Tukituki Water Security Limited Re-scoping Report

November 2021

LEWIS TUCKER & CO.
UNLOCKING ENTERPRISE VALUE

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Structure of the report

For ease of reading and assimilation, this report has been structured as follows:

1. Executive summary:
    - A summary of the work undertaken, and key insights obtained.
    - A summary of the key issues or questions that need to be resolved, and
    - Recommendations and next steps.
2. Detailed section reports covering:
    - Te Mana o te Wai.
    - A desire to partner with Mana Whenua and to agree catchment priorities.
    - Assessment of water security options in the context of Te Mana o te Wai (as defined by Mana Whenua) and the basis of economic viability.
    - Water supply and hydrological reliability.
    - Assessment of the viability of the preferred option.
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    - Water demand and land use change in the Tukituki catchment.
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Executive Summary

Having considered the water security alternatives in the Tukituki and Southern Heretaunga catchments, Te Mana o te Wai priorities, and the compelling benefits of reliable water to the wider community in the face of climate change, TWSL is of the view that catchment-scale storage at the Makaroro site is the preferred alternative to meet the objectives of the project.

Executive summary

The purpose of this report is to assess the alternatives for water security within the Tukituki Catchment in the context of Te Mana o te Wai ("**The Project**"). The Project scope explicitly prioritises Te Mana o te Wai ("**TMotW**"), environmental remediation in the face of climate change, community needs and then those of commercial water users, in that order.

Each option assessed was considered against its suitability with respect to its physical accessibility, geotechnical factors, engineering feasibility, regulatory compliance and economic viability.

This report analyses seven alternatives:

1. Farm scale storage infrastructure;
2. Small or medium scale storage infrastructure;
3. Small scale storage scheme on the Makaroro River;
4. Accessing 'Tranche 2' groundwater;
5. Managed aquifer recharge;
6. Reallocating current water takes; and a
7. Catchment-scale storage scheme on the Makaroro River.

In addition, the counterfactual or 'do nothing' alternative is considered. It should be noted not all alternatives were considered viable. In the absence of a meaningful intervention, the outlook for the Tukituki Catchment, its health, and for the resilience and wellbeing of the communities it supports is considered bleak by TWSL.

These alternatives were considered in the context of the current Tukituki Catchment surface water and groundwater allocations, both of which is mostly allocated and/or extremely difficult to access. By contrast, there is a large tranche of available water under the existing portfolio of consents developed to enable the proposed Ruataniwha Water Storage Scheme ("**RWSS**"). These consents remain viable.

The analysis of these alternatives, together with the stated merits and shortcomings of each alternative outlined in this report draws on multiple, publicly available water security assessments, the first of which was completed by Hawkes Bay Regional Council ("**HBRC**") in 2009. The conclusions reached required validation of the intellectual property held by Water Holdings Limited ("**WHL**") by subject matter experts familiar with the unique features of the Tukituki and Southern Heretaunga catchments.

Executive summary

The Makaroro Storage Scheme (MSS) is the most compelling alternative based on the key evaluation criteria.

However, the ability to capture the benefits of the MSS is time bound.

Lewis Tucker believes the Makaroro Storage Scheme ("**MSS**") is the most compelling alternative based on the following conclusions:

- **It gives effect to Te Mana o te Wai:** The hierarchy of water use under TMotW is clear, its application creates a platform for a genuine and transformative partnership between Iwi and the wider community.
- **Tangata whenua:** Oral history credits taniwha within the Ruataniwha Plains as creating the Waipawa and Tukituki tributaries by draining a lake that was once there. Creation of a lake on Makaroro River is not new, it will enable waters from the Makaroro River to assist in the restoration of other water ways throughout the catchment, namely the Waipawa, Tukituki tributaries, Tukituki Main-stem, and Lake Whatumā/Papanui. In doing so, it enhances mauri and mana.
- **The ability to limit climate change impacts:** Understanding the impacts of climate change is becoming better understood by the community, as are the requirements to address it. Of equal importance, the impacts of climate change are taking place now.
- **Confidence in the hydrology continues to improve:** The reliability of the hydrological records supporting key assumptions behind the MSS's viability have improved materially since the assessment of the RWSS. The MSS today, is more compelling hydrologically than the proposed RWSS.
- **Land use trends require enhanced water security:** The trend to higher value, more environmentally sustainable land uses has accelerated within the Tukituki Catchment in recent years. However, future access to reliable water is a major constraint to this continuing, and by default, a constraint on a higher regional GDP growth trajectory.
- **Demand drivers are highly likely to support the MSS:** In Lewis Tucker's opinion, the combination of the factors above materially reduce the 'demand risk' required to support the MSS, a significant factor determining the viability of the RWSS business case.
- **The compelling economics:** The proposed MSS provides a significantly lower cost per unit of distributable water (m^3), further, MSS's scale underwrites long-term water security for the whole catchment *c.f.* short term localised solutions.
- **Doing nothing is not an attractive alternative:** The counterfactual ('doing nothing') is arguably denying opportunities to restore culturally and environmentally significant bodies of water in the Tukituki and Southern Heretaunga catchments at a time when climate change is degrading water availability. Given this opportunity, choosing not to do anything is arguably socially irresponsible.

Background

This study was commissioned by a community sponsor group comprising Tangata Whenua and Community Leaders from Central Hawkes Bay. The sponsor group has sought to clarify the viable options available for providing long-term water security within the Tukituki Catchment in the context of TMotW (referred thereafter as the "**Tutkituki Water Security Project**", or "**TWSL**").

The two key drivers for the Tukituki Water Security Initiative are:

1. giving effect to Te Mana o te Wai as defined by Mana Whenua; and

2. increasing Community resilience in the face of climate change.

The primacy of TMotW has been written into the National Policy Statement for Freshwater ("**NPSFM**") and whilst it requires local interpretation, it recognises that Mana Whenua have responsibilities to waterways, which lie at the heart of their identity and culture. Mana Whenua have defined this with regards to the Tukituki specifically and their long and enduring relationship with the river and its personality, which lies at the heart of their identity and culture. In so saying, Mana Whenua will recognise and provide for the neighbouring collective of waterways, in particular the Makaroro and the Waipawa Rivers. Their values are core to the definition of water security for the Tukituki Catchment.

Over the duration of human settlement, specifically since European settlement, modification of the Tukituki Catchment has been significant. Water ways have been diverted and wetlands reduced. The former channel of the Waipawa River was diverted into its current confluence from the Tukituki River, and similarly, the flood water flows into Lake Whatumā from the Tukituki River. More recently, increased abstraction of water in low flow periods has reduced main-stem flows in dry periods whilst human induced climate change has exacerbated the adverse impacts. In extreme years irrigation bans based on minimum flows do not afford the river ecology significant protection. In the context of Te Mana o te Wai these issues have collectively trampled on both the mana and mauri of the river and in turn, impacted on the spiritual and physical well being of Mana Whenua.

In 2018 the Heretaunga Tamatea Claims Settlement Act was passed. The Crown offered its profound apology to Mana Whenua, providing redress for acknowledged grievances with the Crown. Mana Whenua are now better positioned to uphold their responsibilities through being an equal partner in freshwater initiatives in the Tukituki Catchment and elsewhere in Hawkes Bay. This TWSL scoping process seeks to articulate how that partnership can be given effect to any enduring water security initiative.

Over the past decade the Tukituki River has suffered from three severe droughts in the 2012/13, 2019/20 and 2020/21 years respectively. In the 2019/20 year in particular, the drought had a major impact on freshwater ecology with multiple small streams drying up and the main-stem flowing well below the regulatory minimum flow for an extended period (~3 months). This is despite the implementation of Plan Change 6 and its flow management regime which included irrigation bans.

The latest report from the Intergovernmental Panel for Climate Change forecasts that global temperatures will increase by 1.5 degrees Celsius by 2040 and that the increased incidence of severe climate issues such as droughts and storms will continue for at least the next 30 years, irrespective of emission reductions. The climate change prognosis for the East Coast North Island is one of rapid drying and heating, the increased incidence of droughts is considered evidence of its arrival.

Water use priorities

In the context of TMotW and climate change, the TWSL sponsor group has nominated the following priorities:

1. Maintaining actual flows in the Tukituki River main-stem to Red Bridge at the minimum flow threshold, as measured by the requirement of the most extreme drought year during the 53-year period during which river levels have been recorded. This was the 2019/20 summer.
2. Providing water for restoration flows to Lake Whatumā and the Papanui stream (noting that this is not an exclusive list).
3. Improving water quality in a complementary manner to Plan Change 6.
4. Following the above preconditions being met, providing water for consumptive purposes throughout the catchment. This would include the former RWSS distribution zones together with the Southern Heretaunga Plains.

'As articulated by the TWSL Steering Group Chair, Mr Mike Petersen, in forming its recommendations, the TWSL Project has prioritised TMotW, environmental remediation in the face of climate change, and community needs before those of commercial water users'

Current water allocation

Water allocation in the Tukituki

Surface water and groundwater in the Tukituki Catchment is fully allocated except for Tranche 2 groundwater and some high flow water in the main-stem Tukituki corridor. By contrast, there is a large tranche of available water under the existing portfolio of consents developed to enable the proposed RWSS. These consents remain viable, but the opportunity is time bound.

Access to alternative sources of water other than that from the consented dam on the Makaroro River is very limited, hard to access and expensive to secure.

Tukituki - Basic allocation statistics

Source allocation	Estimated consumption	Availability for use
Tranche 1 Groundwater 28 Mm^3	Of this ~23 Mm^3 (82%) abstracted in 19/20 year for some takes inability to pump more water thereafter some stream depleting takes connected to minimum flows	Fully allocated
Tranche 2 Groundwater 15 Mm^3	None	10 Mm^3 subject to offsets unproven. Consent applicants have applied for the full volume but are not as yet processed or given
Surface water 17.4 **Mm^3**	~16 Mm^3 (91%) in peak year with minimum flow restrictions	Fully allocated
High flow surface water, 10 Mm^3 in 3 zones (Note: If allocation is taken 150 days every year then the allocation no. is 26 Mm^3 but the take rate unreliable.	~7.6 Mm^3 consented but not all consents currently exercised	Remaining allocation available but only in the Tukituki main-stem corridor zone. Above the main-stem is fully allocated
Makaroro site 104 Mm^3 @ 97% reliability	None	Only available through the MSS

Table 1: Current water allocation

Summary of available, alternative water sources

Alternatives	Following Te Mana o te Wai	Climate Change reliability	Physical Constraints	Regulatory constraints	Multiple benefits (catchment scale)	Economic Per m³ of water	Integrating with another solution
Farm Scale storage	No benefit	Localised benefit	Limited sites	Limited allocation	Single purpose	Med/High cost	N/A
Small/medium scale storage	Limited benefits	Declining reliability	No suitable sites	Allocation	Limited benefits	Uncertain	Uncertain
Small scale storage on the Makaroro	Partial benefits to minimum flow	High reliability but for environmental flows only	none	none	Single purpose environmental	High cost and one source of finance	No clear benefit
Accessing "Tranche 2" Groundwater	No benefit	Localised benefit – reliability uncertain	Limited suitable sites	Limited source No Stream flow offsets unproven	Single purpose economic	Likely high given cost of stream flow offset	Integrates with large scale storage
Managed aquifer recharge	Localised benefits	Localised benefits	Limited suitable sites	Very limited water allocation available	Some benefits	Uncertain	Integrates with large scale storage
Reallocating current water takes	Possible environmental benefit	Winners and losers	N/A	Very significant	Limited in scale	Extremely high	In principle some opportunities with Makaroro storage
Catchment-Scale storage (Makaroro)	Minimum flows and restoration flows	Reliability for storage site and range of uses	none	Land access critical	Multiple purpose	Very good	Makaroro storage could use MAR / Tranche 2 transfers

Table 2: Summary of water source alternatives

Table Key	Description	Table Key	Description
	Ability to deliver against the criteria		Unlikely to deliver against the criteria unless there's a remedy
	Potential to deliver against criteria		No ability to deliver against the criteria

Detailed explanations of solutions, and their ability to meet each criteria, are contained within the detailed report.

The counterfactual or 'do nothing' option

Doing nothing significantly increases the environmental and economic risks for future generations.

TWSL has a four-year window to address this issue.

Doing nothing in the context of catchment-scale storage means:

- A reliance on what is currently a set of unproven and complex water access alternatives which at best, have a localised impact on a limited number of areas within the Tukituki Catchment. By contrast, a catchment-scale storage scheme (as proposed with the MSS) represents a 'whole of catchment solution' that will also improve the effective use of tranche 2 groundwater (or managed aquifer recharge) alternatives currently under exploration by the HBRC.
- Reduced ability, if at all, to improve restoration flows within culturally and environmentally significant water ways including Lake Whatuma/Papanui and the Tukituki River main-stem.
- Increased uncertainty around access to reliable water which will result in a less resilient, and possibly more financially vulnerable rural community. Based on current climatic patterns Hawkes Bay appears to be entering its third consecutive year of extreme drought. From a resilience point of view, there is no other obvious available solution.
- A missed opportunity to develop an exemplar in future Iwi-Rural Community partnership.

Key insights:

1. *The true value of the proposed MSS will accrue to future generations …**it is a once in a generation opportunity** to implement an enduring partnership with Iwi, mitigate against the impacts of climate change on a sustainable basis and redress the current inequities in water allocations. The case for MSS is compelling…*
2. *But it will require strong, united leadership from the TWSL sponsor group, Iwi, community leaders and water users…*
3. *It is time to be bold, to act in the best interests of our children's children and beyond*

Viability of the MSS

1. Delivering against Te Mana o te Wai

The TWSL Project recommends a large-scale storage dam on the Makaroro River that provides (up to) a 20 Mm^3 environmental flow for the Tukituki main-stem in order to maintain actual minimum flows under an extreme drought scenario (most extreme year on record). Further, the MSS can provide meaningful flows of water for restoration purposes into culturally significant waterways. The MSS is a catchment scale solution from the 'Mountains to the Sea', the key variables and risks within the catchment can be managed to meet all stakeholder needs in an integrated and dynamic fashion.

With respect to the Makaroro, Waipawa and Tukituki tributaries, each of these waterways have their own personalities and mana. In creating a reservoir on the Makaroro, with the dam structure comprising materials from within the reservoir site and its immediate surrounds, the MSS can hold water in the winter and release that water in the summer thereby enabling other waterways within the catchment to re-establish their mana. Similarly, the Makaroro can provide water for community needs, the Waipawa and Tukituki tributaries and the Tukituki main-stem fulfill their role by enabling the lake water to flow to its various destinations.

2. Risks and benefits under climate change

The MSS alternative is located in a high rainfall zone adjacent to the Ruahine Range. The hydrological record indicates high reliability inflows, with the data having been further validated after the RWSS project stalled. Technical experts are of the opinion that under climate change, the MSS will benefit from increased westerly rain 'spillover'. Conversely the areas where the water will be 'applied' are likely to dry further.

3. Is the site hydrologically sound and efficient?

Building on the comments above the larger scale dam size refill reliability is sound and the cost per m^3 of water is inexpensive given the reservoir shape.

4. Is there genuine demand for water over and above the environmental needs?

The Makaroro storage alternative is capable of delivering 104 Mm^3 of water at a 97% reliability level. That level of reliability is at a high to very high standard. Assuming circa 84 Mm^3 is available for consumptive purposes, the TWSL Project Team is of the view that the demand for this water will be high, and materially greater than the business case that supported the viability of the RWSS Project. This is due to a greater awareness within the community regarding the cultural, environmental and economic value of having access to secure water, ever tightening ground and surface water allocation rules and a larger command area that can include the Southern Heretaunga Plains. Provision of water into this area should preferably compliment water security initiatives currently being explored by Hawkes Bay Regional Council ("HBRC") on the Ngaruroro. In addition, the rate of conversion to high value land uses (since 2016) to enterprises such as permanent horticulture, and high value seed production has accelerated, utilising the region's favourable growing environment despite access to secure water being less certain. This trend is directly relevant to the TWS.

Viability of the MSS

5. Is the portfolio of Consents from the former RWSS held by Water Holdings Limited ("WHL") still applicable?

The portfolio of consents held by WHL were granted for 35 years and have 4 years to run before they will lapse. They are fit for purpose with regards to the required infrastructure under the large scale Makaroro alternative. Some additional consents will be required to deliver restoration flows into the Lake Whatumā and for the additional environment flow down the Tukituki main-stem. Discharge to land consents will be required if new irrigation areas are opened in the Mangatarata and Heretaunga Plains areas. The portfolio will enable TWSL to manage obligations to make no material contribution to Dissolved Inorganic Nitrogen (DIN) loads in rivers effectively and transparently. Beyond new irrigation zones (above), more diverse land-uses and higher environmental flows reduce any residual risk further.

6. What does the change in the construction sector approach to contracting, risk allocation and pricing mean for the projects viability?

Since 2016 (the year the RWSS Project was procured and contracted) risk allocation and contractual arrangements have shifted 'un-priceable geotechnical risk' away from constructors to clients. Construction price inflation has (clearly) increased. A review was undertaken by relevant experts on these issues and the initial view is the project risks are well understood, well documented and carefully analysed and that subject to a sound capital raise and retention of key experts, the capital cost will remain within 'well defined economic bounds'.

7. Is the project affordable in both an economic and financial sense?

An initial analysis using the RWSS costings as the base information (which were highly developed) has been undertaken to consider the potential sources of capital, the likely cost of capital and the implications of risk allocation on cost capital. The view is that the Project can both attract sufficient customers and offer returns to private sector investors at a 'simplified' water price of circa $0.30 per m^3.

The water price assumes that the environmental flows (20 Mm^3) are financed via the public sector.

8. Are there sources of capital that can be rewarded sufficiently to finance the re-development and build of such a project?

Using a price of $0.30 per m^3, inflated at CPI (2%), the TWSL Project Team determined that the internal rate of return of 10%+ should be sufficient to attract capital under a variety of possible structures including commercial, cooperative, hybrid and including a mixture of equity and debt.

9. Does the Project result in positive economic gains for the region?

It is reasonable to assume the MSS will have a very positive economic impact (~$300 million GDP impact and 2,500 - 3,000 new jobs). However, when viewed through a wider regional lens (taking into account climate change) the positive impact may in part be offset in part by declining farm productivity elsewhere in Hawkes Bay.

Why is catchment-scale storage on the Makaroro the logical option?

The case for catchment-scale storage on the Makaroro remains compelling compared to any other alternatives …and in its absence, the outlook is bleak both for Te Mana o te Wai and for water security generally.

Table 1 highlights that there is very limited (if any) unallocated surface or ground water within the Tukituki catchment that can be used to meet the needs of Te Mana o te Wai, environmental remediation and the wider community needs other than what is potentially available through the construction of a catchment-scale storage dam on the Makaroro site that utilities the RWSS resource consents currently held by Water Holdings Limited. Table 2 offers a high-level overview of the benefits and constraints of potentially available water sources as drawn from the body of work undertaken by previous studies (and reviewed by the TWSL Project Team).

Cumulatively, this analysis implies there is a compelling case for TWSL to revisit (and persevere with) the catchment-scale Makaroro Dam in meeting TWS's stated objectives. It should also provide a very strong incentive to solve the conservation land access issue. The counterfactual being that in the absence of the catchment-scale storage, the prospects for environmental remediation and meeting community water security needs will become increasingly bleak in the face of climate change.

This report has examined the following set of key questions and considerations in more detail to establish viability of the Makaroro Storage Scheme option:

1. Can it meet the local requirements of te Mana o te Wai?
2. Is there genuine demand for water over and above the environmental needs?
3. Is the storage hydrologically sound including consideration of the risks and benefits under climate change?
4. Is the portfolio of resource consents held by Water Holdings Limited still applicable?
5. What does a change in the construction procurement environment, including risk allocation and pricing mean for the project's viability?
6. Having regard to the revised capital costs and water demand forecasts, is the Project affordable in both an economic and financial sense?
7. Can capital providers be rewarded sufficiently to finance the re-development and build of such a project?
8. What issues need to be resolved in what sequence and what are the associated risks to project execution?
9. Does the Project result in positive economic gains for the region?

The answers to these questions are explored in the following pages.

Ehara i muri nei
Nō te Kore
Me tīmata i reira

Te Mana o te Wai

This is not new
It starts way back
At the beginning of time

Definition of Te Mana o te Wai (TMoTW)

Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment and the community:

- It is a fundamental concept in Te Ao Maori (Maori Worldview);
- All things are connected by Whakapapa and imbued with mauri, a life essence;
- From mauri comes mana; and
- Actions of people/tangata can diminish the mauri and therefore the mana of a resource.

Source: Water Commissioners Workshop March 2021 (Annette Sykes, Kahui Wai Maori)

Hierarchy of use under Te Mana o te Wai

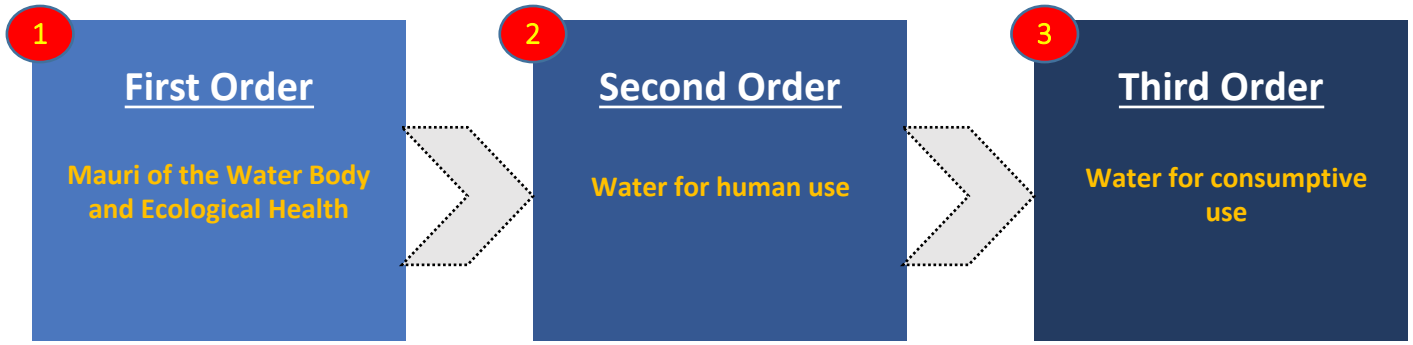

Figure 1: Hierarchy of use under Te Mana o te Wai

For more detail, please refer to Appendix 6.0_Te Mana o te Wai which provides a definition of Te Mana o te Wai prioritised by the National Policy Statement on Freshwater Management 2020.

Te Mana o te Wai

Mana whenua are best placed to define te mana o te Wai within their rohe. Furthermore, any future freshwater initiatives will need to involve genuine partnerships- this should be seen as a development.

The settlement of the historical Treaty claims in 2018 marked a significant milestone in the Crown-Iwi relationships of Heretaunga Tamatea. Alongside is the National Policy Statement for Freshwater Management 2020 requirement to give effect to Te Mana o te Wai in the management of freshwater. A recognition of the birthright or whakapapa responsibilities of Mana Whenua in terms of kaitiakitanga and the integrity of Matauranga Māori, it heralds a maturity within the tribal rohe of Heretaunga Tamatea toward the restoration and management of the health and well-being of waterways and freshwater ecosystems. It also foreshadows invariable strategic alliances with Mana Whenua that are sourced in Te Tiriti Waitangi and informed by the mauri and the emerging values within the waterways.

Mana Whenua have a strong interest in freshwater initiatives in the Tukituki Catchment and elsewhere in Hawkes Bay. The TWSL scoping process has a desire to form a partnership with Mana Whenua, both enduring and with integrity, in any water security initiative.

To succeed, any Partnership must be fundamental and central to the emerging relationship and concrete at all levels of the Project. The Partnership would exude co-design, with co-governance and co-management frameworks that encourage active participation as well as resonating mutual respect and reciprocity for each other's rights and interests and their centrality to freshwater management. The partners would make joint decisions.

Specifically, there may be aspects of the MSS where Mana Whenua could play a lead role, i.e. determining:

- and/or assessing where the MSS impacts on Te Mana o te Wai;
- the relationship of hapū, and their tikanga and traditions, with all water bodies and associated ancestral lands, sites, wāhi tapu, and other taonga and how this might be restored and protected;
- The nature of the authority and responsibility of each iwi and hapū to protect and sustain the health and well-being of the water body and how to recognise and provide for this;
- How to recognise and provide for the application, in relation to water bodies of kawa, tikanga (including kaitiakitanga), and mātauranga Māori; and
- appropriate mechanisms for effective participation by iwi and hapū in the TWSL.

Te Mana o te Wai

TWSL proposes that Mana Whenua and their representative entity (in partnership with WHL) would jointly hold in partnership and in Trust the Intellectual Property developed for the former RWSS and make this IP available for application in the Tukituki Water Security Initiative. In so doing the partners would maintain a long-term and enduring role in ensuring the IP is used for the benefit of both the environment and the wider community.

Consistent with providing Mana Whenua the lead role vis a vis TMOTW they should (though Ruataniwha Tauwhiro Taitaiao Trust or similar) have first right to lead and undertake work required under the consents for environmental remediation and enhancement.

Where the MSS supports community water security including for consumptive uses Mana Whenua could choose a partnership role through potential investment (subject to commercial criteria) and participation in the socio-economic benefits arising.

Depending on what TWSL is ultimately able to progress with respect to infrastructure development in support of water security, Mana Whenua should retain the same level of rights and commitments as expressed in the agreement originally negotiated between Hawkes Bay Regional Investment Company Ltd and the Tamatea Taiwhenua.

Potential mana enhancing initiatives under the MSS

- Enhancing of summer low flows through the Tukituki mainstem that are not fully protected by regulatory instruments.
- Assisting the restoration of Lake Whatumā by providing a constant flow of freshwater through the lake in summer periods. Historically this was a critical source of mahinga kai for Tamatea and currently a sanctuary for indigenous fauna. Whatuma is one of the very few substantial wetlands remaining in the Tamatea rohe and Hawkes Bay more generally. (Note water will in turn flow out of Whatuma to the more degraded Mangatarata stream in the Tukituki catchment).
- Restoration of the Papanui stream through provision of enhanced flows through summer period. The Papanui stream was once the main course of the Waipawa but diverted early in European settlement. Enhanced flows of up to 1.3 Mm^3 will transform this water way.
- Provision of increased mainstem flushing flows enable flow variability and removal of excess algae in the Tukituki main stem.
- Provision of a source of water supply for Marae along the river including Te Tapairu, Mataweka and Te Whatuiāpiti. As part of the consent conditions, and as a commitment to the conservation estate in the Makaroro head waters, undertake a 35-year biodiversity enhancement and predator management project across 2,500 ha of the Ruahine Forest Park.
- Rebalancing inequities as there is no source of water given the current allocation status for Iwi development other than creating storage.
- Ensure the farms irrigating from MSS meet the highest standards of land management such that nutrient and sediment losses to water ways are minimised and/or avoided.
- Maintain a state-of-the-art environmental effects monitoring and management system for key ecosystem health values e.g., understand and action on beneficial and or adverse effects to macro invertebrate populations.

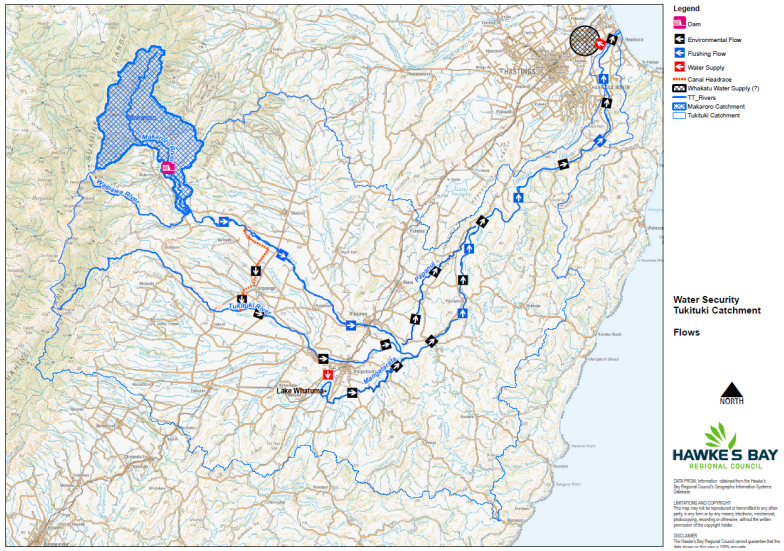

Figure 2: Map of river flows

The MSS due to its scale is uniquely positioned to deliver on transformative improvements in water ways that are culturally of major significance to Mana Whenua throughout the Tukituki Catchment.

Mana Whenua

- In the Crown Apology to Heretaunga Tamatea, recorded at section 10(g) of the Heretaunga Claims Settlement Act 2018, the Crown said:
    - The Crown offers its profound apologies for its actions that alienated hapū from the whenua that had sustained…ancestors for generations, and deprived hapū of access to …lakes, rivers, wetlands and springs." and
    - "The Crown looks forward to restoring a relationship with the hapū of Heretaunga Tamatea that is built on trust, co-operation, and respect for each other and the Treaty of Waitangi and its principles."
- Te Rohe of Heretaunga Tamatea comprises 607k hectares of land extending from the Tūtaekurī River in the north, following the ridge of the Ruahine Range to Takapau, then seawards to Pōrangahau.
- The rohe contains five primary river systems, which comprise an alluvial plains system fueled by the Heretaunga and Ruataniwha aquifers.
- The Tukituki and Waipawa are two of the primary river systems and are both taonga to the hapū of Tamatea and Heretaunga, as set out in the Crown acknowledgment in the Heretaunga Tamatea Claims Settlement Act acknowledging:
    - The lakes, rivers, springs and wetlands of Heretaunga Tamatea, such as ….Whatumā, …Tukituki, Waipawa, Mākāretu and Porangahua/Tāurekaitai rivers…are central to the well-being of the hapū of Heretaunga Tamatea.
    - 43 hapū are represented through 23 marae spread throughout the rohe of Heretaunga Tamatea, 9 within Tamatea/Central Hawke's Bay.

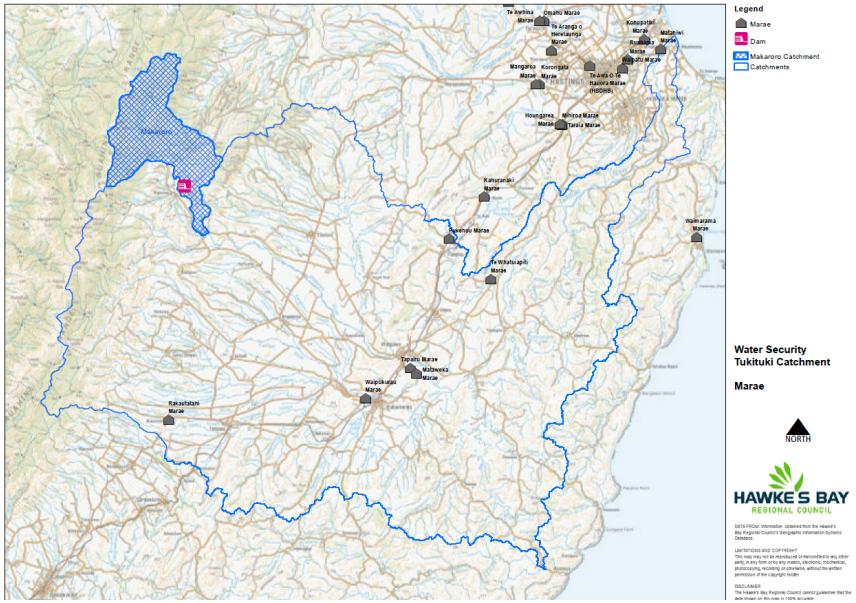

Figure 3: Map of surrounding Marae

Issues in the Tukituki that compromise Te Mana o te Wai

There is a very significant body of knowledge available describing the issues afflicting water ways within the Tukituki. Progressing with the MSS offers a once in multigenerational opportunity to address these issues directly.

Issues in the Tukituki that compromise TMOTW include:

- Compromised flows and high water temperatures in both the main-stem and small streams in times of low flows and severe drought;
- Compromised flows in the Papanui stream, formerly the Waipawa;
- Compromised flows in Lake Whatuma a Taonga of Tamatea and one of Hawke Bay's few remaining wetlands;
- The incidence of poor water quality and excess algae and periphyton at low flow periods in the lower part of the Tukituki main-stem in particular;
- Poor ecosystem health indicators (macro invertebrate index) in streams including the Papanui and the Mangatarata; and
- The increasing rate and scale of Climate Change and its impacts.

Definition, principles and specific commitments

Mana Whenua are an essential partner for any redevelopment process to ensure the values and principles of the scheme are upheld.

In 2018 the Heretaunga Tamatea Claims Settlement Act was passed. Mana Whenua are now better positioned to uphold their responsibilities through being a partner in freshwater initiatives in the Tukituki Catchment and elsewhere in Hawkes Bay. The TWSL scoping process seeks to articulate how a partnership approach could give effect to any enduring water security initiative.

- TWSL has a preference to partner with Mana Whenua and ensure they participate actively in all aspects of the Tukituki Water Security project. Specifically, where aspects of the MSS impact on Te Mana o te Wai Mana Whenua should play a (the) lead role.
- Where the MSS supports community water security including for consumptive uses, Mana Whenua could invest (subject to commercial criteria) and participate in the socio-economic benefits arising.
- Mana Whenua and their representative entity could form a partnership with Water Holdings Ltd to jointly hold in partnership and in Trust the Intellectual property developed for the former Ruataniwha Water Storage Scheme, and commit to make this IP available for application in the Tukituki Water Security Initiative. In so doing TWSL has concluded that this would provide a long-term and enduring role in ensuring the IP is used to the benefit of both the environment and the wider community.
- Consistent with Mana Whenua's lead role vis a vis TMOTW they should (though Ruataniwha Tauwhiro Taitaiao Trust or similar) have first right to lead and undertake work on the work required under the consents for environmental remediation and enhancement.
- Depending on what TWSL is ultimately able to progress with respect to infrastructure development in support of water security, Mana Whenua would retain the same level of rights and commitments as expressed in the agreement originally negotiated between HBRIC Ltd and the Tamatea Taiwhenua.

Water Demand and Land-use in the Tukituki Catchment

Demand has almost certainly increased over the last 3 to 5 years in light of climate change

Key insights

Demand appetite has almost certainly increased more than it was in mid 2016

Key factors informing this view include:

- The incidence of two very severe droughts and an extremely dry winter in 2021 coupled with a greater understanding of the value of water and climate change impacts on agricultural and horticultural enterprises.
- The emergence of more diverse supply locations coupled with potentially a broader range of land uses enterprises and customers
- The complexity involved in accessing alternative sources of water (high flow and 'Tranche 2 groundwater) for much of the catchment there is no ability to access these sources of water.
- The more advanced state of regulatory water access limits a sinking lid in the Heretaunga plains versus mid-2016
- The increased understanding of the value of irrigation, in large partly driven by the education and contracting process initiated and delivered through RWSS development journey
- The continued increase in land values and improvement in landowner balance sheets, and
- The materially cheaper cost of money, however this trend may in part be countered by lenders reduced risk appetite in some areas of agribusiness lending.

It should be noted that this assessment is reliant on learnings from the RWSS and on a mix of judgement and sentiment albeit from well informed parties, from the agricultural and horticultural sectors.

Any redevelopment process should consider what is a minimum level of water contracted and likely target a materially higher threshold than that which was required by the RWSS.

Further, given the potential demand in the Heretaunga plains, there should be consideration of how the MSS might complement the Ngaruroro being investigated by HBRC.

Methodology

Scope

Key Questions:

- RWSS baseline and water uptake forecast
- What is the counterfactual?
- Is the demand still there?
- What is the potential in a "Southern Heretaunga Tukituki Corridor zone"?
- Is there a view on "optimal use of water" and/or is there a clear trend in land-use change?
- Will the MSS materially improve the environment, assuming a 20 Mm^3 environmental flow ? Will this assist with demand sentiment?
- What is the place of re-gen Ag?
- What is the perceived likelihood of dairy expansion?
- What is the preferred ownership structure?

Approach

The following steps were undertaken:

- Review RWSS & 2017 RWSS review contractual and demand material
- Engaged RWSS team members to provide a view
- Workshopped the questions with members of the former RWSS Farmer reference group and HB based other ag/hort experts
- Met with Local Authority staff to ascertain their views on the need for additional public and industrial water
- Updated key findings and variation post RWSS

Findings

Key findings detailed in the report as a set of key questions and answers

Contracted water demand baseline mid 2016

In 2016 192 Farm Enterprises signed 35 year take or pay agreements to access secure water.

Water use was primarily for pastoral use but also included municipal supplies for local towns and industrial and commercial use. While initially there was a thought from MacFarlane Rural Business that Dairy would be a significant water user it only made up 11% of the properties and 22% of the contracted water volume of the contracted water at the time.

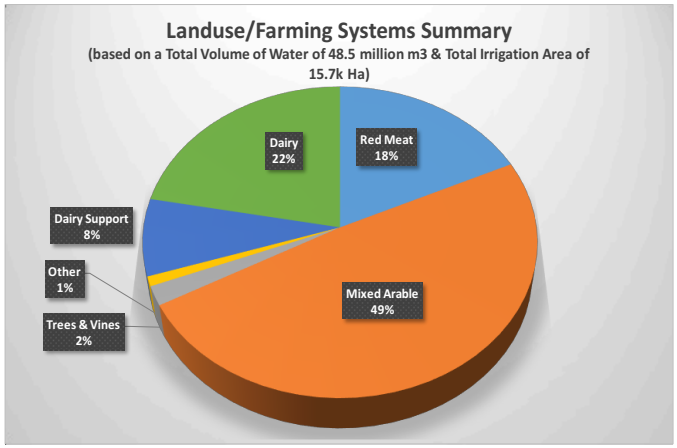

Figure 4: Land use and Farming Systems summary

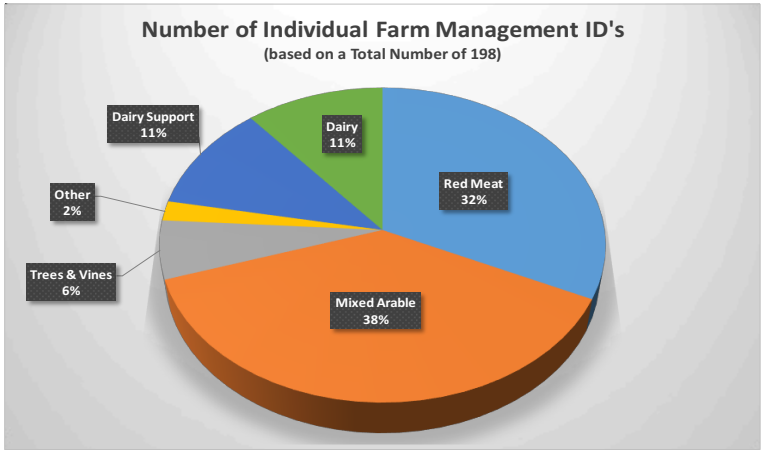

Figure 5: Number of Individual farms

Some compelling reasons identified driving this water demand were:

- The historical extended summer dry climate and its implications for communities on the east coast;
- Future uncertainty due to climate change;
- The known requirement for increased minimum flows being set which would adversely impact reliability for surface water irrigators;
- The known requirement to set seasonal volume limits on ground water consent holders;
- Fragmented access to groundwater across the Tukituki catchment i.e., not physically under all properties; and
- The potential to store high flow water to augment summer flows to sustain the environment and community.

Questions and responses

Questions	Responses
1. What does the counterfactual scenario (no water security) look like considering climate change?	• Access to ground water and surface takes will be progressively restricted as climate change takes place. • Farmers have not historically taken climate change seriously, but this is changing with two consecutive droughts (2019/20 and 2020/21), and possibly a third 2021/22. • No ability to secure new consents on both the Heretaunga Plains as well as Tukituki Catchment (Proposed Plan Change 9 for TANK Catchments), some consent holders have had water taken away in those areas and it is classified as stream depleting. There is a sinking lid in water allocation in the Heretaunga Plains. • In the absence of other water supplies environmental values may also deteriorate. • The 'do-nothing' scenario is not considered a viable option. • Whilst other catchment areas have dedicated strategies (HBRC), the Tukituki does not. This is considered inappropriate given external factors.
2. What is the current water use for Tukituki as a whole?	• The RWSS estimated that there was approximately 7,000 ha irrigated in the Tukituki catchment including lower stem. Since then there will have been some reduction of this area post Plan Change 6. Actual statistics would be reconfirmed in project redevelopment process.
3. How has demand changed since 2016? (Determined by price and escalator), contracting terms, water reliability and ability to use the water i.e., any environmental constraints).	• The strongly held view is that demand remains in place and is likely to be greater given the recent droughts. Demand may also be more concentrated. • Overall, the understanding of the value of water has increased appreciably since the commencement of the RWSS. • Some commentary that urban communities understanding is shifting also (anecdotal). • Some horticultural developments are requiring more water and are prepared to pay a very significant price. • Some horticultural crops require less water but greater reliability and flow.

Questions and responses

Questions	Responses
4. What's the potential in a "Southern Heretaunga Tukituki Corridor zone"	• There is a strong view that there will be an expanded demand in the Heretaunga for water. Both from horticultural and industrial customers. ~6,000 ha of irrigable land is currently unirrigated in addition to the demand associated with the 'sinking lid'. • Not all irrigable land would be accessible for MSS water but may be from a potential Ngaruroro storage. • With the likely implementation of Plan Change 7 and a reduction of access to water, future industrial expansion within the Whakatu Industrial Zone is at risk. The MSS would be a logical source of water for any expansion.
5. Is there a view on "optimal use of water" and/or is there a clear trend in land-use change?	• There is a common view that there will be a trend to higher value horticultural and/or arable use. This is reinforced by the emergence of high value land uses in the area including fine seed production and permanent horticulture as forecast by the RWSS. • Taking that view into account it is noted that there is a proportion of the demand will be driven by that land-use change.
6. Will the MSS improve the environment, assuming 20 Mm^3? Will this assist with demand sentiment?	• There are multiple areas through which the ~20 m^3 can help the environment such as Whatuma/Mangatarata/Papanui. Mana Whenua should help direct where this water is allocated. • Based on the flow variation across hydrological years (53 year record), there could be a very significant volume of water available for irrigation beyond water environmental minimum flows.

7. HBRC has set up a Future Farming Trust: what are the implications of their work on dryland options and regen ag and in turn demand sentiment for irrigated Ag/Hort?	• Regenerative agriculture described by some parties as a philosophy not tightly defined but rather works by a set of principles. Key principles include:
	  • Do not disturb the soil
	  • Keep the soil covered and living roots in the soil
	  • Grow a diverse range of crops or edible species
	  • Reduce grazing animals to increase production per head
	• General view is that Regen Ag does not mean that materially less water is required.
	• ReGen Ag should be seen as an and:and in the context of the MSS i.e., that increased use of the principles is complementary with the need for access to secure water.

Questions and responses

Questions	Responses
8. What is the perceived impact of dairy expansion?	• This is considered highly unlikely to happen, given headwinds e.g., Plan Change 6 constraints in the impending methane emissions tax, however the current high dairy pay-out was the subject of some conjecture. Some held the view that the MSS should explicitly exclude the use of water for dairy expansion, however it is probable that existing dairy farms adversely impacted by minimum flow obligations are natural MSS customers. • The MSS water should logically be available to water users who can meet their environmental obligations.
9. What is the preferred ownership structure?	• There is "leaning" towards a commercial oriented capital structure for the MSS but with a genuine opportunity for farmers /local investment in any such structure. Cooperative structures may be applicable to secondary distribution networks. A view was that an average water user could invest ~$1m (and that the banks would finance this investment given access to water provides a significant value to the land and decreases earnings variability, although not all agreed with this). • The concern associated with a commercial capital structure was managing the tension between investors' appetite for profit (i.e., higher water prices) versus farmers' need for affordability. The RWSS managed this through a concession deed binding the investors. • It will be important to get banks' views around this. • Iwi made it clear that they expect to participate in every element of the ultimate structure and were considered logical long term investors in the storage element of any scheme. • The higher the water demand (uptake) the better the ability to use debt finance (at the outset). • There was a view that HBRC wouldn't have a strong appetite for an investment other than possibly role in financing the 20 mill m^3 environmental flow?
10. Capital Structure and risk allocation	• It is expected that there will be additional construction price risk borne by the sponsor, relative to the contractor compared to the RWSS. A key question is who will take the development risk and at what price. Once built, this capital can be recycled for a margin.

Other considerations

Questions	Responses
11. Access to high flow water allocation in the Tukituki	• Only high flow water is available in the main-stem corridor. Of particular note is that very slow rate of development of on farm storage and tranche 2 ground water is yet to be accessed. To the extent that this reflects either positively or adversely on access to MSS stored water the calculation will lie in the price differential, technical complexity and ability or inability to access alternative water sources.

12. Market storage costs comparative benchmarks	• Some examples around the cost of water storage built recently:
	  • Intensive horticultural enterprise storing water in tanks: $48 / m^3
	  • Horticultural development - $21 / m^3
	  • Irrigated pastoral enterprise storing buffer water : $8 / m^3
	  • Irrigated arable enterprise storing buffer water: $6 / m^3
	  • Irrigated viticultural enterprise storing buffer water: $9 / m^3

13. Consented access to water	• The former RWSS consents provide a comprehensive 'authorising' framework for water access which are well developed, understood and reflected in a Water User Agreement framework
13. Water right transferability	• The water user contract will in time i.e., at full uptake be of value as a transferable instrument as was allowed for in the RWSS. The constraints to transferability may be the physical ability to move water to a different location i.e., distribution and or infrastructure constraints.
14. Water for iwi Development	• There are areas of iwi land with no access to water and further water supply for Marae has been a longstanding issue which needs resolution. Whilst the volumes of water that may be required are uncertain this should be a significant focus of any re-development process
15. Water for Urban and Industrial Use	• The urban water demand from the MSS is likely to be modest however Central Hawke Bay's population growth is out-stripping their 10 year forecast already and there is either limited or no water supply for some proposed developments within the Ruataniwha Basin. Water availability for industrial expansion on the Whakatu Industrial site is extremely limited under plan change 7. The MSS could be a logical source.

Other considerations

Questions	Responses
11. **Summary items**	• The RWSS was aiming to supply 104 Mm^3 at "full uptake". • The MSS has ~84 Mm^3 of water available for consumptive purposes assuming the 20 Mm^3 environmental flow is resumed. • The RWSS contracted 48 Mm^3 in 2016 with another ~10 Mm^3 being taken as options (for a fee). • Of 192 parties contracting the water most under contracted both in water supply volume and flow rate and left a proportion of their irrigable land out of the initial contract. If included, it represented 85% of available water which is greater than the water available under the MSS. • The RWSS estimated that the original customers would take ~85% of the 104 Mm^3 of water. • If this RWSS contracting pattern was retained by the MSS taking into account less water available spread across the original irrigation footprint, the availability of water for the Southern Heretaunga Plains would be severely compromised. • Conversely having a wider supply footprint and a smaller supply volume available will increase competitive tension which will almost certainly drive up the 'day 1 demand' i.e., at financial close.

Summary and proposed next steps

Scarcity of access to water may engender competitive tension between potential water users. This will likely be key to driving rapid and strong uptake as potential users may not want to miss out.

Proposed next steps

- Work should be undertaken to establish where there are logical alignments between HBRCs water security initiatives on the Ngaruroro and the MSS proposal.
- A detailed demand forecast should be undertaken which should involve re-surveying businesses who had contracted with the RWSS as to their in-principle intentions, surveying business seeking to enter or grow their footprint in the area and developing a detailed understanding of future industrial and irrigation water demand within the Southern Heretaunga area.
- Developing a detailed inventory of Maori land within the MSS 'Command area', as well as Marae and their water, needs should be a priority.
- Once the preferred capital structure is settled (in principle) commence a water sales and contracting process essentially uplifting the market development, sales process, and contractual framework as per the RWSS. The capital structure may result in some amendments to the Water User Agreement as may any adjustments in the environmental strategy.
- This work should proceed in parallel with the construction procurement process as there will be a significant interaction between the water contracting process and the re-development of a water distribution network.
- Lewis Tucker believes a minimum of 60 Mm^3 of water contracted at financial close should be targeted and cross referenced against the financial forecast.

Hydrology and water supply

Hydrological flows continue to support the Makaroro Storage Scheme resulting in good reliability

Key Insights

The initial assessment of hydrological storage inflow reliability for both environmental and consumptive purposes is better now (mid 2021) than was assessed in 2012 (RWSS feasibility) based on improved flow data.

Key factors informing this view include:

- Improved hydrological records less reliance on 'synthetic data'. The Burnt Bridge gauging site re-established in 2012 has provided 9 years of additional actual flow data; and
- That hydrology also reaffirms at a 'granular' level that the MSS is located an optimal area for rainfall under climate change forecasts.

The MSS is capable of delivering environmental flows for the mainstem and the requirement for these is likely to increase in the future.

There will be a need to reassess some aspects of the water distribution network to ensure water arrives when and where it is required, including the environmental flows.

There will need to be a detailed reassessment of the precise impact of guaranteed environmental flows on flow reliability for consumptive purposes.

Methodology

Scope

Key Questions:

- Define supply reliability in the context of Te Mana o te Wai
- Describe the Makaroro Storage capacity
- Re-assess the 'inflow' hydrology of the proposed Makaroro Storage based on the latest flow metered data
- Assess the volume of flow required to maintain flows at the 5.2 cumec minimum flow at Red Bridge over the full 53 year hydrological record
- Comment on the ability to supply water to areas where it is required across the catchment
- Comment on the potential impacts of climate change in particular the inflow reliability of the Makaroro Storage

Approach

The following steps were undertaken:

- The interaction between ecological flows and consumptive water reliability is explained
- Tonkin and Taylor were engaged to review the hydrological record for the Makaroro in particular adding flow data collected since 2012
- The review calculated the volume of water required to maintain minimum flows taking into account modelled impacts of the Makaroro storage on flows
- The OHL Hawkins final water balance design was reviewed to check that stored water could be distributed to areas when and where required
- A qualitative view on the Makaroro storage reliability under climate change is provided

Findings

Key findings detailed in the report

Environmental flows and consumptive use

Determining ecological health

- Ecological flow values for New Zealand rivers are determined by what is required for 'habitat protection' during low flow periods. Typically, minimum flows are set at between 70-90% of the mean annual low flow (MALF). For rivers with a high minimum flow > 90% the habitat values for various aquatic species are considered high value.

- It is important to note that a river may in some years drop below the minimum flow despite bans on abstraction for consumptive use. In the Tukituki River flows have dropped for extended periods in both in the 2019/20 and 20/21 summer seasons for periods of time in excess of 80 and 50 days, respectively. In these years ecological health and habitat values have been severely compromised in both the main-stem and tributaries. Table 3 below identifies water access reliability thresholds for consumptive use. Clearly in the past few years the target reliability levels have been severely compromised.

- The minimum flow is simply a regulatory threshold for triggering irrigation take bans, it does not guarantee actual flows but it does compromise irrigation reliability.

Water security for consumptive uses (Refer table 3)

There is a consumptive use hierarchy:

- Domestic supply for human needs (preferably 100%);
- Supply for stock (preferably 100%);
- Supply for industrial and irrigation purposes (depending on the crop); and
- Reliability or security is critical for enterprise economics.

Enterprise type	Reliability	Context
Intensive permanent hort	100%	Within a 6wk crop finishing window
Intensive mixed arable	95- 97%	Through-out the crop growing cycle
Livestock Pasture intensive -	95-97%	Through-out the soil moisture deficit period
Winter feed. irrigation variable, common in parts of the SI, but not in the NI	80-90% depending on ability to irrigate	May or may not happen from season to season

Table 3: Summary of water use by enterprise type

Flow reliability and historical flows

Flow reliability

The key to determining reliability is understanding the reliability (past and future) of the dam inflows from the Makaroro River catchment. This needs to be assessed in two ways:

1. The long-term actual hydrological record; and
2. The likely impacts of inflows from climate change.

Historical Flows

In an average flow year, the Makaroro River catchment yields ~200 Mm^3 (Red line, 6,360 l/s) of water, of which up to 93 Mm^3 (or 47%) will be stored in the proposed Makaroro Dam.

Figure 4 shows the historical mean annual flows on the Makaroro River, or storage dam inflows. Up to and including 2012, the annual river flows are a combination of both measured and synthetic data. The inflows leading into the 2019/20 year were well above the long-term average of 200 Mm^3 (orange line) whereas the inflows for the extreme (2019/20) year were ~75% of an average year at ~150 Mm^3 .

This data set validates that stored water would accommodate both the provision of 20 Mm^3 of environmental flows and water for consumptive use to irrigate ~22,000 ha and or an irrigation footprint and industrial use.

MSS capacity in an average year

The Makaroro catchment average annual yield is circa 200 Mm^3 assuming the dam is built, all that water is either:

- stored for a period of time and then released.
- Released as a permanent residual flow.
- Spills when dam is full.

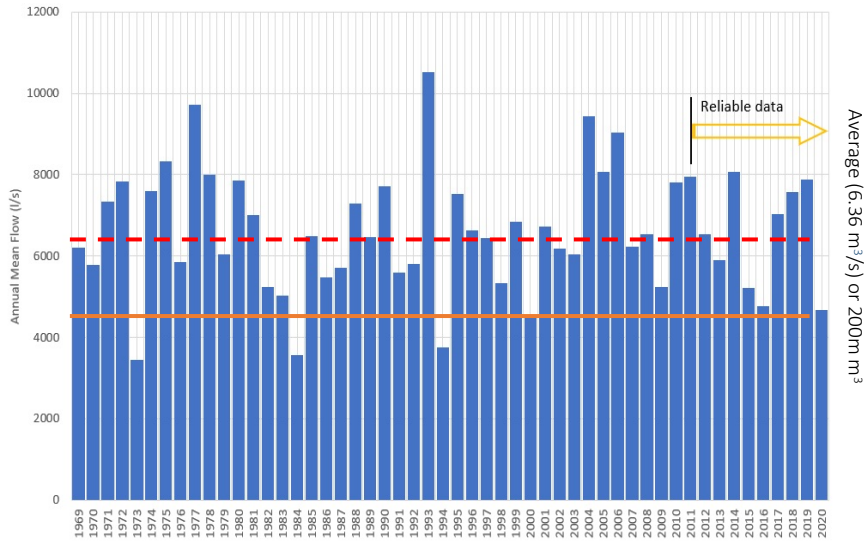

Figure 6: Makaroro mean annual flows

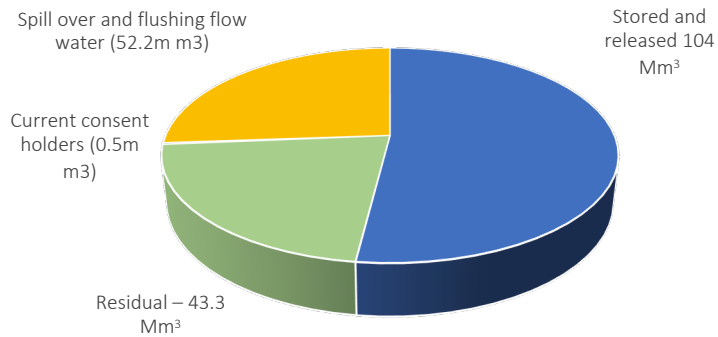

Figure 7: Makaroro water allocation

Providing environmental flows

In 2015, the proposed Tukituki Regulatory Framework (a combined consent application submitted by HB Regional Council and its commercial arm, HBRIC) recommended the following minimum river flows at the Red Bridge on the Tukituki River. The proposal, subsequently adopted a three-step process which saw the minimum flow progressively increasing from 70 to 90% of MALF, as tabulated below in Table 4.

Step-up date	Minimum flow (m^3/s)
2015	3.5
2018	4.3
2022	5.2

Table 4: Minimum flow requirements

The regulatory framework (or Plan Change) embedded an option to develop a water storage scheme within the Makaroro catchment, a dual-purpose scheme to provide 'guaranteed' water during low flow periods as well as water for consumptive purposes, namely urban, irrigation and commercial/industrial use. The average annual catchment yield for the Makaroro is ~200 Mm^3 which translates into annual stored volume of ~104 Mm^3 reflects about 52% of the annual average yield. As a percentage of total Tukituki catchment yield the 104 Mm^3 is approximately 7%.

The environmental flows under the RWSS were not contractual obligations (other than consent requirements for the Makaroro residual and the flushing flows), but rather a 'best endeavours' undertaking delivered through a range of contractual arrangements that resulted in ground water and surface water consent holders transitioning to stored water.

The revised proposition of the MSS highlights the importance of environmental flows within the hierarchy of stored water use. It is based on a premise of reserving more water for environmental flows to bridge the gap between actual flows and the regulatory minimum flow. This construct, including its scale and consequences have been analysed by David Leong of Tonkin and Taylor (Refer Appendix 1).

During the 2019/20 summer the average river flow at Red Bridge between January 2019 and April 2020 averaged 3.1cumecs, and in the 20/21 summer, 4.0 cumecs despite HBRC imposing irrigation bans. The learnings; the regulatory minimum flows provided limited benefit in the absence of environmental flows available from a storage scheme, especially in 2019/20 irrigation season which was considered an extreme year.

Hydrology and Water Supply

- Figure 8 outlines the volumes of water required to be released from the storage dam to maintain a minimum flow of 5.2 cumecs at Red Bridge over a 53year period (1968-2020).

- The most extreme year in this series is the 2019/20 irrigation season. To maintain the 5.2 Mm^3 minimum flow, a volume of water equal to 15.3 Mm^3 would need to have been released from the dam during the irrigation season. Tonkin + Taylor note (based on an conservative assessment) that a further ~4.0 Mm^3 should be provided to allow for the impacts of currently consented takes (even after the scheme is operational) and other uncertainties, taking the total volume of water required for environmental flows to ~20.0 Mm^3.

- The net effect of shifting 20.0 Mm^3 of water from consumptive purposes to environmental flows is to either reduce TWS's irrigation footprint by ~5,000ha (from ~27,000ha to ~22,000 ha assuming 97% reliability), or provide irrigation at reduced reliability.

- The 53-year series requires a 'mean' (average) release (in volume) over the irrigation season would have been 1.4 Mm^3 35 of the 53 years in the series required 0.50 Mm^3 or less. Where 20 Mm^3 is provided to support environmental flows, the worst-case scenario based on historical records, significant surplus water would be available for other purposes than purely the minimum flow.

- In addition to above, given the minimum flow below Black Bridge (Mill Road) drops from 5.2 cumecs to 4.3 cumecs (due to reduced ecological need) some of the environmental flow could be subsequently allocated to consumptive purposes within the Southern Heretaunga (Mangatarata) and Whakatu area.

- Lewis Tucker suggests MSS determine a maximum environmental flow, the question being, should it be determined using the extreme year recorded in 2019/20? Or, at a lower level, but well above the average mean volume required?

- Lewis Tucker recommends further, detailed analysis to determine more accurately flows and the impact on reliability using the Goldsim Hydrological Model should be undertaken if the MSS proceeds. This was not possible within the scope of this Re-scoping Assessment.

From	To		Actual	Scenario 4
1/07/1971	30/06/1972		0.01	0.56
1/07/1972	30/06/1973		2.53	5.49
1/07/1973	30/06/1974		-	0.17
1/07/1974	30/06/1975		-	-
1/07/1975	30/06/1976		-	-
1/07/1976	30/06/1977		0.10	0.83
1/07/1977	30/06/1978		0.64	2.34
1/07/1978	30/06/1979		3.99	6.12
1/07/1979	30/06/1980		-	0.23
1/07/1980	30/06/1981		-	-
1/07/1981	30/06/1982		0.08	1.17
1/07/1982	30/06/1983		0.01	1.78
1/07/1983	30/06/1984		0.96	2.46
1/07/1984	30/06/1985		3.97	5.14
1/07/1985	30/06/1986		-	0.05
1/07/1986	30/06/1987		0.96	3.23
1/07/1987	30/06/1988		0.20	1.04
1/07/1988	30/06/1989		-	1.20
1/07/1989	30/06/1990		-	0.05
1/07/1990	30/06/1991		0.35	1.60
1/07/1991	30/06/1992		-	0.10
1/07/1992	30/06/1993		-	-
1/07/1993	30/06/1994		-	0.66
1/07/1994	30/06/1995		0.12	0.55
1/07/1995	30/06/1996		-	-
1/07/1996	30/06/1997		0.48	0.60
1/07/1997	30/06/1998		8.39	10.98
1/07/1998	30/06/1999		-	0.20
1/07/1999	30/06/2000		0.01	0.45
1/07/2000	30/06/2001		-	-
1/07/2001	30/06/2002		-	-
1/07/2002	30/06/2003		0.74	0.96
1/07/2003	30/06/2004		-	0.01
1/07/2004	30/06/2005		1.20	1.31
1/07/2005	30/06/2006		-	0.00
1/07/2006	30/06/2007		1.65	1.90
1/07/2007	30/06/2008		1.38	1.30
1/07/2008	30/06/2009		0.79	
1/07/2009	30/06/2010		0.19	
1/07/2010	30/06/2011		0.71	
1/07/2011	30/06/2012		-	
1/07/2012	30/06/2013		11.28	
1/07/2013	30/06/2014		0.20	
1/07/2014	30/06/2015		2.27	
1/07/2015	30/06/2016		1.86	
1/07/2016	30/06/2017		0.82	
1/07/2017	30/06/2018		0.02	
1/07/2018	30/06/2019		-	
1/07/2019	30/06/2020		15.28	

Figure 8: Annual Summary (Water Years)

Future flows with climate change

Future flows with climate change

In 2012 an assessment was undertaken by the HBRC of the potential climate change effects. This assessment relied on published IPCC models at the time. The view was that Makaroro River catchment inflows may increase slightly due to 'spill over' effects of rain bearing westerly weather patterns, whilst the irrigation command zones would become dryer. The proposed storage dam is located in the defined 'spill-over zone'.

Updated climate change models and assessments undertaken by NIWA suggests the gradual drying across the east coast using a coarse mapping scale. However the most recent view held by Tonkin + Taylor is that James Renwick's 2012 inflow hypothesis (Renwick is a leading climate change scientist based at Victoria University) is an increased spill-over rainfall (and inflow) remains a scientifically sound hypothesis when assessed at a finer scale i.e., in the catchment headwaters. This view takes into account the inaccuracies of NIWA's modelled rainfalls, when compared to its own historical database and the HBRC measured rain gauge data.

This question was a key issue covered in depth during the feasibility stages of the RWSS. It is also relevant to providing confidence that environment baseline flows can be achieved at Red Bridge, and that the efficacy of other proposed environmental flows such as 'flushing flows' can be achieved, as well as ensuring the timely delivery of water for consumptive use.

Water Supply and the Distribution network

The RWSS water balance envisaged moving water via the river bed, canal and primary piping network pipe to various locations 'in part' to avoid a substantial 'losing reach' segment of the Waipawa River.

Providing an environmental flow at Red Bridge should be relatively straight forward assuming the core elements of the RWSS scheme distribution design remain in place and that water moved through the head race is used to avoid the Waipawa losing reach. However as noted in Appendix 1: Hydrology Re-scoping Report, there may be issues with the efficacy of flushing flows given that these flows utilise the Waipawa tributary and pass through its losing reach. This issue may require further consideration. A further consideration is that the OHL Hawkins Water Balance design assumed water for the Otane/Papanui zones was channelled through the Waipawa including through the 'losing reach'. This element of the network should be reassessed.

Impact on financing and capital structure

Financing infrastructure of the type contemplated is predicated on the cost of the water stored and delivered ($ per cumec) and secondly, the cost of construction and capital. The environmental flows utilise ~20% of the dam storage and head race capacity. Unlike the RWSS where these costs were internalised in a water price, it is likely that the sole customer for this water is the public sector.

Proposed Next Steps

Proposed next steps:

- Provision of environmental flows should be valued and, if relevant, optimised. For example; the volume, reliability and other considerations in using streams like Lake Whatuma, the Mangatarata or Papanui Streams as conduits. That optimisation should also consider alternative uses of the water in years when the need is modest.
- Assuming the environmental flow is a first ranking commitment, meaning at 100% reliability, then the impact on consumptive water reliability will need detailed assessment.
- If the project is procured and developed, previous hydrological models e.g. RWSS GoldSim model should be upgraded to incorporate additional water offtakes, and supply zones such as the Tukituki Corridor. There is significant Intellectual Property value in this model, but specialist capability will be needed to both modify and run it.
- The hydrological and water supply model will also be an essential tool for assisting with refining water demand analysis, infrastructure design and water pricing. Depending on progress with Tranche 2 Ground water and Managed Aquifer Recharge (MAR), capacity should be incorporated into the model to enable these sources to be factored into either water supply or demand.
- Determine who owns, and should pay for, the environmental flows and consider the impacts on the proposed capital structure.
- Further to above, detailed consideration of climate change impacts should be undertaken.

The Project and Alternative water security options

The Makaroro Storage Scheme is the only option that delivers meaningfully on Te Mana o te Wai

Framework for assessing alternative water security options

Alternative water security options considered are as follows:

1. Farm scale storage infrastructure;
2. Small or medium scale storage infrastructure;
3. Small scale storage scheme on the Makaroro River;
4. Accessing 'Tranche 2' groundwater;
5. Managed aquifer recharge;
6. Reallocating current water takes; and
7. Catchment-scale storage scheme on the Makaroro River.

The lens through which they are assessed includes:

The ability to contribute to key initiatives under Te Mana o te Wai, including but not limited to supporting minimum flows and contributions in support of restoration of Whatuma, Mangatarata and the Papanui and then their economic viability (that parameter takes into account both regulatory, physical and financial opportunities and constraints relies on the judgement of the authors which has in turn been tested with the project steering group).

A substantial body of work has been undertaken on alternative water security options within the Tukituki over the past decade. It is this work which enables a realistic assessment of the pros and cons of each option in the context of contributions to Te Mana o te Wai.

Current water allocation

Status of water allocation in the Tukituki

Tukituki Catchment surface water and groundwater is **fully** allocated except for Tranche 2 groundwater, some high flow water in the Tukituki main-stem corridor. By contrast, there is a very substantial additional tranche of water available assuming the existing RWSS consents can be exercised.

Tukituki - Basic allocation statistics

Source allocation	Estimated consumption	Availability for use
Tranche 1 Groundwater 28 Mm^3	Of this ~23 Mm^3 (82%) abstracted in 19/20 year for some takes inability to pump more water thereafter some stream depleting takes connected to minimum flows	Fully allocated
Tranche 2 Groundwater 15 Mm^3	None	10 Mm^3 subject to offsets unproven. Consent applicants have applied for the full volume but are not as yet processed or given
Surface water 17.4 Mm^3	~16 Mm^3 (91%) in peak year with minimum flow restrictions	Fully allocated
High flow surface water, 10 Mm^3 in 3 zones (Note: If allocation is taken 150 days every year then the allocation no. is 26 Mm^3 but the take rate unreliable.	~7.6 Mm^3 consented but not all consents currently exercised	Remaining allocation available but only in the Tukituki main-stem corridor zone. Above the main-stem is fully allocated
Makaroro site 104 Mm^3 @ 97% reliability	None	Only available through the MSS

Table 5: Current water allocation

Note: *The above table has been developed through dialogue with HBRC's Consents Manager*

Alternatives: Smaller storage at the Makaroro site

The cost of providing this water is ~3x greater per m3 than full scale storage.

Overview

50m high dam storing 18 Mm^3 costing ~85% of the capital cost of the large scale dam.

Opportunities:

- Provides environmental flows (support minimum flow).
- Provides flushing flows for algal removal.
- Subject to building key distribution infrastructure water can be provided into Whatuma, Mangatarata and Papanui
- The site and water takes are consented, and the dam is at an advanced design stage.
- The water supply is highly reliable.
- Avoids inundated conservation land.

Challenges:

- Single purpose storage provides environmental flow water only.
- Excludes multiple potential benefits e.g., water security for urban, industrial and high value irrigated land use including into the Heretaunga Plains.
- Climate change will compromise water security for consumptive purposes; small-scale storage does not resolve this issue.
- Cost of providing this water is approx. 3x greater per m^3 than full scale storage.
- Only one source of finance (public sector)

Alternatives: Small to medium scale storage in different locations

Overview

Two investigations by HBRC and Tonkin and Taylor of small to medium scale storage within the Tukituki with a primary focus on providing water security to the Ruataniwha basin-2009/2020. The RWSS review April 2017 also traversed these issues.

The purpose is to find water storage sites with the potential to be used:

- Both as the primary source for irrigation (reducing actual reliance on surface and ground water takes) to enable summer low flows to re-set to 'near natural'; and 2) expand the irrigation footprint; 3) smaller scale sites were ruled out on the basis of geological instability and infill pumping; 4) Makaretu investigation reinforced this issue in detail and resulted in shift to the Makaroro site.
- An assessment in 2020 was undertaken because the impacts of regulation (now operative) were being felt (i.e., min flows and irrigation curtailments) and concerns about climate change. The second study involved some early scoping scale assessment of several sites - focus on four sites theoretically capable of storing between 2-15 Mm^3 of water being:
    1. Addis Road
    2. Mangamate Stream
    3. Ongaonga
    4. Sherwood
- All options located on alluvial gravels and within 1 to 5 kms of fault lines (Refer right).
- Identified engineering challenges were significant.
- Options were tested with a community reference group (the Tukituki Leaders Group) and subsequently HBRC decided not to proceed any further with small/medium scale storage but instead focus on investigations of MAR.
- Issues that the RWSS faced in finding viable storage sites were repeated in the 2020 review.

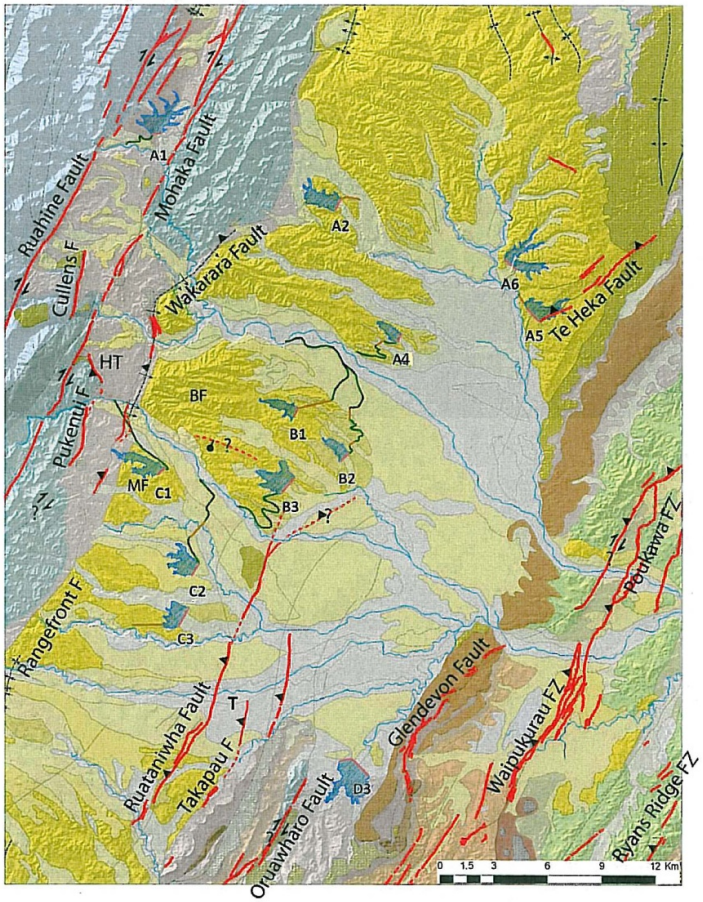

Figure 9: Known active fault (red) and fold traces (black dashed lines) that are in close proximity to the proposed scheme.

Alternatives: Small to medium scale storage in different locations

Opportunities

- In theory this could provide environmental flow water although this would depend on the location of the storage facility.
- Avoids requirement to use conservation land.

Challenges

- Unproven from a feasibility perspective.
- Locations are on alluvial material and close to faults.
- Unconsented with no consideration of specific stream restoration let alone enhancing Whatuma, Papanui or Mangatarata.
- Requires at least 5 years and 10% plus of total capital cost of a given storage to achieve consents and a viable feasibility level design before procurement.
- Cost per m^3 water stored uncertain but likely high given geotechnical challenges.
- Locations are in drying zones under climate change.
- Unlikely to be able to provide flushing flows for algal removal.

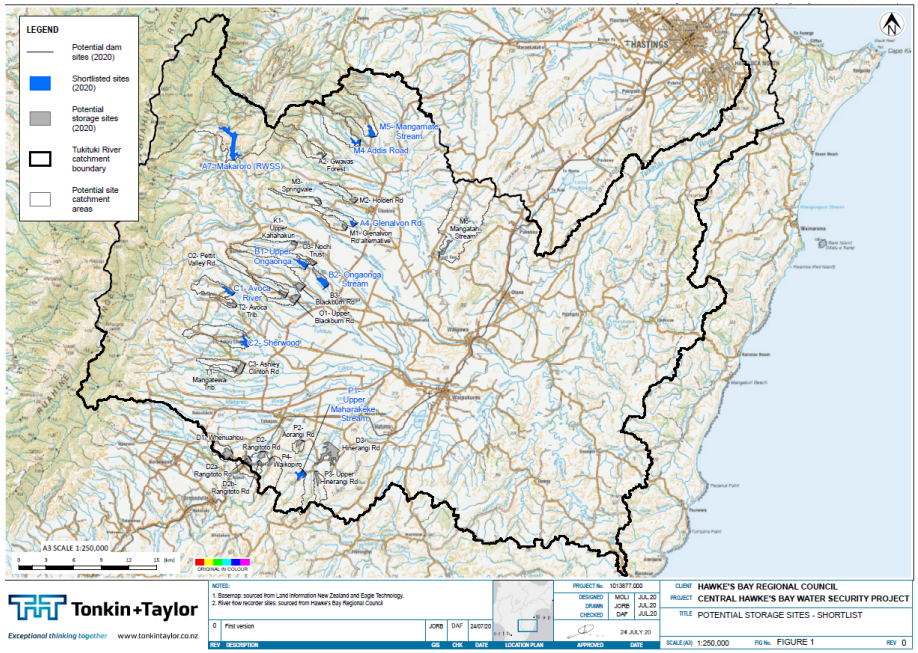

Figure 10: Map of the theoretical water storage sites that have the subject of some level of investigation between the years 2009-2020

Over the past decade in excess of 20 small/medium scale storages sites have been considered and discounted at prefeasibility stages. The issue for discontinuing are consistently based on complex and high risk geotechnical hurdles.

Alternatives: On-farm dams

On farm dams are estimated to be in excess ~5x the cost of the MSS per m3 of water stored.

Farm dams are typically constructed for consumptive water security not for environmental purposes.

Overview

Assumes sufficient water can be found in the aquifer or pumped from rivers and streams. To date 7.6 Mm^3 of high flow water has been consented for on-farm storage, with 3.3 Mm^3 of storage constructed in the Tukituki catchment. Of that storage, 2.4 Mm^3 (or 31%) was constructed prior to the RWSS being abandoned.

Opportunities:

- Avoids the conservation land.

Challeges:

- Likely to be located on high value land and purpose is typically to provide buffer water for irrigators i.e., improving reliability when added to surface water takes subject to ban.
- Will not contribute direct flows to the streams and rivers of the Tukituki.
- Cannot provide flushing flows for algal removal.
- Even if farm scale dams **could** be used purely for environmental purposes assuming an average price of $10 per m^3 (anecdotally quoted as average current cost nation wide) overall cost for proving a 20 Mm^3 flow is approx. $200m, **5x** full scale storage.
- Climate change is highly likely to reduce small scale storage reliability.
- In the absence of water supply contractual obligations (under scheme) consent conditions are more difficult to manage.
- The high flow water allocation is capped and fully allocated in 2 out of 3 zones.

Alternatives: Tranche 2 groundwater

Overview

15 Mm^3 of additional groundwater allocation was made available under Plan Change 6, provided the impacts of abstraction on stream flows can be offset. The RWSS estimate was that for every cubic meter abstracted a third of a cubic meter would need to replaced in the adjacent stream to maintain like for like flows. So far no consents to abstract this water have been granted.

Opportunities:

- Tranche 2 ground water provides a potential water security solution for consumptive purposes in localised areas within the Ruataniwha Basin.

Challenges:

- Tranche 2 groundwater was allocated for consumption not environmental enhancement.
- The obligation of abstractors is to offset the impact on adjacent stream flow.
- There are limited locations where the water may be abstracted and none are adjacent to culturally significant waterways e.g. Whatuma/Papanui.
- There is no ability to augment main-stem flows or provide a 20 Mm^3 environmental flow.
- Cannot provide flushing flows for algal removal.
- The impacts of climate change are unknown.
- The RWSS calculated the cost of provision of this water as being at or more expensive then the RWSS water.

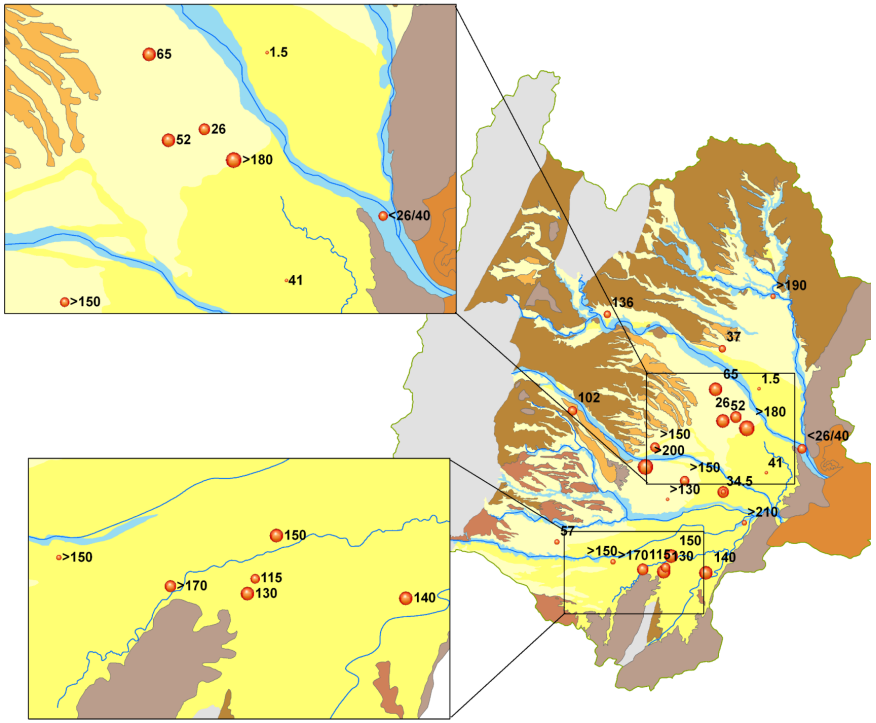

Figure 11: Map of water age testing.

Based on the environmental offsets required access to ground water is very difficult and much of the ground water is 'old'.

Alternatives: Managed Aquifer Recharge

MAR offers opportunities for localised water security and stream improvement but its application is limited to areas where groundwater is already present. Further there are major constraints on the availability of high flow water for this purpose. The mechanism however could potentially be more effective if coupled with the MSS.

Overview

The Ruataniwha basin aquifer is formed of lenses of water found in different locations at different depths, it is not one contiguous source of water.

Based on current and historical abstraction and use the primary ground water location is in the Northern "zones of the basin i.e. crossing over between the RWSS zones A and B either side of the Waipawa river.

HBRC is pursuing a pilot scheme in the same area to investigate whether MAR can provide a more durable source of water for adjacent springs and streams and for irrigation supply.

Results from the Pilot scheme are estimated to take 2-5 years and the scheme may be able to access approximately 3 Mm^3 of high flow water. There is a consent application pending for this water.

Opportunities:

- MAR may in localised areas provide a means for improving adjacent stream flow, although this effect may be limited to the pilot area adjacent to the Waipawa in the Ruataniwha basin.
- MAR may also provide a source of water for current irrigators noting this has an estimated 8 week reliability duration.
- MAR may be a means of diluting nitrogen concentration in deep groundwater, in specific circumstances.

Challenges:

- There are limited locations where the aquifer may be recharged, and none are adjacent to the culturally significant Lake Whatuma.
- No ability to meaningfully augment main-stem flows and / or provide a 20 Mm^3 environmental flow. For example, the 3 Mm^3 consent application for the pilot project will result in high flow water source being almost fully allocated.
- Cannot provide flushing flows for algal removal.
- The method is unproven in the Ruataniwha Basin specifically and will take time to prove.
- The impacts of climate change are unknown.
- The cost of MAR at an operational level in the Central Hawkes Bay area is unknown.

Alternatives: Status quo of current water allocation

Over the past few years there has been commentary from some parties that a reallocation of water from consumptive users (in particular irrigated dairy) to other uses would be a solution at least in part for the Tukituki. Table 6 below identifies the allocation status of various sources of water.

Source	Assessment
Tranche 1 Groundwater 28 Mm^3	Fully allocated and consumption is constrained to circa 23 Mm^3
Tranche 2 Groundwater 15 Mm^3	Only available in Ruataniwha basin in localised areas. Consumption likely limited to 10 Mm^3
Surface water 17.4 Mm^3	Fully allocated and use banned under minimum flows thresholds.
Surface water high flow 10 Mm^3 . Upper range of theoretical take 26 Mm^3 but reliability and physical constraints.	Some available in main-stem subject to storage but no available storage Downstream of Papanui/Whatuma/Mangatarata.
Makaroro site 104 Mm^3 @ 97% reliability	Available subject to Makaroro Dam and distribution infrastructure.

Table 6: Current water allocation

Alternatives: Shifting water allocation

Whilst some parties would prefer water was not allocated to some land uses the ability to change this quickly and successfully is extremely complex and high risk. Its more likely that external drivers of change will mean land use conversion over time and more quickly than direct interventions.

Delivering an environmental flow of 20 mill m3 would result in no ground water based irrigation.

Considering the limitations expressed in the table 6 on water allocation, and in the absence of the MSS, the only viable source of water for reallocation from consumption, particularly for the purposes of Te Mana o te Wai is the 28 Mm^3 of Tranche 1 Groundwater and some limited high flow water in the main-stem water management zone. The central question is "is there any method of re-allocating water from consumptive use to environment and, or other uses, and what's the likelihood of success?

Method	Assessment of success
A Compulsory regulatory shift	Not legally possible to the extent the consents to use are rendered inoperable.
A shift based on changed allocation within future plan	Is possible but not one based on targeting a consumptive activity (Dairy) per se. Further, cessation of the consent terms delays plan implementation and both the plan and any consent condition reviews can be expected to be heavily litigated with natural justice principles applying. Many consents have 20+ year terms.
Commercial solution could be to buy out Farms	Who would be the purchaser and why, noting it still requires a willing buyer/seller. Its unlikely that a case for public sector financing could be made for this type of intervention.

Table 7: Water re-allocations and assessment

What's a more likely scenario assuming the purpose is to improve water quality?

Objective	Assessment of success
Reducing nutrient losses and improving water quality through land-use change	40 years ago dairy farms were common on the Heretuanga Plains, today there are none. Land-use has shifted to higher value horticultural uses, all of which require access to reliable water. The underlying 'value drivers' which drove conversion coupled other 'headwinds' i.e. nutrient leaching rules/methane taxes may well result in the changes to land use occurring in the Tukituki without further intervention.
Re-directing water to environmental flows and restoration initiatives	There is no other realistic solution than storing water from the residual high flow allocation. The high flow allocation is now fully allocated in the Ruataniwha zones and in the main-stem corridor is not available in a logical location for restoration flows for Whatuma/Mangatarata/Papanui However, in theory the remaining high flow allocation and shallow pond storage along the Tukitukii main-stem may be worth future consideration - but outside of flood hazard zones.

Table 8: Likely re-allocation scenarios and assessment of success

Alternatives: Catchment-scale storage on the Makaroro site

Overview

The Makaroro storage site can store ~93 Mm^3 (static storage) for a 35-year period. The associated dam design is well advanced.

Positives

- The Makaroro storage can provide 104 Mm^3 of water at a 97% reliability level.
- The site is considered to be within a high reliability zone for rainfall and inflows including under climate change.
- The volume of water stored opens up multiple use opportunities for mana enhancing initiatives including:
    - Maintaining minimum flows
    - Providing water for Lake Whatuma, the Mangatarata Stream and the Papanui
    - The cost of providing environmental flows of 20 Mm^3 is a third of that provided by a small-scale storage and or multiple farm scale dams
- Providing water for consumptive purposes opens up a range of financing opportunities other than purely relying on public sector financing.
- The cost of water stored per cubic meter is less than $2 per m^3.
- Tamatea Taiwhenua support and likely broader across hapu throughout the catchment (to be confirmed).

Negatives

- The full-scale storage would inundate 22 ha. of deemed conservation land.
- There is a perception in some parts of the community that large scale dams are risky and that they drive unsustainable land use.
- ENGOs, Forest and Bird and Greenpeace historically opposed.
- This land issue requires a legislative resolution similar to the Waimea Dam land and Tangata Whenua sponsorship/leadership on this issue is critical.

Summary of Alternatives

Solution	Following Te Mana O te Wai	Climate Change reliability	Physical Constraints	Regulatory constraints	Multiple benefits @ catchment scale	Economic Per m³ of water	Integrating with another solution
Farm Scale storage	No benefit	Localised benefit	Limited sites	Limited allocation	Single purpose	Med/High cost	N/A
Small/medium scale storage	Limited benefits	Declining reliability	No suitable sites	Allocation	Limited benefits	Uncertain	Uncertain
Small scale storage on the Makaroro	Partial benefits to minimum flow	High reliability but for environmental flows only	none	none	Single purpose environmental	High cost and one source of finance	No clear benefit
Accessing "Tranche 2" Groundwater	No benefit	Localised benefit – reliability uncertain	Limited suitable sites	Limited source No Stream flow offsets unproven	Single purpose economic	Likely high given cost of stream flow offset	Integrates with large scale storage
Managed aquifer recharge	Localised benefits	Localised benefits	Limited suitable sites	Very limited water allocation available	Some benefits	Uncertain	Integrates with large scale storage
Reallocating current water takes	Possible environmental benefit	Winners and losers	N/A	Very significant	Limited in scale	Extremely high	In principle some opportunities with Makaroro storage
Catchment-Scale storage (Makaroro)	Minimum flows and restoration flows	Reliability for storage site and range of uses	none	No RMA constraints But conservation land access critical	Multiple purpose	Very good	Makaroro storage could use MAR / Tranche 2 transfers

Table 9: Summary of water source alternatives

Table Key	Description	Table Key	Description
	Ability to deliver against the criteria		Unlikely to deliver against the criteria unless there's a remedy
	Potential to deliver against criteria		No ability to deliver against the criteria

Detailed explanations of solutions, and their ability to meet each criteria, are contained within the detailed report.

MSS overview

The MSS is framed within Te Mana o te Wai meaning it places mauri and ecological health values first. Once established, water for other purposes can be enabled.

The MSS proposes to supply up to 20 Mm^3 of water for **summer** environmental flows in **addition** to the consent obligations for flows of 40 Mm^3. Restoration projects will include improving culturally significant water ways including lake Whatuma, the Mangatarata Stream, the Papanui Stream and the Tukituki mainstem.

Multiple reviews have been undertaken to establish the Makaroro dam site as the preferred option, as considered under the RWSS. The results are based on work undertaken around Geotech, foundation materials, faulting, slips and hydrology. This serves as the baseline for re-scoping.

As referred to in Figure 10 The MSS will be capable of supplying stored water for consumptive purposes to 8 Zones as per the RWSS.

The MSS can provide 104 Mm^3 of stored water at a reliability of 97%. This is approximately 9% of the Tukituki annual average volume. The MSS is capable of Hydro-generation of approximately 7.5 mega watts.

The MSS is capable of supplying ~22,000 ha of irrigable land. This is at an assumed reliability level of 97%. 'Consumptive purposes' also includes an intention to meet both urban and industrial demand.

In order to deliver the volume of water required, the MSS will require a dam with static storage of 93 Mm^3 located in the Makaroro catchment and a 16 km canal which can accommodate a flow of 9 cumecs of water into the Tukituki tributary. Turbines will be positioned at the dam and in the headrace with transmission infrastructure. Further secondary distribution infrastructure will be required for use in some areas.

There is an existing portfolio of seventeen 35-year consents covering the dam, diversion of water, and discharge of water to land. The consents need to be exercised within four years. Additional consents may be required for movement of water into the Whatuma-Mangatarata, the proposed environmental flow for the main-stem and in the Lower Tukutuki corridor-Southern Heretaunga zone.

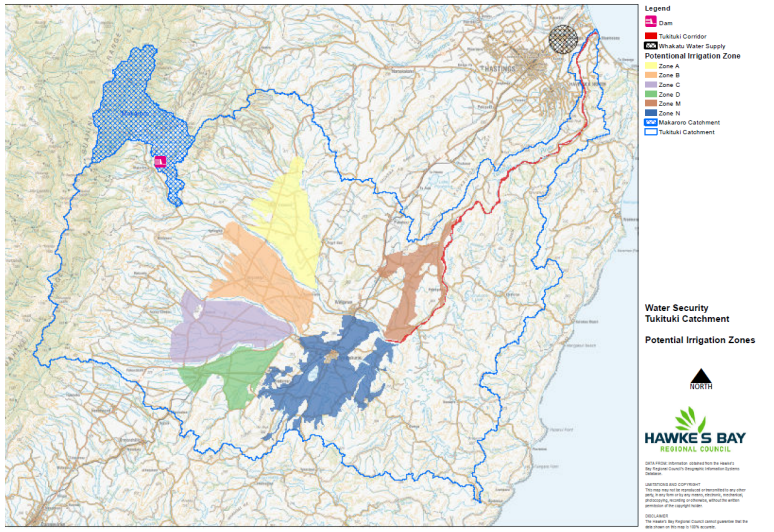

Figure 12: Potential Irrigation zones

Figure 13: Proposed Makaroro dam illustration

Summary

- Over 10 years of analysis has been invested in exploring water security options for the Tukituki.
- The environmental issues have been considered in detail and a regulatory framework to assist in driving improvement is in place but that alone is unlikely to achieve systemic improvement.
- There appears to be widespread acknowledgement that infrastructure options should be considered and this is demonstrated by repeated and ongoing investigations into water security options.
- Various options ranging from small scale, farm scale, managed aquifer recharge and possible change of land use all theoretically offer partial solutions to very specific and or localised issues, but none offer an integrated catchment scale opportunity for improvement. However, some of these alternative options if integrated with catchment-scale storage could well deliver greater value to the community.
- Other than the full scale Makaroro solution no other options deliver an and:and opportunity i.e., both environmental enhancement **and** water security for consumptive purposes.
- Other than a small-scale storage on the Makaroro site (versus the full scale) and the development of some small-scale farm dams no viable option has progressed to feasibility stage or been consented. Farm dams are not designed, intended for environmental improvement.
- Proving feasibility, achieving consents and then designing, procuring and financing infrastructure is a long-term complex and high-risk task likely 10-year journey with no certainty of success.
- Outside of some high flow water allocation for the main-stem and accessing Tranche 2 groundwater (which is extremely complicated) all available water for consumptive purposes is allocated and or applied for within the Tukituki. This means that there is no other source of water for initiatives such as restoration for Whatuma or Papanui. Nor is there another source of water capable of providing a 20 Mm^3 environmental flow.
- The RWSS consents and allocation under Plan Change 6 provide for an additional high reliability allocation of approximately 104 Mm^3 of water but they are specific to the Makaroro storage site and not transferrable, **and they need to be exercised within 4 years.**
- There is a high risk that if the consents are not exercised the opportunity for a catchment-scale solution for the Tukituki is abandoned permanently just as climate change gathers pace.
- This makes obtaining access to the 22 ha of conservation land a ‘mission critical priority” and Tangata Whenua leadership is critical to its success.

Assessing viability of the MSS

Given the 4 year window to exercise consents work-streams will need to be run concurrently and a team assembled with sufficient expertise to ensure the development program is optimised.

The RWSS feasibility and development processes were founded on conditions precedent underpinned by work-streams largely driven concurrently which is not necessarily a traditional approach. Among the conditions precedent and work streams were:

1. Contracting a volume of water sufficient to justify building the infrastructure in both volume and financial terms.
2. Securing commercially viable consents.
3. Securing a construction entity and contractual arrangement able to deliver the project.
4. Securing investment and a capital structure which met the return expectations of HBRIC and its parent entity HBRC.
5. Securing access to the deemed conservation land for the Makaroro site.

The approach to running multiple work streams in parallel sped up development and only the conservation land issue ultimately pushed to the backend of the process by the counter party, and then Minister of Conservation. This approach is directly applicable to **both** the brief assessment undertaken in this review and in any subsequent development and procurement process.

A project of this complexity will undergo adjustment and refinement as each work-stream is progressed. If work streams are progressed in a linear sequence i.e., not simultaneously there will be higher the risk of disconnects and fatal flaws. Further such an approach will take considerable time, risk loss of key personnel and institutional memory and replication of work-streams. Given the impending cessation of the Consents Lapse Clause there is likely not the time for this.

Having said this there are two critical exceptions to this approach being as follows:

- Securing the IWI TWSL partnership with a public profile; and
- Securing political support for access to the Deemed Conservation Land on the Makaroro.

Consistent with the approach described above the assessment outlined here on covers:

- Water demand and land use change in the Tukituki catchment;
- Hydrology and Water Supply;
- Utilsing existing consents in support of the TWSL proposition;
- Construction risk allocation and pricing in support of the TWSL proposition;
- Water pricing and financial output overview; and
- Proposed capital structure and capital raising issues.

All these subjects will require further work should the Project proceed.

Consents

Consents remain fit for purpose, and of significant value……

Key Insights

Consents remain fit for purpose, of significant value, and well aligned with Te Mana o te Wai.

Key factors informing this view include:

- The consents enabling the preferred MSS alternative to be be pursued;
- Critically the consents enable the storage of water for additional environmental flows and restoration projects such as the Papanui, are already allowed for; and
- They are well aligned with the latest national regulatory developments.

A limited number of new consents may be needed notably for the proposed main-stem environmental flow and for the Whatuma Mangatarata zone.

There is significant risk if the Consents are not exercised before the cessation of the lapse date, that they cannot be replicated, and a critical catchment scale water security option is lost permanently.

Aligning HBRC views with the assessment of the applicability of the consents will be important and should be initiated and solved prior to extensive publicity.

Consents methodology

Scope

Key Questions:

- Review the applicability of the current RWSS consents to the TWS
- Identify new consents if required – in support of the environmental initiatives and for 'new' supply zones
- Identify any specific compliance issues that need consideration
- Identify any issues within Local Authority Plans that need consideration
- Identify any changes in national planning and environmental legislation that need consideration

Approach

The following steps were undertaken:

- Mitchell Daysh were contracted to review the consents in the context of the MSS proposition
- A team of ex RWSS personnel/contractors worked with Mitchell Daysh on the interpretations and identification of key issues
- Mitchell Daysh tested various consents requirement issues with HBRC regulatory staff

Findings

Key findings detailed in the report

Applicability of current consents and new consents

A limited number of new consents may be required both for environmental flows and enabling access of stored water for consumptive purposes.

Assessment of applicability:

- The consents are well aligned to Plan Change 6.
- In large part this is due to the way in which the Tukituki strategy was developed ten years ago. The regulatory limits and the storage scheme were intended to compliment each other. Critically the Makaroro storage is not just consented but it is also directly embedded in the plan.
- All current RWSS consents remain relevant to the MSS assuming the Makaroro High Dam option is progressed. This is evident given the recent cessation of the Water Wairarapa Project.
- The consents have significant value assuming this option is pursued but limited or no value under any other scenario.
- The consents are granted for a 35-year period and have a 10-year lapse clause that has 4 years to run.

New Consents

- Under the proposed environmental and restoration projects namely additional water into Lake Whatuma, the Mangatarata stream and additional environmental flows in the main-stem consents will be required for these initiatives.
- To the extent the MSS seeks to deliver water to new zones, namely Whatuma/Mangatarata and a Southern Heretaunga zones consents will be required for water offtakes and structures.
- These consents are not considered complex or controversial and Mana Whenua sponsorship support will materially assist.

Refer to Appendix 5 for a detailed consenting overview and RMA and environmental aspects.

Consent compliance risks

- The RWSS consents conditions architecture creates a set of obligations as outlined below.
- Provided the MSS embeds these obligations in the construction and operating structure for the scheme then it should be well placed to meet its compliance obligations. The operating budget carried forward from the RWSS to the MSS financial and capital structure assessment allows for this.

1

Key conditions established by BOI aligning with Plan Change 6 water policies and rules

Primary Water Quality and Quantity Conditions

- Constant residual fow of 1.2 cumecs enhances extreme low fow periods in main stems
- Water quality managed through specifc consent conditions (Schedule conditions 4A to 12), EMPs, FEMPs, Contracts.
- Process for approving farm systems and maximum nutrient outputs in each sub-catchment
- Flushing Flows provide periphyton control in Makaroro, Waipawa, and sections of the Tukituki Rivers in summer periods
- HBR C initiated MC monitoring and adaptive management regime in smaller streams (Ecological Health Monitoring Protocol)

2

Project management & reporting framework for key effects and issues (Condition Schedule in brackets)

Management and Monitoring Plans

- Irrigation Environmental Management Plan
- Farm Environmental Management Plans
- On Farm Monitoring Plan
- Construction Environmental Management Plan
- Supplementary Construction Environmental Management Plans
- Reservoir Filling and Edge Rehabilitation Plan
- Construction Traffc Management Plan
- Infrastructure Stormwater and Maintenance Management Plan
- Sediment Management Plan
- Emergency Action Plan
- Water Level Safety Plan
- Groundwater Monitoring Plan
- Groundwater Mounding and Drainage Monitoring Plan
- Monitoring Protocol

3

Establishes a community liaison reporting & recommending structure

Community Liaison

- Kaitiaki Runanga (KR)
- Construction Liaison Group (CLG)
- Ruataniwha Biodiversity Advisory Board (RBAB)
- Scheme Operations Liaison Group (SOLG)
- Community Liaison Offcer

4

Provides environmental compensation for key effects with philosophy of "like for like" mitigation and offset

Integrated Mitigation & Offset Approach (IMOA)

MOA Protects A to F (Schedule 6) set out the ecological and cultural offset, mitigation and monitoring programmes (Schedule 2 Conditions 5 to 9):

- Requires monitoring and Annual Review Meetings to report on progress
- Establishes the role & functions of the RBAB

Figure 12: Existing consent condition architecture

Dissolved Inorganic Nitrogen concentrations in waterways

The MSS proposition with a potentially larger command area than the RWSS coupled with a smaller irrigation footprint and changed land-use reduces the nutrient contribution risk materially.

The risk of an increased DIN is diminishing.

Arguably the most controversial element of the RWSS revised consent architecture was its obligations concerning making no material contribution to Dissolved Inorganic Nitrogen ("**DIN**") concentrations in waterways.

Context

Plan Change 6 contains a target in instream concentrations of DIN of .8 mg/l, some water ways within of the catchment exceed this target primarily in winter including within the Ruataniwha basin and parts of the main-stem.

- The RWSS consents obligation is to not materially contribute to any increase in DIN by 2030.
- Calculations undertaken in the RWSS due diligence process concluded that provided the farms met the Farm Environment Management Plan ("**FEMP**") obligations and the irrigated land was spread across the final RWSS' command area' then there was a high level of confidence in this outcome. (See appendix 5 for more detail).

Consequences for the TWS

- Under a revised MSS proposition this risk reduces further in our assessment as a result:
  - A reduced irrigation footprint 22,000 ha. vs 27,000 ha. across a larger area e.g. including the Heretaunga.
  - The effect of environmental flow in the mainstem is likely to improve overall annual trend.
  - A more rapid conversion of livestock farm systems to high value arable systems and permanent horticulture.
- Provided the MSS adopts the Water User Agreement contractual framework as per the RWSS then it will provide ample ability to accept or reject farm systems that don't meet the necessary standards. It will also be within the schemes discretion as to whether to make some of its decisions in this area public (though within the constraints of the Privacy Act).
- In the unlikely eventuality the MSS did make a material contribution to DIN then there are requirements within the consent conditions to take an adaptive management approach to on farm management systems.
- The subject is likely to need its own public engagement strategy however given its profile previously.

Head race designation and local planning instruments

The is material risk to the future of water security in the Tukituki if the MSS does not exercise the RWSS consents within the next four year period

TWSL should test its proposed approach vis a vis management of DIN with HBRC before proceeding publicly.

Headrace designation

- The location of the RWSS head race designation (16 km) alongside SH 50 is designed to secure the route within the CHBDC District Plan.
- Post HBRC selling the IP to WHL, CHBDC picked up responsibility for the Head Race Designation.
- If CHBDC is not intending to be a financial partner to MSS then the designation needs to be transferred to an entity that is.
- Further that entity will need to be assigned Requiring Authority Status by the Minister for the Environment on application.

Local planning instruments

- CHBDCs proposed District Plan contains provision for two Significant Natural Areas ("SNA") of interest to the MSS being:
  - The Makaroro Gorge;
  - Lake Whatuma;
  - In the case of the Makaroro Gorge the current RWSS consents over-rides this provision but may not survive if not exercised by the Lapse date; and
  - Heretaunga Tamatea has lodged a submission as a party to the proposed Whatuma SNA.
- The approach should test with HBRC vis a vis management of DIN with HBRC before proceeding publicly.

National planning instruments

The overall assessment of the RWSS consents fit with the latest national regulations represent good alignment but this should be tested with HBRC.

National Policy Statement for Freshwater Management (NPSFM)

- TMoTW and the RWSS consents are considered to be complementary.
- Mana Whenua involvement in the MSS will likely enhance this view.

Freshwater National Environment Standard

This instrument will require any dairy conversions and establishment of "Feedlots" to be specifically consented if progressed under the RWSS consents, notwithstanding the discharge to land consents already prevailing. It is the view of Lewis Tucker that Dairy Conversions are highly unlikely and on this basis this is not considered a major issue for the TWS.

Future of Overseer as a regulatory tool

Given the uncertain future of Overseer as a regulated nutrient management tool, there is conjecture that there will be shift to requiring adoption of (yet to be determined) input based versus output based regulatory tools. Whilst this is a substantive subject in its 'own right' the RWSS initially built its environmental effects analysis on the back of a more complex, but data rich framework developed by Plant and Food Ltd (SPASMO).

The consent conditions were written in a way that enabled a shift from use of Overseer to another nutrient management forecasting and compliance tool should the need arise. An initial assessment reveals that shift may be more of an opportunity than a threat.

Actions arising

It should be tested with HBRC that this assessment of the consents fit with the NPSFM and Freshwater NES 2020 is consistent with their interpretation and further seek clarification as to whether HBRC would seek to initiate a Section 128 Consent Condition review.

Next steps

With one or two exceptions most of the work on Consents can await material progress on the MSS development phase.

The short-term exceptions are:

- An agreement needs to be reached with HBRC as to the Mitchell Daysh interpretation of the consents. This should be done as a matter of priority in that misalignment carries risk from a Public Relations perspective.
- If and when the development entity for the MSS is established, that entity should apply for "requiring authority status" from the Minister for the Environment.

Longer term

- Actions in the re-development phase will include the scoping, applications for and advocacy for new consents potentially covering the environmental flow, flows into Lake Whatuma and the Mangatarata stream and a related irrigation zone. Similarly take and use consents may be required for a Southern Heretaunga Plains zone.
- Capacity and consents advice will need to be allowed for through a construction procurement process and through investor due diligence.
- As with other work streams, utilising personnel from the RWSS process should if possible be the primary option.

Construction risk allocation and pricing in support of the MSS proposition

The construction market has changed with constructors now taking less risk

Capital Structure, pricing and economics

The base case financials appear to support a commercial or hybrid capital structure

Commercially sensitive. Not for public release.

RWSS regional economic impact studies

Multiple economic assessments of the RWSS indicated a substantial positive economic impact within the Hawkes Bay economy.

Three Regional Economic Impact studies were undertaken by Butcher and Partners (2012, 2016 and 2017) for HBRC and HBRIC.

- 2012 Study:
  - Used the RWSS feasibility assessment to derive a view on the project's economic viability and contribution to Regional GDP and employment. This assessment contributed to the decision by HBRC to proceed to procure and develop the RWSS.
  - The headline impacts were assessed using a 5% discount rate and a 70-year scheme life which projected to create 2,520 jobs and an annual GDP uplift of $250 million per annum.
- 2016 Study:
  - This study was commissioned by HBRIC ltd as part of its investment recommendation to HBRC. The study was based on refined data as compared to the 2012 assessment. The scenario assumed conversion of land from ~1,100 ha to ~4,000 ha of higher value Horticulture and Viticulture. That forecast was based on local advice and assessments of profitability.
  - The headline impacts include an annual GDP uplift of approx. $400 million and creation of 3,580 jobs.
- HBRC RWSS review 2017:
  - With a change in the composition of the elected arm of HBRC a review of the RWSS was initiated and another assessment was undertaken with some minor changes in cost/financial inputs into the economic model. Two scenarios were run which included the 2016 land use change scenario and a more conservative land use change scenario.
  - Headline impacts suggested a GDP uplift of ~$380 million and creation of 3,580 jobs assuming the 2016 land-use change forecast. The more conservative land-use change forecast projected a GDP uplift of $295 million and 2,670 jobs.
  - Note the numbers outlined above assumed a 5% discount rate which in today's low interest rate economic environment seems reasonable.

Regional economic impact assessment

It is reasonable to assume the MSS will have a very positive economic impact within the Hawkes Bay economy even though it may deliver less water for consumptive use (than the RWSS proposed).

However, any assessment should take into account the climate change impacts on primary sector productivity elsewhere – part of its purpose may therefore be assisting with wider regional resilience.

The MSS proposition projects (at a high level) a drop in irrigated area of approximately 5,000 ha or 20%. The question is, should the economic analysis be re-run, taking into account the revised capital cost, water price, water uptake and land use change numbers, and if so which.

The project scope has not explicitly allowed for this undertaking, however, this type of analysis should be re-run assuming the project moves to a redevelopment phase. The underlying assumptions should be further developed as a part of the redevelopment project plan and the analysis run once there is a high level of confidence about construction cost forecasts and water demand.

This analysis will be materially useful for informing conversations with regards to public sector investment of capital/debt and or revenue if any. In the meantime it will not be unreasonable if quoting GDP and employment numbers to suggest they are expected to be 20% less than those quoted in the RWSS 2017 review i.e., as follows:

- 'Fast Land- use conversion', GDP uplift of approx. $300 million and 3,080 jobs; and
- 'Conservative land use conversion', GDP uplift of approx. $230 million and 2,130 jobs (rounded).

It is reasonable to expect that the MSS will have a life in excess of 70 years and these numbers may be conservative if any of the 20 million environmental flow is ultimately used in part for consumptive purposes in the years where it not required for the minimum flow maintenance. Land use change to permanent horticulture and other higher value land uses e.g., fine seed has progressed in the Ruataniwha Plains where there is reliable water.

When viewed through a broader regional lens, at least some of the economic uplift associated with the MSS may be in part offset by declining dryland farm productivity.

It should be noted that the Hawke's Bay Local Authorities through the regional economic development strategy 'Matariki' have water security made water security a key issue.

Appendices

1. References

Title	Title
1. Appendix 1 - TWSS - Hydrology Letter DCL	Water uptake Statistics HBRIC Ltd presentation to HBRC 2016
2. Appendix 2 - RWSS Climate Change Report	Central Hawkes Bay Water Security Project, Tonkin and Taylor, June 2020
3.0 Appendix 3.0 - TWS Construction Update May21	Central Hawkes Bay MAR Pre-feasibility Assessment, WGA/HBRC, 2019
3.1 Appendix 3.1 - Ruataniwha Tender Design Review	MAR Consent Applications, Mitchell Daysh
3.2 Appendix 3.2 - SDS Map	Te Mana o te Wai, Water Commissioners Workshop, March 2021
4.0 Appendix 4 - Secondary Distribution Memo	He Pukenga Wai, Salmon Lecture, justice Joe Williams, 2019
5.0 Appendix 5 - Consenting Overview	Tukituki Board of Enquiry Tukituki Proposal Decision 2015
6.0 Appendix 6 - Te Mana o Te Wai	RWSS Financial Model 2016
RWSS Pre-feasibility Report 2009	RWSS Technical Due Diligence Report, Snowy Mountains Engineering Corp, August 2016
RWSS Full Feasibility Report 2012	RWSS Review HBRC 2017
RWSS Business Case, HBRC 2014	RWSS Intellectual Property database (held by Water Holdings Ltd)
RWSS Design Support and Endorsement, Obrascon Huarte Lain SA Technical Services, August 2013	
RWSS Tender Design Peer Review, Dam Watch, August 2013	

Glossary of Terms

Term	Terminology
Command Area	The gross area that could be supplied with water from a scheme
Cumecs	Cubic meters per second
CPI	Construction Price Index
Current Irrigators	Farms with a current consent to take water whether they irrigate or not
Dryland Farms	Farms that do not have a consent to take water (for irrigation)
Effective Area	The actual area of land farmed. (Excludes all non-productive areas)
Farm	Single or multiple properties owned and/or managed and operated by a farmer as a farm unit; for clarity a farm can include leased land and operated as part of that farm
Farmer	A person or entity responsible for operating a farm and for the purpose of WWL will make decisions on behalf of the farm
Irrigable Area	The farm area that could potentially be irrigated, excluding all non-productive areas (as defined by the farmer)
Irrigated Area	The current irrigated area on a farm (as informed by farmer)
Net Supplied Area	The portion of the Command Area expected to actually be irrigated/supplied, after accounting for buildings, tracks, hedges etc.
Property	An area of land with a legal title; a farm may comprise several properties
Stakeholder	Any party interested or affected by the Project; includes communities, individuals, and groups who are either indirectly or direct affected
Total area of farms involved in the Scheme	The gross area of whole farms that could be influenced by the Scheme. This includes the parts of farms directly within the Command Area, plus the parts of farms currently assumed to be outside the Command Area (for example hills) but that are still affected because the farms are operated as whole units