information provided in the application documents and accompanying technical reports (DHI 2014, Hamill 2014) predicted relatively minor salinity changes in most parts of the estuary, with some areas increasing and some decreasing. Overall, there was expected to be a slight increase in the upper estuary of up to 5 PSU. According to P. De Monchy (personal communication, February 22 2022), it was hoped that mid-lower estuary salinity reductions would create conditions more suitable for Zostera, with a mean lower than 15 PSU. The predicted changes were given as ranges and of course salinity varies through the tidal cycle.

Dissolved oxygen

Dissolved oxygen (DO) measured in the estuary prior to the re-diversion had very large daily fluctuations and, in many places reached minimums detrimental to marine life and in the Papahikahawai lagoon would have excluded many fish species (Hamill 2014). There were still expected to be fluctuations after the re-diversion but oxygenated water from the river was expected to reduce the magnitude of these, as was improved flushing of macroalgae accumulations which were in part responsible for the extreme fluctuations in DO (Hamill 2014). A resultant improvement in conditions for grazers was expected with the flow-on effect of further reducing macroalgae biomass and therefore further improving DO. No timeframe was given for these improvements but considering that a large part of the improvements was predicted to result from flushing of algae from the estuary and from input of higher volumes of oxygenated water from the river, at least some improvement was expected be seen within the first couple of years. Coinciding reductions in macroalgae should also be evident.

Keith Hamill predicted that dissolved oxygen concentrations would improve after the re-diversion, primarily because of the flushing of algae and overall decrease in algal biomass.

Bacteria and Shellfish

DHI (2014) predicted that faecal coliform concentrations would increase in the estuary as a result of the re-diversion and that shellfish gathering would be unsafe (faecal coliform levels above the NZ guidelines for shellfish gathering) 20.6% of the time, up from 12.6% of the time prior to the re-diversion.

Tuangi and pipi are sensitive to salinity changes which can affect distribution, feeding habits and growth rates. The slight decrease in overall salinity from the re-diversion was expected to have at most a minor effect on the distribution of shellfish in the estuary and the inward extent of shellfish beds was not expected to change. Increased flow and reduction in algal biomass was expected to benefit filter feeding shellfish (Hamill 2014).

Nutrients

The DHI (2014) model predicted that there would be an increase in the nutrients in the mid and lower estuary and a slight increase in the upper estuary under normal conditions. However, the model did not include biological processes or internal nutrient loading within the estuary. Under the pre-diversion conditions anoxic sediments and the high algal biomass were considered likely to be contributing large nutrient loads to the estuary and with the increased flushing of both algae and nutrient-laden anoxic sediments, and subsequent reduction in algal biomass, this internal nutrient loading would decrease significantly (Hamill 2014). The timeframe for these changes to take place was not discussed.

4.1.2 MONITORING REQUIREMENTS

Condition 32 of the resource consent details the requirement for water quality and shellfish monitoring:

32.1 The Consent Holder shall use data loggers to measure dissolved oxygen, temperature and salinity in the Ōngātoro/Maketo Estuary. Monitoring shall occur during the periods January to March (inclusive) with measurements made at intervals of 10 minutes (or less) for a period of at least 14 days.

32.2 The monitoring required by condition 32.1 shall occur at the following two locations shown in Figure 4.1, page 51 of Hamill (2014) "Kaituna River Re-diversion Project: Ōngātoro/Maketo Estuary condition and potential ecological effects" attached to the application material: (a) Mid-estuary; and (b) Papahikahawai Lagoon 2.

32.3 The monitoring required by condition 32.1 shall be carried out as follows: (a) Once within two years of Commissioning of the diversion control structure; and (b) Once at five years after Commissioning.

32.4 From Stage 1 commissioning, the Consent Holder shall undertake water quality monitoring three times every year during the periods December to March (inclusive) at high tide and low tide. Samples shall be collected from Ford's Cut, the mid estuary and at Maketu boat ramp, and analysed for: (a) Total nitrogen; (b) Nitrate-nitrite nitrogen; (c) Total ammoniacal nitrogen; (d) Total Phosphorus; (e) Dissolved Reactive Phosphorus; (f) Salinity; (g) Faecal coliform bacteria; and (h) Enterococci bacteria.

32.5 From Stage 1 commissioning, the Consent Holder shall undertake shellfish flesh and water quality sampling at low tide on three occasions every year for each of the periods December to March (inclusive) and June to August (inclusive).

32.6 The samples required by condition 32.5 shall be collected at three sites in the lower to mid Ōngātoro/Maketu Estuary and contain a minimum of five shellfish and associated water quality samples taken from the same site, comprising a minimum of: (a) Two pipi; and b) Two cockle samples.

32.7 The shellfish and water quality samples required by conditions 32.5 and 32.6 shall be tested for Faecal Coliform and Enterococci bacteria concentrations.

32.8 Annually, from Stage 1 commissioning for a period of five years, the Consent Holder shall undertake a pipi survey in the lower estuary for the period December to March (inclusive) comprising a minimum of eight replicate cores along a transect parallel to the channel. All shellfish in the cores shall be identified and counted in 5.0 millimetre size classes.

32.9 Annually, from Stage 1 commissioning for a period of five years, the Consent Holder shall sample shellfish at three sites in the mid estuary during the period December to March (inclusive) comprising eight replicate sediment cores randomly collected over a 10 metre radius of the site location. All shellfish in the cores shall be identified and counted in 5.0 millimetre size classes.

4.1.3 DISCUSSION

Salinity

Marked changes in salinity levels were recorded and reported in the 2019-20 annual report and again in the 2020-21 report. Drops in average salinity of 5 – 10 PSU were seen at both the Papahikahawai Creek and mid-estuary sites between 2019 and the Stage 1 commissioning in 2020, and additional small drops after the 2021 full commissioning. The measurements in 2021 were made in very low flow conditions but show relatively low salinity levels in the Papahikahawai Creek (15.9 PSU average) and are lower by about 5 PSU than predicted (i.e., predicted PSU decrease up to 5 but actual PSU decrease of 5–10).

Although perhaps not expected in low flow conditions, salinity levels this low were predicted for the upper estuary in mean flow conditions and are not of concern.

Dissolved Oxygen

The 2019-2020 Annual Report includes annual data on dissolved oxygen levels at two sites collected since 2017. After Stage 1 commissioning, there was initially increased variability in DO and drops in the minimums at the Papahikahawai Creek site, but the concentrations returned to something similar to pre-diversion levels within a few weeks (Park 2020). Improvements were noted at the mid-estuary site between 2019 and 2020 after Stage 1 commissioning.

The way that dissolved oxygen was reported between the 2019-20 and 2020-21 annual reports changed. In the 2019-20 report, raw data from four monitoring years is shown which includes large daily fluctuations. In the 2020-21, report the data was simplified and only average DO and the average of the daily minimum DO levels is shown. Although the averaged data is easier to follow, there is very little interpretation of the results in the report and whether the slight improvement after full commissioning is meaningful.

Dissolved oxygen is heavily influenced by primary production in the estuary, nutrient cycling, and inputs from the river, and it is likely that low DO levels, and large fluctuations will continue to occur as the system stabilises. What is not clear, either in the application material or the annual reports, is how long that stabilisation is likely to take. Currently the average daily minimum results are below ANZECC trigger values[1]. However, no unexpected effects have been detected to date and it seems likely that improvements will continue. The current monitoring regime appears to be adequate to detect any adverse effects as well as expected improvements.

Bacteria and Shellfish

Monitoring of bacterial levels in the water column and in shellfish was not required to begin until December 2020 and is therefore only reported in the 2020-21 annual report. Monitoring detected a substantial increase in bacterial levels in the flesh of pipi during summer 2020-21, but no increase was detected in the winter results or in the flesh of tuangi in either summer or winter (Park 2021). Similarly, no change was detected in water column bacterial levels (Park 2021). The type and frequency of monitoring for bacteria meets the conditions of the consent and should be sufficient to detect changes over the longer term.

The pipi survey has been more thorough than that required by condition 32.8 in that a baseline survey was undertaken in 2018 and a much larger area was surveyed. Results were displayed in the 2020-21 annual report in such a way that made them difficult to interpret, however it was reported that overall densities and sizes were similar on average. It was noted in the commentary that the channel morphology has changed with the additional flow and that pipi beds move naturally which makes results difficult to interpret.

[1] ANZECC 200. Australian and New Zealand guidelines for fresh and marine water quality. Volume 1, The guidelines. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

Although including the raw densities and size class distribution is useful, it would be helpful to include information on changes in average densities and sizes in tabular form as this, in our opinion, is really what is of interest to the consent authority. Despite this the survey methodology used is more comprehensive than is required and will be capable of detecting changes if/when they occur.

The information included in the 2020-21 annual report on shellfish to satisfy condition 32.9 is somewhat unclear and confusing. Change in density of shellfish (tuangi and hanikura) over time is displayed in graphical form for seven sites; two in Papahikahawai Creek and five in the mid-estuary. Most of these sites, apart from site P1, show a clear increase in shellfish density after 2018, and in some cases either a drop or a flattening after 2020. However, the interpretation of the data states that there was no significant changes as a result of the additional flow. In the next monitoring report, it would be useful to have some discussion about why the initial increase may have happened, and if possible, some significance tests reported.

Nutrients

Nutrient monitoring was not required to be done prior to December 2020 so has only been reported in the 2020-21 annual report. There was very little discussion on the nutrient monitoring results included in the report. The statement was made that "nutrient levels do not show any obvious change from those recorded prior to the increase in flow…" but no insight was provided as to why this might be or whether the monitoring has been sufficient - temporally or spatially - to detect a change or identify potential drivers of change.

It is likely that more data is needed in order to detect a trend in nutrient levels from the significant variation that is intrinsic in the system, so a more detailed examination of the results should be expected in future annual reports.

4.2 Ecology – Fauna

4.2.1 EXPECTATIONS AND PREDICTIONS

Macroalgal cover was expected to decrease over time because of the re-diversion project, primarily as a result of increased flushing (also see section 4.4.1 below).

Monitoring of benthic fauna was not required by the time of the 2020-21 annual report and so is not discussed here.

4.2.2 MONITORING REQUIREMENTS

Monitoring requirements for macroalgal cover mapping and benthic fauna are specified in consent condition 33:

33.1 *The Consent Holder shall undertake broad scale mapping of algae distribution and species in the estuary annually from Stage 1 commissioning for a period of five years. Reporting shall generally be in the form of Figure 2.1, page 6 of Hamill (2014). Kaituna River Re-diversion Project: Ōngātoro/Maketa Estuary condition and potential ecological effects" of the application material.*

33.2 The Consent Holder shall undertake a survey of benthic macrofauna at the eight sites identified on BOPRC Plan Number RC67958/12 and one site in Papahikahawai Island lagoon and one at the end of Papahikahawai Creek as follows:

(a) Infauna shall be sampled using eight replicate sediment cores randomly collected within a 10 metre radius of the site location and macrofauna identified;

(b) Epifauna shall be surveyed using eight randomly placed 0.25 m2 quadrats; and

(c) The survey shall be undertaken once within two years of Commissioning and then again at five years from Commissioning.

33.3 At the location of each macrofauna replicate required by condition 33.2, measurements shall also be taken of the following variables using methods consistent with those used for condition 35.3:

(a) Algae cover and type;

(b) Per cent cover of mud/silt;

(c) Depth of mud/silt; and

(d) Anoxic depth (that is, depth of RPD (redox potential discontinuity)).

4.2.3 DISCUSSION

The broad scale macroalgal mapping required by 33.1 was not carried out in the year following Stage 1 commissioning because of technical difficulties with the aerial photography. However, mapping has been done annually from 2018 – 2020.

The reporting method used in the 2020-21 annual report is not what was specified in the consent condition, giving total cover, rather than area of algae in various cover classes, but perhaps when the first post-diversion monitoring is undertaken, this will be rectified.

Monitoring of benthic fauna was not required before the time of the 2020-21 annual report and the outcome of such monitoring is expected to be provided in the 2022 annual report.

4.3 Ecology – Flora

4.3.1 EXPECTATIONS AND PREDICTIONS

Roger MacGibbon (2014) predicted that the major saltmarsh remnant in the southern part of the estuary near the Waitepuia Stream outlet would unlikely be impacted by the re-diversion, and that the smaller saltmarsh remnants in the Papahikahawai Creek and lagoon may change in species composition away from searush dominance but unlikely to decrease in extent. The freshwater wetland vegetation around Ford Island and further upstream in the 'Titchmarsh Wetland' was predicted to experience changes in salinity that may impact vegetation composition over time. No major change or short-term loss of vegetation was predicted, but condition 34.5 was put in place to monitor for any adverse effects and provide provision to rectify them.

4.3.2 MONITORING REQUIREMENTS

Condition 34 in the Resource Consent covers the monitoring requirements for flora:

34.1 *The Consent Holder shall undertake vegetation transect monitoring to determine the effects of the re-diversion on terrestrial and wetland vegetation as follows:*

Location Frequency Transects 1-8 as shown on BOPRC Plan Number RC67958/12 with Transect 7 being extended to the waters edge of the new re-diversion channel no later than 6 months after full commissioning and thereafter annually for 5 years. Transect 9 1 new transect to be established on land in the general location shown in BOPRC Plan Number RC67958/12No less than 1 month prior to Stage 1 commissioning and then no later than 6 months after full commissioning and thereafter annually for 5 years; Transect 10 and 11, 1 north-south and 1 east-west transect to be established on the land north of Fords Cut using paired plot methodology, no less than 1 month prior to Stage 1 commissioning and then within 6 months of each planting stage and then annually for 5 years

34.2 *Transects should be measured using the methodology from section 3.1.5.1, on pages 8 to 20, of MacGibbon (2014) 'Kaituna River Re-diversion Project: Ōngātoro/Maketu Estuary Enhancement Project - Terrestrial, Avian and Wetland Ecology' provided as part of the application material in the locations shown on BOPRC Plan Number RC67958/12.*

34.3 *In the event that access to Transects 6 and 8 cannot be gained from the landowner, there is no requirement to monitor. The Consent Holder shall notify the Regional Council in writing within 10 working days of access being denied identifying the attempts made to gain access.*

34.4 *The salt marsh remnants and the small Sacocornia patch in Papahikahawai Creek shall be monitored using photopoint monitoring. Surveys shall be carried out annually from Stage 1 commissioning for a period of five years.*

34.5 *The vegetation composition and spatial extent along the true left bank of the re-diversion channel shall be surveyed prior to river re-diversion and monitored 6 monthly for a period of two years following Commissioning. In the event that any die back is observed, the dead plants shall be replaced with alternative salt tolerant plants as soon as practicable.*

34.6 *Any observed die back and subsequent replacement planting shall be reported on under sub-clause 29.1(vi) of this resource consent.*

4.3.3 DISCUSSION

No photopoint monitoring of the saltmarsh remnant in the southern estuary, or the *Sarcocornia* remnant at the eastern end of Papahikahawai Island has been provided in the annual reports, and neither has the monitoring of the Titchmarsh wetland as required by condition 34.5. The monitoring of the vegetation along the true left bank of the diversion channel should have been carried out at least once in 2021 after full commissioning and reported in the 2021 annual report along with the baseline information collected prior to the re-diversion.

Annual photo monitoring of the saltmarsh remnant and *Sarcocornia* remnant should have been carried out at least once and included in the 2020-21 report. If this monitoring has not been done, it should be started as soon as possible. If not setup prior to Stage 1 commissioning, then photos taken for other purposes could be used and repeated. A series of 360 degree drone photos were taken prior to commissioning and these could be repeated as part of the photo monitoring programme.

Vegetation monitoring has been established on the new Te Pa Ika wetland and Ford Island as per condition 34.1 and re-measured once in 2021 after full commissioning. The remaining eight transects are to be measured in February-March 2022 which will be later than they should have been, but the monitoring time was chosen to be done in the same season as the original monitoring to reduce seasonal variability and increase the likelihood of detecting actual change.

Results of the re-measurement of transects 9-11 show substantial changes; none of these are attributable to the additional water through the re-diversion but are the result of direct restoration action and, in the case of transects 10 and 11, to complete landform change, vegetation stripping and in some areas re-planting. Changes in vegetation composition and structure will take many years to detect in most cases, but the monitoring programme is sufficient to detect major changes.

4.4 Sediment and Algae

4.4.1 EXPECTATIONS AND PREDICTIONS

It was expected that the additional volume of water from the Kaituna re-diversion would result in a slight increase in nutrient levels in the estuary overall. This was expected to promote algal growth but would likely be offset by changes in salinity levels which supress algal growth, as well as flushing (Hamill 2014). Increased current in many parts of the estuary, and only slightly reduced current in other parts (but remaining above the critical level), will flush algal biomass out of the estuary. It was thought possible that overall improvements in ecological health would improve conditions for grazers (fish and invertebrates), which will in turn reduce the algal biomass.

Nutrient cycling from sediments was thought to be playing a significant role in algal growth and was more important than the nutrients within the water column. The increased flushing from the re-diverted river water was predicted to flush these sediments and reduce the overall nutrient loading in the estuary, thus resulting in lower algal growth over time, although no timeframe was given in the initial technical reports.

Overall, algal biomass was predicted to decrease significantly due primarily to the flushing effect. Flushing was also expected to reduce nutrient-laden fine sediments in the estuary.

4.4.2 MONITORING REQUIREMENTS

Condition 35 requires monitoring of sediment and algae as follows:

35.1 The Consent Holder shall undertake a survey of sediment and algae in the estuary as follows:

(a) Along a minimum of three transects in the upper estuary;

(b) Along a minimum of three transects in the mid-estuary, (including one at the downstream end of Papahikahawai Creek); and

(c) Along a minimum of one transect in the lower estuary.

35.2 The sediment survey shall be undertaken:

(a) Once prior to the Stage 1 commissioning of the diversion control structure;

(b) Once within one year of the Stage 1 commissioning of the diversion control structure;

(c) Once within two years of the Commissioning of the diversion control structure; and

(d) Once within five years of the Commissioning of the diversion control structure.

35.3 Variables assessed during the sediment survey shall include:

(a) Algae cover and type;

(b) Per cent cover of mud/silt;

(c) Depth of mud/silt; and

(d) Anoxic depth (that is, depth of RPD (redox potential discontinuity)).

4.4.3 DISCUSSION

Macroalgal cover was reported in both the 2019-20 and 2020-21 reports. The results show a clear trend of declining macroalgal cover overall but this was attributed mostly to a natural cyclic reduction, except in the Papahikahawai Lagoon where the removal of the causeways caused flushing of the dense macroalgal beds that occurred there (Park 2021). The report notes that continued cyclic increases and decreases of macroalgae is to be expected and that the key effect of the additional flow from the re-diversion will be to reduce the overall extent of any blooms.

Monitoring of sediment was required prior to Stage 1 commissioning and then once between then and the 2020-21 annual report. The post-commissioning monitoring was reported in the 2019-20 annual report, but no data was included for the baseline monitoring and no comparison was made except for one site (P8) which was discussed in the technical memo (Park 2020) but not in the annual report itself. It seems that the data is being collected but it hasn't been properly reported as required by condition 35 and 29.1.

5 Cultural matters

This part of the review was guided by the following parts of Condition 29.1:

(b)(i) *Monitoring results from the Mauri Monitoring Plan (condition 8B):*

(f) *Identify instances where the Consent Holder has provided opportunities for Tāngata Whenua involvement under condition 28.2(i) and Condition 8A.*

(g) *Identifies any recommendations made by any of the Tāngata Whenua groups under condition 8B.7 and, where the recommendations have not been adopted by the consent holder, the reasons for not adopting those recommendations.*

5.1 Mauri monitoring

5.1.1 EXPECTATIONS AND PREDICTIONS

The decision report to the resource consent noted that none of the Cultural Impact Assessments identified any adverse cultural effects as a result of the re-diversion. They all "identified positive effects of the proposal on the ecology of Maketu Estuary and a general alignment with goals and aspirations of tāngata whenua, in particular restoring the mauri of Ōngātoro (Maketu Estuary)."

5.1.2 MONITORING REQUIREMENTS

Condition 8B of the resource consent provided for the development of Mauri Monitoring Plan(s) to identify the process and methods for monitoring whether a decline in mauri is occurring over time as a result of the Project. Te Toko Whitu[2] and Ngāti Pikiao produced their own Mauri Monitoring Plans in 2018.

Condition 29(b)(i) requires the annual report to include monitoring results from the Mauri Monitoring Plan. The 2020-21 annual report notes that baseline mauri monitoring work had been "undertaken in 2019 and reported in 2020". However, the results of this monitoring was not included within the same annual report.

The abovementioned baseline mauri monitoring report was also reviewed. Of notable mention is the following statement:

> *"The report finds that mauri relationships expressed by participants currently come from a 'diminished' (less positive) state and that there is a general expectation that the environmental restoration project will lead to more positive mauri aspirations across all wellbeing domains".*

The report also recommends continued use of an online survey; 5 yearly cycle of hui, wānanga and korero as well as an establishing of a Reporting Committee to receive results.

Finally, the 2020-21 annual report highlights that "further mauri monitoring work should be undertaken now".

[2] Ngati Rangiwewehi, Ngati Whakaue ki Maketu, Tapuika, Waitaha, Ngati Tunohopu and Ngati Makino

5.1.3 DISCUSSION

Baseline mauri monitoring was carried out in 2019. However, the results of this monitoring were not included in any subsequent annual reports.

The focus for the next 6-12 months should be planning for the next round of mauri monitoring by tāngata whenua. It is understood that these discussions are already underway.

5.2 Opportunities for tāngata whenua involvement

5.2.1 EXPECTATIONS AND PREDICTIONS

The decision report to the resource consent noted that several conditions or recommendations within the Cultural Impact Assessments highlighted the importance of ongoing involvement of tāngata whenua in the implementation of the Project.

Condition 8A of the resource consent provided for the development of Tāngata Whenua Collaboration Plans to provide for the active involvement of tāngata whenua at all stages of the Project. It would detail, at a minimum:

(a) *How and when tāngata whenua will be involved with planning and implementation of:*

  (i) *wetland restoration;*

  (ii) *monitoring in the estuary and the river; and*

  (iii) *any other matter identified through the development of the Plan;*

(b) *Opportunities for providing improved tuna and īnanga fish passage and habitat;*

(c) *How local cultural knowledge may be incorporated in monitoring of the effects of the Project;*

(d) *Mechanisms for enabling local employment and providing education opportunities for tāngata whenua, including making material and knowledge available for educational use;*

(e) *A process for tāngata whenua to have input into and provide feedback on the annual report prepared under Condition 29 prior to its lodgement with the Regional Council.*

Te Toko Whitu and Ngāti Pikiao produced their own Tāngata Whenua Collaboration Plans in 2018 (combined with their Mauri Monitoring Plan). Each Plan provided an excellent level of detail relating to Condition 8A above.

5.2.2 MONITORING REQUIREMENTS

Condition 29(b)(i) requires the annual report to identify instances where the Consent Holder has provided opportunities for tāngata whenua involvement under condition 28.2(i) of the consent[3].

It is notable that cultural matters were not introduced at all until the 2019-20 annual report. Both the 2019-20 and 2020-21 annual reports provide a brief summary of opportunities for tāngata whenua involvement within the project. It is unclear if this information was purely sourced from the Collaboration Plans and/or added to as a result of project-related meetings with tāngata whenua.

5.2.3 DISCUSSION

The last two annual reports provide a brief update on actions and outcomes relating to opportunities for tāngata whenua involvement within the project. In our view, it would be useful for more information to be provided, beyond one sentence updates. This contrasts highly with other sections of the annual report which include photographs and a lot of detailed information. Providing more detail would also help to highlight the importance and value of the partnership and working relationship with tāngata whenua, particularly with the amount of work that had been put into their Collaboration Plans in the first place.

It has been four years since the development of the Tāngata Whenua Collaboration Plans. It may be timely for a quick review of these plans to ensure that they are up-to-date and working effectively for tāngata whenua, particularly from an implementation point of view.

5.3 Recommendations from tāngata whenua

5.3.1 EXPECTATIONS AND PREDICTIONS

There are a number of consent conditions that ensure appropriate mechanisms are in place for tāngata whenua to provide feedback or recommendations to the consent holder or consent authority.

This is highlighted in the Tāngata Whenua Collaboration Plan for Te Toko Whitu, which notes that "successful collaboration is based on inclusive processes, two-way communication, trust, information sharing and dealing with conflict if it arises"

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[3] (i) Identify and provide opportunities for tāngata whenua and the community to be involved in developing education or research projects associated with the Project, particularly around incorporating elements of Mātauranga Māori, and in wetland restoration and ecological monitoring.

5.3.2 MONITORING REQUIREMENTS

Condition 29(g) requires the annual report to identify any recommendations made by tāngata whenua under condition 8B.7[4] and, where the recommendations have not been adopted by the consent holder, the reasons for not adopting those recommendations.

This condition has been a little difficult to review effectively. As already mentioned, cultural matters were not introduced until the 2019-20 annual report. The annual reports only include feedback or recommendations from annual meetings with tāngata whenua to provide and discuss project updates, including monitoring results. No information is available about feedback or recommendations provided outside of those meetings or directly to the consent authority.

The 2019-20 annual report includes a brief summary of key points from the 21 July 2020 meeting to discuss the annual monitoring results with tāngata whenua. Only two pieces of feedback was listed. There was no mention of questions or concerns raised about the movement of sediment and Maketu Beach Road edge erosion, which were outlined in the respective notes from the same meeting.

The 2020-21 annual report adds to the previous report with the key points from the 28 July 2021 meeting and a copy of the presentation to tāngata whenua.

There was no information available within the annual reports regarding reasons for recommendations that were not adopted by the consent holder. Therefore, no comment can be made in respect to that part of Condition 29(g).

5.3.3 DISCUSSION

As noted earlier, the last two annual reports only provide a brief update on annual meetings with tāngata whenua to discuss the outcomes of monitoring over the previous year. It would be useful for more information to be provided, beyond a couple of bullet points.

Based on the information provided to date, it is unknown whether tāngata whenua representatives have provided feedback or recommendations to the consent holder, outside of annual meetings, or directly to the consent authority. Likewise for reasons for recommendations that were not adopted by the consent holder.

[4] 8B.7 Notwithstanding this condition or any other condition, tāngata whenua may at any time make recommendations directly to the Consent Holder or to the Regional Council on measures to be undertaken to address or mitigate cultural impacts arising due to the operation of the Project.

6 Hydrological and engineering matters

This section of our report deals with hydrological and engineering matters relating to the re-diversion. This section is broken into three parts - Operational, River and Estuarine Engineering and Hydrology.

6.1 Operational

6.1.1 ASSET MANAGEMENT PLANS

The Peer Review Panel requested a copy of any Asset Management Plans (AMPs) of the assets constructed and managed for the activity authorised under the consents for the diversion.

AMP's are a principal document to understanding planned maintenance and operation of structures created as a result of this project. It would give the Peer Review Panel confidence in the ongoing long-term management and maintenance of the structures. This includes identification and mitigation of risks where failure can cause significant adverse environmental effects.

With the project still under a period of defects liability and only completed within 6 months of the latest reporting, it is recognised that asset management planning for the structures will be at an early stage. It is noted that a revised AMP for the Regional Parks and Coastal Catchments assets was approved as part of the LTP 2021-31 process just after the reporting period for this review concluded (P. De Monchy, personal communication, February 22 2022).

6.1.2 OPERATIONS AND MAINTENANCE MANUAL

Development of the Operations and Maintenance Manual (OMM) has been ongoing since prior to stage 1 commissioning of the project. Additional information and refined maintenance procedures have been included following stage 2 commissioning.

As required, consultation and agreement reached during the development of the document with Western Bay of Plenty District Council operational sections. Inputs were provided by Bay of Plenty Regional Council Rivers and Drainage Operations and Engineering sections. Currently both these sections have key roles in the ongoing operational and flood management requirements for the project.

Review and Independent verification occurred 30 March 2021 with final publication and circulation to the Rivers and Drainage section December 2021. The OMM contains monitoring and other activities that are linked to the commissioning plans, these are required to be enforceable through the consent. An example of this is the requirement for ongoing erosion monitoring and repairs through the diversion channel and Fords Cut. Ongoing review of the OMM will capture any changes to procedures, new issues, repairs or further monitoring requirements where adverse effects are developing.

The next review is due February 2023 or after any significant floods or incidents with gate operation.

6.1.3 FLOOD MANAGEMENT

Flood Management protocols and processes to manage the flood risk for Maketu Township have been developed and included in Bay of Plenty Regional Council's Flood Manual and the project's OMM.

Flood Managers and Flood Forecasters have also been trained in the application of the protocols.

To date, no floods or sea storms have triggered gate closure.

6.2 River and Estuarine Engineering

This sub-section specifically looks into erosion, scour and deposition at specific sites.

6.2.1 MAKETU BOAT RAMP

Condition 31.4(c) requires surveys of bed and channel depths within the boat ramp access channel from Maketu Boat Ramp to 100m seaward.

Current monitoring to date has included a cross section profile from the boat ramp extending out 100m across the estuary. This should be changed to measure bed inverts and channel depths in the channel from the boat ramp extending 100m seaward but staying in the channel where it is deepest. The intent is to monitor for boat access in this channel.

6.2.2 MAKETU SPIT

Results of monitoring since 2020 on the Maketu Spit transect sites 1 &2 indicate erosion on the estuary side of both transects. Both transects also show deepening of the channel over the same period. These changes are consistent with the commissioning of stage 1, opening 9 gates, 12 February 2020 and full commissioning on 12 February 2021 of the diversion structure.

With the increase of volume and flow through the diversion culverts, erosion and scour of the defined channels within the estuary will develop as the energy available to transport sediments increases. This erosion and scour is in its early stages following the introduction of additional water to the estuary and will continue until an equilibrium of energy and resisting forces is reached.

With the alignment of the channel against the dune, the loss of the toe and the deepening of the channel, these factors will continue to induce upper dune erosion as the resisting shear strength is reduced on a steepened dune face.

Any eroded material will continue to be transported away while the channel exists in its current position maintaining domination of erosion as opposed to accretion on the estuary side of the dune.

A new channel away from this current alignment is unlikely to form reducing erosive forces against the dune. Only with time and long term morphological changes as a result of the reduction in the flood tide delta, will movement of the channel away from the dunes occur.

On the ocean side both transects show general accretion has occurred over the short period of time from 2017 to 2021. This is consistent with a number of other beach reaches along the Bay of Plenty coastline over that period.

Breaches of the Maketu spit have occurred previously, in 1979 and 1994. The location of the current erosion is located upstream of the previous breach sites. A possible breach "in the next few years" at the current erosion site was identified during consenting in the Assessment of Effects. It was highlighted that a breach at this site may cause more significant disruption of the inner harbour morphology than has occurred previously.

Whist additional monitoring sites were a requirement of consent, no conditions were imposed to intervene or repair erosion to reduce the risk of a breach and no mitigation of the existing risk was proposed as part of the project.

Council staff note that, in working through the application with tāngata whenua, it was clear that little support existed for either dredging the lower estuary to create a greater hydraulic capacity, nor engineering works to decrease the risk of erosion on the estuarine side of the spit. The agreed mitigation in the event of likely spit breach being detected through monitoring was to invoke the permitted activity rule for Coast Care earthworks allowing up to 500m^3 sand per site per year to be shifted, or emergency works if a greater volume was required. There is some evidence that the flood tide delta extent is reducing (reducing the erosive pressure on the back of the spit), based on the cross sections monitored (P. De Monchy, personal communication, February 22 2022).

6.2.3 FORDS CUT AND DIVERSION CHANNEL

Erosion has occurred along the right bank of Fords Cut following Stage 1 commissioning. While 2 monthly inspections were undertaken the Stage 1 Commissioning Plan required photo points to be established and a cross section downstream of the culvert apron to be surveyed. It appears the photo points were never established, and the cross section survey was not undertaken prior to Stage 2 commissioning.

In June 2020, following a visual inspection significant erosion was identified. Works were carried out during October 2020 to repair the erosion, approximately 3500 tonne of rock rip rap was imported. Further inspection during Oct 2021 identified more erosion downstream of the "new rip-rap along Fords Cut".

All erosion sites discovered and/or repaired should be included in the annual report so that readers can get an understanding of potential long term adverse effects developing following commissioning of the re-diversion.

S. Brown confirms that the appendix to the 2020-2021 annual report notes the diversion channel erosion works. It was also discussed during the community and tāngata whenua briefings in mid-2021. Any observations relating to erosion in Oct 2021 will be reported in the 2021-2022 annual report (personal communication, February 23 2022).

Note: the erosion identified to date is extremely likely to have been initiated by the re-diversion flows and exacerbated by the alignment of the structure and the range of variability of water volumes diverted into the estuary through differing river flows and tide states (described later in the report).

6.2.4 RECOMMENDATIONS

All erosion sites discovered and/or repaired should be included in the annual report so that readers can get an understanding of potential long term adverse effects developing following commissioning of the re-diversion.

It is noted that not all erosion sites will require intervention or repair. Sites with low environmental risk or where no other third party infrastructure exits will generally only be monitored until stabilisation or self-healing occurs.

6.3 Hydrological and Hydraulic

6.3.1 KAITUNA RIVER FLOWS AND VOLUMES

The project goal is to significantly increase the volume of water (particularly freshwater) flowing from the Kaituna River into Te Awa o Ngātoroirangi/Maketū Estuary for ecological and cultural benefits while limiting economic and adverse environmental effects. Outputs from a numerical model were used to predict flows and volumes and for culvert sizing for the project. Below is an extract from the AEE and presented through the consenting process.

> *"The volume of water to be re-diverted varies considerably depending on the tidal range, which drives the difference in water levels between the river and estuary. The mean flow in the lower Kaituna River is around 2,900,000m^3 per tidal cycle. Of this, approximately 315,000m^3 (11%) can be re-diverted during neap tides, 574,000m^3 (20%) during mean tides, 788,000m^3 (27%) during spring tides, and more during flood events." Reference Volume A: Assessment of Effects on the Environment Report.*

Consent conditions require the holder to undertake monitoring pre and post project to confirm volumes and flows and to validate the DHI model findings. Subsequent to this monitoring DHI have prepared an updated memo (DHI 14 December 2021) that includes an analysis of measurements to confirm compliance with consent conditions.

In general, the validation conditions are separated into three components:

- Pre and post monitoring measurement criteria
- Kaituna River ebb tide volume validation
- Validation of consented flow from the Kaituna River to Estuary

Effects both positive and negative were based on the model predictions throughout the project development, consenting and construction.

6.3.2 PRE AND POST MONITORING MEASUREMENT CRITERIA

The consent conditions are very specific around criteria for the collection of data for monitoring and model validation. The DHI memo sets out the criteria when measurements should be undertaken and actual conditions during the measurements that were undertaken.

Both DHI and the peer review panel conclude that consent conditions have not been met for the collection criteria of pre and post project measurements. The panel also understands and agrees that being able to meet these strict conditions and repeatability windows would have taken considerable time and effort with the likelihood of project construction being deferred while waiting to achieve exact monitoring criteria requirements.

6.3.3 KAITUNA RIVER EBB TIDE VOLUME VALIDATION

DHI have presented results, table 5 below, of the two pre and two post ebb tide measurements and the calculated percentage differences as required by consent condition 30.4(g). The condition requires that, after any adjustments for minor differences in river flows or tidal range, if any of the two Post-Project measured ebb tide volumes are found to be less than any of the two Pre-Project ebb tide volumes by 20% or more, mitigation measures shall be undertaken to ensure the actual flows are within 20% for "low flow" river conditions.

Note: In table 5 (DHI) below there is uncertainty on the date these measurements were undertaken, the plot in the DHI report is for the 14th June 2016 and 18th January 2017 but in the table below 16th June and 17th January respectively are stated.

Table 5 Calculated percentage difference for ebb tide volumes through Kaituna River mouth for all surveys.

Survey Date	16th June 2016	17th January 2017	24th February 2021	2nd December 2021
16th June 2016	N/A	6.4%	-19.7%	0.1%
17th January 2017	-6.0%	N/A	-24.5%	-5.9%
24th February 2021	24.5%	32.5%	N/A	24.7%
2nd December 2021	-0.1%	6.3%	-19.8%	N/A

On one occasion (highlighted) the reduced volume post vs pre difference is greater than 20%. DHI have provided adjustments and reasoning around the difference. Much of the explanation is valid. If the measurements had been undertaken as close as possible to the criteria of the consent conditions many of the uncertainties would not exist.

Results from monitoring to validate the model, consent condition 30.4(f), are presented in the table below.

Survey Date	Tide Phase (moturiki recorder)	River Flow (m^3/s)	Project Phase	Measured Volume (m^3)	Predicted Volume (m^3)	Percentage Difference
14 June 2016	Close to neap (range 1.20m)	30.8 – 28.9	Pre-Project	1,405,900	1,190,700	18%
18th Jan 2017	Close to mean (range 1.62m)	24.7	Pre-Project	1,495,900	1,383,300	8%
24thFeb 2021	Close to neap (range 1.11m)	22.0	Post-Project	1,129,100	1,162,300	-3%
2nd Dec 2021	Mean (range 1.52m)	25.1	Post-Project	1,407,500	1,622,800	-13%

Without adjustments for tidal range, it can be seen that for the low flow river – mean tide range, the model predicts to +- 13% of measured flow, and for the low flow – neap tide range to +- 18%, across both pre and post project measurements. There is no trend in the percentage differences between pre and post comparisons.

Due to the measurements not being undertaken within or as close as possible to the strict criteria of the consent conditions, noting the difficulty in collecting measurements within the strict criteria, comparisons between modelled pre and measured post project volumes should be interpreted with the full understanding and detail of adjustments made for model validation of ebb tide volumes.

The strict criteria in the consent conditions for repeat measurements is to compare actual measured volumes to modelled volumes under the same conditions without significant adjustments. By using unvalidated model outputs to adjust actual measurements so they match the model conditions is not a robust validation process. Any inaccuracies in the model become inaccuracies in the measurements by incorporating adjustments from the model.

6.3.4 VALIDATION OF CONSENTED FLOW FROM THE KAITUNA RIVER TO ESTUARY

The Project was consented for the diversion of approximately 600,000 m^3 of water per tidal cycle from Kaituna River into Te Awa o Ngātoroirangi /Maketū Estuary, for a mean tide mean flow scenario.

Post project flow measurements were undertaken over a full gate opening cycle on 24th February 2021 and 2nd December 2021 to compare predicted modelled volumes against as built measured volumes.

Table 7 below (DHI), sets out the predicted volumes from the model that were presented through the consenting process and to size the culverts to achieve the projects goals.

Table 7 The predicted Post-Project ebb and flood volumes to estuary for a range of river flow and tide condition.

Tide State	River Flow	Ebb or Flood Tide	Volume (m^3)	
			Fords Cut	Maketū Estuary Entrance
Neap	Low	Flood	294,100	Not calculated in original study
		Ebb	N/A	
	Mean	Flood	315,200	392,600
		Ebb	N/A	734,900
Mean	Low	Flood	532,200	Not calculated in original study
		Ebb	N/A	
	Mean	Flood	574,500	680,900
		Ebb	N/A	1,237,400
Spring	Low	Flood	727,500	Not calculated in original study
		Ebb	N/A	
	Mean	Flood	787,800	954,800
		Ebb	N/A	1,772,000

Results from the two measured volumes over a gate opening cycle compared with predicted volumes are set out in the table below. Results include minor adjustments for tide range based on actual records from Moturiki Tide station (NIWA) and minor adjustments to river flow based on records from Kaituna River at Te Matai (BOPRC).

The tide station is open ocean, approximately 24 km's to the west of the Kaituna River mouth and in the same coastal reach. Any wave or other setup will be captured in the records from this station. Kaituna at Te Matai Road has been used for flow adjustments.

Survey Date	Tide Phase (moturiki recorder)	River Flow (m^3/s)	Project Phase	Measured Volume (m^3)	Predicted Volume (m^3)	Minor Tide Adjustment Measured Volume	Minor Tide and Flow Adjusted Measured	% Difference predicated vs adjusted measured
24thFeb 2021	Close to Neap (range 1.11m)	22.0	Post-Project	447,400	294,100	403,900	402,660 (neap tide-low flow)	+37%
2nd Dec 2021	Mean (range 1.52m)	25.1	Post-Project	639,800	574,500	619,800	652,040 (mean tide-mean flow)	+13.5%

During the development of this table discussion was undertaken with DHI (Ben Tuckey, personal communications, March 2022) to understand the sensitivity of peak tide ranges and flow to the results. Agreed adjustments and in particular appropriate peak tide ranges were established to apply when making adjustments to compare measurements with modelled outputs.

Agreed figures for the tide range over a mean tide in terms of MVD53 are –0.62m to 0.88m, with a volume adjustment of +-5,000 m^3 per cm per tide cycle variation from the peak tide figure of 0.88m MVD53.

It can be seen from the results above that the predicted volume used for consenting and design has underestimated compared with the as built flow going through the diversion culverts. For the neap tide low flow, the volume diverted per tide cycle is approx. 37% greater and for mean tide mean flow the volume diverted per tide cycle is approx. 13% greater.

These results confirm that flow volume is within 10% of 600,000 per tidal cycle for the mean tide mean flow scenario.

For the neap tide low flow scenario with 37% greater volume per tide cycle passing through the gates salinity concentrations and flow velocities entering into the estuary will be higher than modelled.

6.3.5 RECOMMENDATIONS

That the consent holder undertakes a flow measurement as close to mean tide mean flow to confirm flows passing through the gates. This flow could then be used to develop an algorithm to estimate volume through the gates over most tide cycles and sea states. This estimation method would meet condition 30.1(d) and also provide an opportunity to modify the gates operating regime to optimise fresh water entering the estuary during low river flows. r

7 Summary

This report documents the first independent peer review of the technical and cultural aspects of the annual reports associated with the Kaituna River Re-Diversion and Te Awa o Ngātoroirangi/Maketu Estuary Enhancement Project. The review of annual reports is guided by Condition 29A of the resource consent and informed by the numerous technical reports and plans associated with the project.

7.1.1 ECOLOGICAL AND WATER QUALITY MATTERS

In terms of ecological and water quality matters:

- Salinity: low salinity levels in the upper estuary in mean flow conditions but are not of concern.
- Dissolved oxygen: no unexpected effects have been detected to date and it seems likely that improvements will continue.
- Bacteria and shellfish: the interpretation of the data within the annual reports indicate no significant changes as a result of the additional flow.
- Nutrients: more data is needed in order to detect a trend in nutrient levels from the significant variation that is intrinsic in the system.
- Macroalgal cover: macroalgal mapping required by Condition 33.1 was not carried out in the year following Stage 1 commissioning because of technical difficulties with the aerial photography. However, mapping has been done annually from 2018 – 2020. The reports note that continued cyclic increases and decreases of macroalgae is to be expected.
- Benthic fauna: monitoring was not required before the time of the 2020-21 annual report and the outcome of such monitoring is expected to be provided in the 2022 annual report.

It is notable that the monitoring requirements for this resource consent rely heavily on the interpretation of results by the consent holder and their interpretation of what constitutes an unexpected adverse effect.

The consent conditions do not set any performance standards or define the acceptable change for any of the ecological or water quality parameters, which leaves monitoring subject to interpretation and without any clear feedback loop for remedying any unexpected effects.

Furthermore, the annual plans did not link the results to the expected effects as they were outlined in the application documents and technical reports, which would be required for the reports to be meaningful and for the consenting authority to understand the actual effects of the project.

7.1.2 CULTURAL MATTERS

In terms of cultural matters

- Mauri monitoring: baseline mauri monitoring was carried out in 2019. However, the results of this monitoring were not included in any subsequent annual reports. It is understood that planning is underway for the next round of mauri monitoring by tāngata whenua.

- Opportunities for tāngata whenua involvement: The last two annual reports provide a very brief update on actions and outcomes relating to opportunities for tāngata whenua involvement within the project. More detail is needed, beyond one sentence updates, to highlight the importance and value of the partnership and working relationship with tāngata whenua.
- Recommendations from with tāngata whenua: it is unknown whether tāngata whenua representatives have provided feedback or recommendations to the consent holder, outside of annual meetings, or directly to the consent authority. Likewise for reasons for recommendations that were not adopted by the consent holder. This detail would be useful in future annual reports.

7.1.3 HYDROLOGICAL AND ENGINEERING MATTERS

In terms of hydrological and engineering matters

- Operations: An Asset Management Plan and Operations and Maintenance Manual are in place. Flood Management protocols and processes have also been developed.
- River and Estuarine Engineering: Erosion has occurred along the right bank of Fords Cut along with the estuary side of Maketū Spit transect sites 1 &2. These changes are consistent with Stage 1 commissioning and full commissioning. Whist additional monitoring sites were a requirement of consent, no conditions were imposed to intervene or repair erosion to reduce the risk of a breach and no mitigation of the existing risk was proposed as part of the project. Current monitoring to date of the Maketu Boat Ramp has included a cross section profile from the boat ramp extending out 100m across the estuary. This should be extended to monitor for boat access to the channel.
- Hydrological and Hydraulic: Flow and volume measurements undertaken following full opening of the gates confirm that the volume of water entering into Maketū Estuary is within 10% of 600,000 m^3 per tidal cycle for the mean tide mean flow scenario. The monitoring has also confirmed that the volume passing through the gates over any one tide cycle is very sensitive to the actual tide state, sea conditions and Kaituna River flow. The likely scenario, over the long term, is that more water will be entering the estuary than estimated from initial modelling.

7.1.4 REVIEW LIMITATIONS

The peer review was only limited to the technical and cultural aspects of the annual reports (as per Condition 29A of the consent).

A number of important matters to this project were outside of the scope of the annual report and peer review. This includes, but is not limited to:

- the sheer significance of the project to tāngata whenua, culminating in the commissioning of the control gates, in returning flow and life to Te Awa o Ngātoroirangi/Maketu Estuary. This project has been decades in the making.
- the relationships and goodwill that have been built (and maintained) with tāngata whenua, community groups and local community over the years.
- community and school tree and wetland planting days particularly in recent years.
- multiple national awards won for this project (e.g. NZ Planning Institute, Association of Consulting and Engineering).

Monitoring also was not required for many of the parameters in the first couple of years. Therefore, this peer review only provides a snapshot based on a limited number of parameters (and limited data sets). It is also still early days and improvements across all parameters will take time.

8 Recommendations from the Peer Review Panel

There are 15 recommendations for the consent holder and one recommendation (condition 13) to the consent authority. These relate to actions needed to:

- address an adverse effect;
- address potential gaps in monitoring;
- better understand the significance of monitoring data, particularly changes over time;
- improve the general structure, form and content of annual reports;
- enhance collaboration with tāngata whenua.

This peer review will hopefully provide useful guidance in terms of future monitoring, data analysis and annual reporting.

8.1.1 RECOMMENDATIONS TO ADDRESS ADVERSE EFFECTS

#	Recommendation	Report Reference
1.	**Erosion repairs** Consent holder to undertake site specific repairs on an ongoing basis as erosion is discovered along the diversion channel and Fords Cut, as appropriate.	6.2

8.1.2 RECOMMENDATIONS TO ADDRESS POTENTIAL GAPS IN MONITORING

#	Recommendation	Report Reference
2.	**Photo monitoring** Consent holder to carry out and/or complete photo monitoring. This can be a very effective way to monitor significant change in vegetation and morphological change. If baseline photos were not taken in accordance with the consent conditions (34.4, 34.5) then other photos taken at that time may be useful. There are at least oblique aerials taken by drone which could easily be repeated.	4.3.3
3.	**Photopoint monitoring** Consent holder to complete photopoint monitoring to comply with Condition 34.4.	4.3.3
4.	**Diversion channel vegetation monitoring** Consent holder to complete the monitoring of vegetation on the true left bank of the diversion channel.	4.3.3
5.	**Sediment monitoring** Consent holder to complete and/or report on sediment monitoring required by Condition 35.	4.4.3

#	Recommendation	Report Reference
6.	**Mauri monitoring** Consent holder to continue working with tāngata whenua to co-ordinate an updated mauri monitoring process.	5.1
7.	**Maketu boat ramp channel monitoring** Consent holder to align the monitoring survey to described consent conditions.	6.2.1
8.	**Erosion monitoring** Consent holder to establish erosion monitoring, as prescribed in the commissioning plans.	6.2

8.1.3 RECOMMENDATIONS TO BETTER UNDERSTAND THE SIGNIFICANCE OF MONITORING DATA, PARTICULARLY CHANGES OVER TIME

#	Recommendation	Report Reference
9.	**Data summary and interpretation** Consent holder to summarise and interpret data instead of just presenting raw data. For example, data such as pipi size distribution and density would be more easily interpreted and of more use to the Regulatory Compliance team if it was summarised, rather than simply presenting raw data.	4
10.	**Consistent reporting methods** Consent holder to have consistent reporting methods. Some data (for example dissolved oxygen) was reported differently in the 2019-20 annual report vs the 2020-21 report which makes it difficult to compare.	4
11.	**Include statistical analysis (if possible)** Consent holder to present, if possible, statistical analysis of the significance of any changes seen. *It is acknowledged that monitoring is in its early stages and there are only a few data points in some of the datasets.*	4
12.	**Kaituna River diversion flows and volumes** Consent holder to undertake a measurement of volume through the gates at mean tide mean flow to confirm diversion volumes. *Note: that the flow can be artificially adjusted by the Okere Gates to achieve mean flow to match a neap tide timing.* Consent holder to also consider developing an algorithm to estimate flows through the gates based on this measurement and the three key sites that are primary controls of diversion volumes over a tide cycle. The sites are Moturiki Tide level, Kaituna at Te Matai flow and Fords Cut downstream of the gates.	6.3.4
13.	**Review data collection criteria** Consent authority to review data collection criteria and requirement (or not) to undertake additional monitoring surveys to validate ebb tide predicted volumes from the model.	6.3.2

8.1.4 RECOMMENDATIONS TO IMPROVE THE GENERAL STRUCTURE, FORM AND CONTENT OF ANNUAL REPORTS

#	Recommendation	Report Reference
14.	**Revise the method and structure of annual reporting.** Consent holder to review and revise the method and structure of annual reporting. This improves clarity and readability. For example: • Structure the reports as per Condition 29 (a)-(g). • Where an annual report matter is not included, outline why. • Provide more information and detail regarding involvement of tāngata whenua within the annual report. • If applicable, include feedback or recommendations from tangata whenua outside of annual meetings as well as reasons when recommendations are not adopted. • If applicable, include notable activities or events over the year. • Ensure that results are better linked to expected effects for these reports to be meaningful and for the consenting authority to understand the actual effects of the project. *Annual reports should be structured in such a way that they not only meet the condition but also directly address how the results compare with the expected effects. This would simplify the report for the compliance officer and technical reviewers responsible for approving them, to understand what the monitoring is showing and whether they need to do anything as a result. Standardising the structure for each annual report may be beneficial to readily identify changes year on year and ensure easier comparison with previous reports.*	3, 5
15.	**Reporting of erosion monitoring and repairs** Consent holder to include a summary of erosion repairs undertaken.	6.2

8.1.5 RECOMMENDATION RELATING TO TĀNGATA WHENUA COLLABORATION

#	Recommendation	Report Reference
16.	**Tāngata Whenua Collaboration Plans** Consent holder to work with tāngata whenua to review their collaboration plans. This is to ensure that they are up-to-date and working effectively for tāngata whenua, particularly from an implementation point of view.	5.2

Appendix 1: Key Consent Conditions

The following are key consent conditions that are referenced within this report:

Condition	Wording
29.1 Frequency and content of reporting	The Consent Holder shall, annually from the commencement of this resource consent and, by the 1st of August each year, provide to the Regional Council a written monitoring report that: (a) Covers the previous 12 month period ending on the 31st of May; (b) Provides a copy of the results of all monitoring for: i) Monitoring results from the Mauri Monitoring Plan (condition 8B): ii) The certified Wetland Restoration Plan (condition 27); iii) Water Levels and Flows (condition 30): iv) Erosion and Bed Levels (condition 31); v) Water Quality and Shellfish (condition 32); vi) Ecology (fauna) (condition 33); vii) Ecology (flora) (condition 34); and viii) Sediment and Algae (condition 35). (c) Provides an analysis and interpretation of those results prescribed by condition 29.1(b) of this resource consent; (d) Identify and prescribe the proposed measures and responses to issues identified following an analysis of monitoring results; (e) Identify the means of measuring the effectiveness of proposed measures and responses under 29.1(d) including any necessary amendments to the Environmental Monitoring Programme; and (f) Identify instances where the Consent Holder has provided opportunities for Tangata Whenua involvement under condition 28.2(i) and Condition 8A. (g) Identifies any recommendations made by any of the Tangata Whenua groups under condition 8B.7 and, where the recommendations have not been adopted by the consent holder, the reasons for not adopting those recommendations.
29A Peer Review	29A.1 The Consent Holder shall appoint an independent peer review panel following consultation with the Regional Council and Tangata Whenua. 29A.2 The peer review panel must comprise three independent experts each suitably qualified and experienced in at least one of ecological, cultural or hydrological, engineering or coastal matters of relevance to the Project, except that there must at all times be an expert in cultural matters. 29A.3 The Consent Holder must submit the annual report as well as all preceding annual reports submitted in accordance with Condition 29 to the independent peer review panel for review. (a) On the 1st August of the year following Stage 1 commissioning; and (b) (b) Once every five years thereafter for the duration of the consent. 29A.4 The role of the peer review panel is to provide for an integrated and independent review of the technical and cultural aspects of the annual reports and make recommendations to the Consent Holder on measures to address any identified adverse effects attributable to the Project.

Condition	Wording
	29A.5 The peer review panel must provide a draft written report to the Consent Holder within 2 months of receiving the annual reports under condition 29A.3, including any recommendations as it considers appropriate. The final written report must be submitted to the Consent Holder, the Regional Council and Tangata Whenua within 3 months of receiving the annual reports under condition 29A.3. 29A.6 The peer review panel may consult directly with the Consent Holder and Tangata Whenua if necessary in order to fulfil its role under Condition 29A.4. 29A.5 The peer review panel may make recommendations to the Consent Authority that a review of conditions be undertaken for the purpose of avoiding, remedying or mitigating adverse effects attributable to the Project.

Appendix 2 Information provided to the peer review panel

This peer review is guided by documents provided by, and correspondence with, the consent holder (Bay of Plenty Regional Council).

TECHNICAL REPORTS

Annual reports	For 2017, 2018, 2019, 2020 and a draft annual report for 2021.
Application documents, technical reports, and decisions	2015 Decision report. 2017 Resource Consent 67958 (20 consents, 67 pages). Hamill KD 2014. Kaituna River Re-diversion project: Ōngātoro/Maketū estuary condition and potential ecological effects. Report prepared for Bay of Plenty Regional Council. River Lake Ltd, Whakatane. MacGibbon 2014. Kaituna River Re-diversion & Ōngātoro/Maketu Estuary Enhancement Project. Terrestrial, avian and wetland restoration ecology. Assessment of Environmental Effects. Ōpus International Consultants Ltd, Hamilton. 73pp. DHI 2014. Kaituna River Re-diversion and Ōngātoro/Maketū Estuary Enhancement Project. Numerical Modelling. Prepared for bay of Plenty Regional Council. DHI Water and Environment Ltd, Auckland.
Complaints	Record of complaint received in November 2019 regarding water flows.
Cross section data	Maketu erosion monitoring survey April 2019, May 2019, June 2020, March 2021 and April 2021. Ford's erosion monitoring survey June 2020. Lower Kaituna River cross sections. Maketu Spit monitoring data July 2019 and June 2020.

Cultural information	2014 Cultural impact assessments for (1) Ngati Rangiwewehi (2) Ngati Whakaue ki Maketu (3) Tapuika and (4) Waitaha, Ngati Makino, Ngati Pikiao and Ngati Tunohopu. 2018 Tangata Whenua Collaborative Plans and Mauri Monitoring Plans for (1) Te Toko Whitu and (2) Ngati Pikiao. 2018 Mauri Monitoring Baseline Report. Meeting records of project hui with tangata whenua on 28 February 2019, 30 January 2020, 21 July 2020 and 28 July 2021.
Inspections	Inspection reports and photos between August 2019 and October 2021.
Navigation	2015 Effects of Kaituna Re-diversion on boating in the form of a (1) Memo and (2) FAQ Information sheet.
Other	2021 Stage 2 Commissioning Report. 2021 Lower Kaituna River Tidal Flow Survey memo 2021 Ebb tide volume consent condition compliance memo. Park S 2020. Maketu Estuary benthic ecology monitoring 2020. BOPRC Memorandum to Pim de Monchy. Bay of Plenty Regional Council. Park S 2021. Maketu Estuary Consent 67958 Compliance Water quality and Ecology. BOPRC Memorandum to Pim de Monchy. Bay of Plenty Regional Council. Objective ID – A3804018.
Wetland vegetation monitoring	2020 Vegetation Monitoring Plan for Ford Island. 2019 Restoration Plan for Te Pa Ika. 2018 and 2019 Vegetation Monitoring Reports for Te Pa Ika.

Correspondence

There was also email correspondence between the peer review panel and consent holder in relation to the following:

- Complaints register
- Asset Management Plans
- Operations and Maintenance Manual
- Monitoring of the mooring basin
- Copies of the Water Levels and flows
- Monitoring contained in the Commissioning Plan
- Documentation of maintenance and repairs
- Analysis of aerial photography
- DHI memo regarding validation of ebb tide volumes for consent compliance
- EDS Fords Cut Tidal Gauging memo