

Ruataniwha Water Storage Scheme Review

Report

May 2017

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Approved By:

James Palmer, General Manager Strategic Development

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Background to the review

This Review of the proposed Ruataniwha Water Storage Scheme (RWSS) was initiated by resolution of the Hawke's Bay Regional Council (HBRC) on 14 December 2016 with a set of specific review questions detailed throughout this report.

In commissioning the Review, the Council agreed that the purpose was to ensure that "the costs and benefits of the scheme, as well as risks and opportunities with decisions to proceed, abandon or shelve the scheme, are clearly identified and articulated in order to facilitate informed decision making." It should be noted that the Council agreed that while "the purpose of the review is not to recommend to councillors whether to proceed, abandon or shelve the RWSS", the review provides the Council with an opportunity to reconsider and reset the 'conditions precedent' for the scheme should they choose to continue with its development.

The Review was conducted independently of both councillors and the RWSS developers, the Hawke's Bay Regional Investment Company (HBRIC Ltd). However, in commissioning the Review the Council agreed that the approach should be to "leverage the knowledge of internal staff and existing advisors to the greatest extent possible and use 'fresh' eyes by exception where councillors identify this as being necessary."

In any event, 'fresh eyes' were used to examine evidence and provide advice on most matters in this process. However, it has been necessary to have some dependence on the evidence and opinions of several individuals with prior associations with the scheme. Where this has taken place their evidence and opinions have been subject to further review and consideration by fresh advisors working through this Review process.

The Review has been led by the Council's Group Manager Strategic Development (GMSD), who is responsible for both resource management planning and economic development within the Council, and the views expressed in the cover report are either his or those of other advisors where attributed. The Review involved many inputs from Council staff, HBRIC Ltd management, and contracted expert advisors, with those inputs principally contained in the appendices to this report.

The process of commissioning and assembling this advice has been overseen by a Community Reference Group drawn primarily from interested persons within the Central Hawke's Bay Community; appointed by the GMSD. Statements on the process from this Group are set out on page 77.

Limitations

This Review has not sought to re-evaluate every aspect of the proposed RWSS scheme, or every element of Plan Change 6 in the Tukituki catchment. The time and resources available for the Review have precluded this and to do so would be to repeat many of the evaluative processes, including judicial processes, which have previously occurred. There has been extensive evaluation of many of these matters through the Board of Inquiry process and subsequent court proceedings, which considered more than 26,000 pages of evidence. There has also been substantial ongoing advice to the Council on the RWSS proposal over the last 5 years.

This Review has aimed to provide a high level summary of the key legal, financial, economic, environmental and engineering issues associated with any decision by the Council to proceed with its investment in the scheme. In assembling this summary effort has been made to address issues of ongoing concern in the community about the costs and benefits, and risks and opportunities associated with the scheme. Inevitably there will be matters of importance to some members of the community that will have been given less emphasis than those individuals believe they deserve.

Executive summary

The Tukituki River catchment is a large, heavily modified catchment that has been significantly transformed since European settlement for undertaking agriculture, predominantly for sheep and beef production. The River carries rainfall from the headwaters in the Ruahine Ranges, through extensive pastoral landscapes in Central Hawke's Bay, which are commonly dry and drought-prone in summer months, out to the sea near Havelock North, Haumoana and Clive, covering a distance of over 100 km. The middle and lower reaches of the River are particularly valued by the community for recreation and amenity. Owing to the scale (2500 km²) and geomorphology of the catchment, predominance of pastoral livestock farming, and the low rainfall and river flows typical in summer months, the Tukituki River presents major challenges to the Hawke's Bay community in achieving substantial improvements to river water quality.

In 2012 the Hawke's Bay Regional Council embarked on new policy development for the catchment aimed at addressing the low summer flows associated levels of algae and slime, or periphyton, via a plan change to the Regional Resource Management Plan, known as Plan Change 6 (PC6). The policy sought to modify the rules governing water allocation to address over-allocation of surface and groundwater, and to regulate land use in order to reduce the phosphorus losses from land to water that stimulate periphyton growth. This policy culminated in a combined strategy to also advance water storage in the catchment to assist with meeting the flow, water security and water quality objectives of the catchment through what has come to be known as the Ruataniwha Water Storage Scheme (RWSS).

The RWSS is a nationally significant proposal involving long-term public and private investment in large-scale infrastructure, with complex hydrology and engineering, and involving land use and water quality implications that will require careful ongoing management. The RWSS is an unprecedented intervention for any regional council in New Zealand. In seeking to generate better environmental outcomes with economic and social benefits via commercial water storage, the Hawke's Bay Regional Council (HBRC) has taken the role of an environmental regulator into the higher risk realm of using its financial balance sheet to more actively enable change.

The proposal to capture the higher winter rainfall from the headwaters of the Makaroro River and use this to reduce pressure on groundwater resources and increase the availability of water for irrigation in dry summers is transformational. To do this all within a commercial framework that enables the concept to be self-financing over time, and turn a profit, is bold. As it is both transformational and bold the RWSS therefore also involves both opportunities and risks.

Over the last 7 years an enormous amount of analytical work has been undertaken to plan and evaluate the many aspects of the scheme. The proposal was scrutinised by a central government-appointed Board of Inquiry, which considered over 26,000 pages of evidence, and has been further evaluated by numerous advisors for the HBRC's development entity, Hawke's Bay Regional Investment Company Ltd (HBRIC Ltd), and other RWSS investors, and then subsequently by the team conducting this Review.

Overall, it can be concluded that the risks associated with the scheme have been extensively assessed and the Council can have confidence that these risks have been identified and, where possible, quantified. How satisfactorily these risks have been mitigated by the proposed financial, engineering and environmental management arrangements for the RWSS, and how reasonable it is for various risks to remain, is a matter of judgement for the Council in determining whether or not to continue with developing the scheme.

Some risks are inherently more manageable than others. In general, this Review concludes that where 'de-risking' can be undertaken, it has been. However, despite this de-risking there are aspects of the scheme proposal that cannot be known definitively in advance. These are the areas of uncertainty and are the areas of principal risk involved in the RWSS proposal.

Of the five major themes of this Review – legal, financial, economic, environmental and engineering – two of these present relatively low levels of uncertainty and therefore low risk to the Council's interests.

The first of these is in the legal area where the Review has confirmed the Council's right to withdraw from pursuing the RWSS as long as due process is followed and the community is consulted in a meaningful way. In the event the Council follows this path then the Review has confirmed that the risks of liabilities to the Council, beyond writing down the \$19.5 million value of the investment to date, are relatively low. The Crown may seek repayment of its approximately \$7m co-investment to date but there is no contractual obligation on the Council to do so.

Conversely, should the Council wish to continue with the development of the scheme the necessary legal framework and principal resource consents are in place for the scheme to proceed. While further resource and building consents, and consent modifications will be required before construction can commence these are judged to not represent substantive risks to the scheme's ability to proceed.

The second area of relatively low uncertainty is in the engineering theme. Gravel management, seismic risk to the dam structure, future costs of decommissioning and catchment hydrology were all reviewed in the course of this exercise. Based on the advice contained in this report and attached appendices these are not considered to present material uncertainty to the Council as an investor.

Alternative dam sites and on-farm storage have also been considered at a high level and while these could spread risk away from a single site project and such a large capital commitment, and could avoid the controversial Department of Conservation land, these alternatives are considerably more expensive on volumetric basis. These alternatives also pose new issues with respect to obtaining water, mitigating the effects of land use and the loss of productive land. The engineering section overall suggests that the RWSS is the most cost effective and efficient method of storing water for Central Hawke's Bay irrigation at scale.

An area that presents a higher level of uncertainty is the RWSS' economics, principally due to the uncertainties about future land use under the scheme. This Review has confirmed that RWSS water is affordable at farm level across a range of possible land uses. Affordability and profitability on-farm are forecast to improve further in time, with productivity growth arising from improved management skills, technology and genetics.

What is less clear is how much land will migrate to what types of use over time in response to the availability of reliable water supply. Different land use profiles have differing economic impacts for the region, including on downstream processing and the number of new jobs created. Agricultural exporters canvassed during the Review were generally positive about the benefits of the RWSS, including for vegetable and arable farming, but also highlighted that despite apples and grapes currently being grown in the RWSS supply zones, new horticulture and viticulture development is likely to be limited in the short to medium term.

Provided the anticipated land profitability is reached, then under all scenarios tested including base case, slower conversion to orchards and vineyards, and smaller final areas in orchards and vineyards, the project generates a net benefit from a financial perspective provided it continues for 70 years. This is the case even if a discount rate as high as 7% is applied.

If the anticipated profitability is not reached (if Earnings Before Interest and Tax, or EBIT, is less than has been predicted), then obviously project financial benefits decline. If the project has a 70 year life, then at a 5% discount rate all scenarios tested still have a positive Net Present Value, even with a 15% decline in EBIT. However, if the discount rate is increased to 7%, then the highly conservative scenarios, which have slower or zero additional conversion to orchards and vineyards, have a negative NPV.

At full uptake of RWSS water the scheme is forecast to increase annual regional Gross Domestic Product by between \$130 million in a pessimistic scenario and \$380 million in the 'base case', and create between 1130 and 3580 jobs. Increased revenue for the Council-owned Port of Napier in either a low or base case orchard and vineyard conversion scenario is forecast to be between \$2 million and \$2.5 million. More weight should be given to the mid-point of all these ranges given lower levels of horticulture production are anticipated in the short to medium term but more horticultural development is expected in the longer-term.

A key benefit of the RWSS is that it will help manage the impacts of new PC6 'minimum low flow' restrictions for the catchment, without which there will be reduced irrigation security for existing irrigating farmers in 2018, further exacerbated in 2023, when the restrictions on irrigation lifts by 50%. The annual farm earnings (EBIT) impact of this reduced irrigation security, without the RWSS, is estimated to be a reduction of \$900,000 on average and over \$4 million in the driest years.

In assessing the proposed financial arrangements relating to the construction and operation of the RWSS this Review has concluded that these have been thoroughly scrutinised, including by other investing parties, are mostly predictable and (unless they materially change) present relatively low risks to the Council. The detailed design, construction and operation of the scheme are all subject to fixed pricing arrangements.

The 35 year 'take or pay' water contracts with Foundation Water Users provide a solid and secure revenue base for the RWSS. Furthermore, with these Users comprising 61% of irrigable land able to be supplied by the RWSS and owning enough irrigable land to use nearly all of the RWSS water supply, the Council can have confidence that the risk of financial failure by the RWSS is very low.

However, while the RWSS is forecast to 'break even' from Year 1, there remains a degree of uncertainty about the timing and therefore quantum of the financial returns to HBRIC Ltd. Over the scenarios used for financial modelling in this Review, and even in a 'severe downside' case of water sales never exceeding 82% of full uptake, the scheme returns at least a 7.1% return to HBRIC Ltd over the first 35 years. The cash returns are forecast to fall well short of the 6% required by the Council in the first 22 years however, and therefore HBRIC Ltd will be required to undertake substantial borrowing against its equity and future earnings in the scheme, or require greater dividends from the Port of Napier, if it is to pay the 6% required by the Council during the early years of the scheme's operation.

The key financial question the Council needs to resolve is whether it believes the rates of return on the Council's capital, including the risks around the timing and quantum of these returns, are acceptable in light of the Council's broader strategic economic and environmental objectives. The Council also needs to determine whether it requires a higher level of initial uptake to manage the risks to its financial returns, and whether it wishes HBRIC Ltd to borrow against its equity to maintain distributions to the Council.

Achieving the construction of such major infrastructure to address significant environmental and regional economic objectives at not only no additional cost to the ratepayer, but also at a commercial return commensurate with other infrastructure assets, is an ambitious goal. The Council needs to clarify which of its objectives are paramount and which ones it is comfortable can be put at risk.

The area of greatest uncertainty and risk for the Council relates to the environmental management challenges for water quality arising from land use in the Tukituki catchment. A key finding of this Review is that substantial environmental risks and uncertainty exist for the Council in this catchment with or without the RWSS. However, the RWSS was developed as a complementary element of a dual management strategy with Plan Change 6 and the risk profile for the Council is markedly different depending on whether or not the RWSS proceeds.

The environmental management risks are the most difficult to definitively quantify due to the scale of the catchment and the scheme, the inherent uncertainties, complexities and knowledge gaps with natural and biological systems, and the imperfect planning and policy framework of Plan Change 6. Environmental management is rarely a perfect science and usually requires decisions with imperfect information and judgements about how to treat risk. When faced with uncertainty environmental regulators can often manage risk by adopting 'adaptive management' approaches that allow methods to be tested and modified over time. This presents the Council with a particular challenge when confronting such a binary decision with long-term consequences such as is the case with the RWSS.

Possibly the most readily quantifiable aspect of the Review's environmental considerations is in the area of river flows. In addition to the increased river flows for conveyance of irrigation water to down-stream abstraction points, and expected additional irrigation 'losses' through groundwater to surface water, the RWSS is required to assist with low summer flows as conditions of its consents. These conditions require the scheme to contribute an additional 1.9 million m³ of water, on average each year, to the low summer flows in the Makaroro, Waipawa and Tukituki rivers. Much more is provided in dry years, and to demonstrate, the 2013 drought year would have required 6.77 million m³ in flow augmentation. These flows will bring environmental, social and cultural benefits at times of high water stress in the catchment.

In addition the RWSS is required to provide four 'flushing flows' each summer each of 1 million m³ over 9 hours to remove periphyton. These flows were reviewed as part of this Review, and were concluded to be likely to provide effective flushing in the Makaroro and Waipawa rivers, but there is less certainty about effectiveness in the Tukituki River. The RWSS therefore plans to 'piggyback' on rainfall events to enhance flushing in the Tukituki. The opportunity exists to increase capacity in the dam for rates of flushing by 60% at a cost of up to \$2.95 million.

While the relationship between flows and periphyton can be quite direct, the relationship with nutrients is far more complex. The levels of Dissolved Inorganic Nitrogen (DIN) in the Ruataniwha sub-catchments including from winter-based, intensive stock trading and finishing production systems, already exceed water quality limits in PC6 now. As a result more than 100 farms currently planning to join the RWSS (and come under the RWSS' global consent for all supplied farms) are likely to have to be regulated by resource consent on a property by property basis if the RWSS does not proceed. The Council will need to actively regulate land use on these properties and others in the exceeding sub-catchments, through uncertain mechanisms, while it is working with the wider catchment on improving other priority issues such as sediment, erosion and Dissolved Reactive Phosphorus (DRP).

The Review has highlighted that the 'Land Use Capability' (LUC) nitrogen leaching rates in PC6 actually allow for *increased* nitrogen losses on many farms and do not provide an effective mechanism to control land use to meet the Plan's limits for in-stream DIN. The Board of Inquiry accepted some increase in nitrogen losses occurring at catchment scale but set in-stream DIN limits that work against this notion on the Ruataniwha

Plains. This places additional risk and uncertainty on the extent to which increased irrigation enabled by the RWSS can be compatible with achieving the limits in PC6.

The Review has also highlighted the lack of any clear case for the DIN limits being set at their current level relative to the objectives in the Plan, other than being a trigger for more intensive management effort. However, the Plan provides no guidance on what actions should or can be taken once the DIN limits are triggered other than farms must apply for resource consents and meet LUC leaching rates. Furthermore, the Review has highlighted that meeting the DIN limits in all Tukituki sub-catchments by 2030 is highly improbable and may even be physically impossible. It appears the Board of Inquiry may have misunderstood the requirements of the National Policy Statement on Freshwater Management in setting the DIN limit timetable of achievement by 2030. The discontinuities in Plan Change, as well as emerging national requirements, highlight that elements of the Plan will need to be reviewed in time, with or without the RWSS.

The RWSS proposal includes a mitigation package of environmental enhancement – fencing, planting, pest control – as well as the supplementary summer flows and flushing flows, mentioned above, to remove periphyton. The scheme is required to manage environmental compliance of all its supplied farms through nutrient allocations and Farm Environmental Management Plans, establish research farms and to monitor a wider range of environmental parameters than the Council. Overall, Council staff believe that without the RWSS the Council's implementation of PC6 will be more costly and some of the objectives harder to achieve.

Taken together, the environmental issues canvassed by the Review present a difficult choice for the Council because there are risks and uncertainties whether the RWSS proceeds or not. This choice is essentially to either: 1. principally rely on regulation of land use, based on uncertain science and law (and currently deficient policy), to reduce intensive livestock farming on the Ruataniwha Plains with little or no economic upside; or 2. to complement PC6 regulation, with all of its limitations, by using the Council's investment in the RWSS as a driver of land use change on the Ruataniwha Plains from winter to summer-based production systems, and with less livestock and more arable and horticultural production over time. The full extent to which the Council can use its investment in the RWSS in this way, and how quickly and effectively it can be done, requires significantly more analysis than has been available for this Review but the opportunity is genuinely apparent. Both options will involve years of effort with no guarantee of success.

A third approach, which has been beyond the scope of this review, could be to supplement the regulatory approach required by PC6 without the RWSS and deploy the Council's financial resources in a less commercial model, possibly with little or no financial return, to facilitate land management and land use change without large-scale irrigation development.

Given the ability of the RWSS to manage land use collectively and to require more actions on-farm than the Council under PC6, the RWSS option presents more flexibility with more economic upside. Equally, it is not possible to rule-out land use from RWSS-enabled irrigation exacerbating the current nitrogen management challenge. The theoretical ability to require the RWSS to drive down the nitrogen losses of its supplied farms is already in the Council's hands via PC6 and the RWSS consents. The question will be one of the practicalities of regulating based on as yet unknown legal and scientific tests.

Put simply, the Council has the principal levers to ensure the RWSS operates in a manner consistent with achieving the PC6 water quality targets and the RWSS has the levers to ensure its farmers comply. Quantifying what this will involve on any given farming operation cannot be determined without considerably more analysis and farmer engagement than has been available to this Review.

The Council needs to decide which set of risks it prefers, and which set of levers presents the best prospects of achieving the highly durable *objectives* of Plan Change 6. Both courses are fraught with uncertainty and the Hawke's Bay Regional Council does not have the luxury of 'doing nothing'.

In addition to deciding whether or not to continue with the RWSS, this Review concludes that the Council needs to clarify or re-state its objectives for the catchment, including and particularly timetables for achievement. In time, it will need to ensure the policy and planning framework is fit-for-purpose for achieving the objectives in the desired timeframes.

Given the RWSS's ability to influence land management and land use in the Ruataniwha Basin within the existing PC6 construct, this Review concludes that should the scheme proceed it would be appropriate to continue to work through the DIN-limit implementation issues in PC6 over the next four years during the construction phase. The development of the Irrigation Operational Management Plan, required by the RWSS consents before water is delivered, is the key opportunity to plan the approach to reducing nitrogen losses under the RWSS.

However, should the RWSS not proceed this Review concludes that it will be necessary to revisit and review Plan Change 6 with some urgency. This will involve significant science and planning resources that will need to be allocated within the upcoming 2018-2028 Long Term Plan.

1 History of the Tukituki Catchment

Located centrally within the Hawke’s Bay Region, the Tukituki catchment covers approximately 2,500 km² (250,000 Ha), making it the third largest catchment in the region. Prior to human occupation the Tukituki catchment landscape was mainly dense bush on the hill country to the west of the catchment with swamp and scrubby vegetation on the lower flatter parts of the catchment. Erosion was occurring and sediment was moving through the Tukituki Catchment’s network of rivers. There would have also been low levels of nitrogen and phosphorus being added to the streams through natural pathways.

Over the last 2 million years the Ruataniwha basin was formed, as a result of uplift of the Ruahine ranges. The Ruataniwha Basin is bounded to the west by the greywacke rocks of the Ruahine Ranges. The eastern boundary of the basin was uplifted between 2.5-5 million years ago and formed the Turiri Ranges, Rakawa Ranges, Pukeora Hills and Mount Vernon out of siltstone, sandstone and limestone. Over the last 1 million years river sediments have infilled the Ruataniwha Basin to give us what we call today the Ruataniwha Plains. Uplift and erosion of the basement rocks resulted in deposition of the gravels that underlie the Ruataniwha Plains, displacing the seaway (Ruataniwha Strait) that linked it with the Heretaunga Plains.

During this process a complex multi-layered aquifer system was formed. The main aquifers within the Basin are comprised of two main gravel layers. The top layer is composed of young gravels from the Late Pliocene (5.333 million to 2.58 million years ago) underlain by older gravels, known as the Salisbury gravels. Both layers are thickest in the northern and western reaches of the Basin and thin or absent toward the southern and eastern edges (Baalousha, 2010).

According to legend two *taniwha* lived in a lake situated somewhere in the upper basin of the present Tukituki River. They fought for possession of a boy who fell accidentally into the lake and their struggles formed the Waipawa and Tukituki Rivers, which drained the lake. Tukituki means “to demolish” and it is thought that this refers to the destruction of the lake mentioned in the story.

Māori settled in Hawke’s Bay around 1250–1300 AD. The people who became known as Ngāti Kahungunu arrived in the region sometime during the 16th century. Māori used tracks and waterways to get around. Rivers running down to the coast that were navigable by waka (canoe), such as the Tukituki, were used like highways.

Leading into the 1800s European settlers entered the region.

2 Current State of the Tukituki Catchment

Land Use

Over time, a large part of the catchment has been extensively modified by the clearance of vegetation, land drainage, and land development. However, the upper reaches of the catchment have largely escaped human influence and are dominated by native vegetation. There are approximately 1500 rural properties in the catchment. 1100 of these are 5 Ha or larger (the Tukituki Plan Change requires farming properties over 4 Ha to have a farm plan). Sheep and beef land use dominate this catchment, making up seventy two percent followed by indigenous forest, being nine percent. Dairy only occupies four percent of the catchment area while short-rotation cropland covers two percent of the area.

Figure 1 – Tukituki catchment land use

New Land Use	Hectares	Percentage
Sheep and Beef	163,786	65%
Indigenous Forest	21,454	9%
Beef	16,789	7%
Exotic Forest	11,925	5%
Dairy	10,499	4%
Deer	4,363	2%
Short-rotation Cropland	4,206	2%

There is a relatively small amount of horticulture (apple growing), viticulture and perennial crop, which combined is a total of one percent.

Groundwater

Groundwater extraction in the Hawke's Bay has been occurring since the mid-19th Century. The largest groundwater resources exist within the Quaternary deposits beneath the Heretaunga and Ruataniwha Plains. The aquifers consist predominantly of river gravels eroded from the axial ranges and transported to the plains. More than 90% of the region's consented groundwater allocation and 84% of the wells are on either the Heretaunga or the Ruataniwha Plains.

Surface Water

The community consider periphyton growth to be a major issue in the Tukituki River. This is a long-standing issue. A 1968 publication by the Hawke's Bay Acclimatisation Society refers to summer conditions bringing "weed, which gradually builds up in the shallows as the river recedes, and spreads out thirty feet or more from the edges in a great slimy yellow-green mass". It is noteworthy that recent monitoring would suggest that periphyton growth at Red Bridge would place it in a 'B' band according to the National Objectives Framework (NOF). Additionally, PC6 targets on periphyton are likely to be met at most sites in the Tukituki, because the rules only stipulate a maximum growth for within an 'accrual period' of 30 days.

The time when the community are least happy with the level of periphyton is during protracted periods of low flow, when the level of periphyton would not be assessed as it falls outside the 30 days accrual period.

We do not have trend information on periphyton, but based as mentioned above it appears to be a problem that has been around for quite some time. So, in terms of periphyton growth, we currently have levels that the community are not happy with, but we are likely to meet targets set both by PC6 and the NOF.

Macroinvertebrate indices (e.g. MCI) are thought to reflect overall 'ecosystem health'. We are currently not meeting PC6 MCI targets at any subcatchment monitoring site in the Tukituki catchment for which we have data. This represents a significant management challenge.

Faecal contamination in the catchment is variable, as measured by *E. coli*. It is difficult to provide an overall 'score' for *E. coli* because PC6 has prescribed targets which differ for season and flow conditions. HBRC has not been able to fully assess compliance against these targets with recent data in the timeframe of this Review. However, based on data from 2004-2013, many sub-catchments appear to be failing the PC6 targets including the Porangahau, Kahahakuri, Papanui, Mangatarata and the upper and lower Tukituki corridors. It is worth noting that monitoring sites that appear to be failing PC6 targets were either in, or downstream of, priority sub-catchments, within which land management are focusing efforts around environmental farm plans and stock exclusion. Faecal source tracking has been done for the Papanui and Porangahau sub-catchments and indicated that cows were the most common source of contamination.

Three sites are monitored along the Tukituki River as part of our recreational water quality monitoring programme, and so we can report that the Tukituki at Black Bridge is considered "poor" for recreation, and the Tukituki and Walker Road are considered "Fair". These ratings are somewhat conservative, given that all three of these sites were considered safe to swim 95% of the time during the summer of 2015-16.

In terms of nutrient levels and targets set in PC 6, we are currently failing to meet the Dissolved Reactive Phosphorus (DRP) and Dissolved Inorganic Nitrogen (DIN) targets in 65% and 24% of the sub-catchments, respectively. Noncompliance with DIN limits are centred around the Ruataniwha Plain sub-catchments, whereas non-compliance with DRP limits are more evenly spread.

About half of the 17 sub-catchments (n=8) require a greater than 50% reduction to meet DRP targets. Recent trend analyses (for the period 2004-2013 – the most recent two 5-year trend reports) identified 3 sites with deteriorating phosphorus trends, and 1 site improving.

Of the 6 sub-catchments currently exceeding their DIN limit, all but one require a reduction of more than 50%. This is likely to reflect the dominance of pastoral land use and intensive stocking practices on the Ruataniwha Plains. There were 4 sites with improving nitrogen trends, and no sites deteriorating.

To summarise, phosphorus is a major problem in much of the Tukituki, and is currently a more extensive problem than nitrogen. However, nitrogen is a problem within the Ruataniwha Plains sub-catchments where there are already major exceedances of PC6 DIN limits. This is of particular relevance to this Review and the matters canvassed in the Environment section on p38.

Consents

There are 226 water permits within the Tukituki catchment. These authorise the taking of groundwater (162) and surface water (64), including from on-farm storage dams. Water is consented for use for a range of purposes, including irrigation, frost protection, potable supply to communities and towns, industry and agriculture. Noting that consented use is predominantly for irrigation (88% of the consented 28-day volume), followed by potable supply (6%), dam filling (4%) and industry/agriculture (2%). The majority of the consented volume is from groundwater (71% of the consented 28-day volume), with the remainder from

surface water. In addition, for further granularity, of the water allocated for irrigation, 47% of the volume is for pastoral irrigation, 39% is for irrigation of crops, 12% for orchards, and 2% is for irrigation of vineyards.

If we narrow this down to the Ruataniwha Basin, there are 60 consents to take groundwater from the Ruataniwha Basin. Most (47) of the consented groundwater takes in the Basin are located in Groundwater Allocation Zone 3 (south of the Waipawa River). There are 13 consented groundwater takes from Groundwater Allocation Zone 2 (north of the Waipawa River). The major consented use is irrigation (90% of the consented 28-day volume), followed by industry (9%) and potable supply (1%).

- Of the water consented for irrigation use, most is for irrigation of pasture (48% of the annual volume consented), followed by crops (42%), and orchards (10%).

Allocation Summary

The Ruataniwha Basin Groundwater Allocation Zones are fully allocated. All groundwater consents have been reviewed and have had seasonal volumes added. Minimum flow conditions have been added to consents where applicable, and will take effect from 2018 unless the consent holder moves to deeper bores, or is able to prove that the take is not affecting surface water flows.

- The Otane Groundwater Allocation Zone is not currently fully allocated, with 17% unallocated.
- The Tukituki River is fully allocated for direct surface water takes. There is some allocation available for stream depleting groundwater takes, where these are located outside of the Ruataniwha Basin.
- There are a number (12) of groundwater consents in the Lower Tukituki River which currently do not have minimum flow restrictions, but will have minimum flow conditions added in 2018 unless consent holders move to deeper wells or prove that their takes are not affecting the river. These consents are predominantly for irrigation of crops and orchards.
- There are 15 consents authorising high flow takes (i.e. taking water from the river above median flow levels) to fill on-farm storage reservoirs or for damming waterways to create on-farm storage reservoirs. There is remaining allocation available for high flow takes.

Tranche 2 Groundwater – Ruataniwha Basin

- The Tranche 2 concept provided for in PC6 allows for abstraction of up to 15 million m³/year from 'deep' groundwater (wells screened > 50 m in depth) provided that the effects of the take are mitigated through augmentation of the Waipawa or Tukituki River. The concept is that the consent holder will calculate their effect, and replace this by discharging water to the river affected. See Pol TT8 and Rule TT4(c).
- We are currently processing six applications for Tranche 2 water, totalling a volume of 24.593 million m³/year. The largest volume sought is by HBRIC Ltd (10 million m³/yr). The volume applied for exceeds the allocation limit, and is made up of a volume for irrigation and a volume for the required stream/river augmentation.

HBRIC Ltd Consents

- HBRIC Ltd was issued with 17 consents to authorise aspects of the proposed RWSS scheme. These were issued in June 2014 and subsequently amended in June 2015 after the referral back to the Board of Inquiry from the High Court Appeal.
- Two of the consents are land use consents with HDC and CHBDC. The remaining 15 consents are HBRC consents, and relates to matter such as installation of intake structures in river beds, dam construction, damming and taking of water, discharges of water, production land use and beach renourishment.
- The consents are contingent on a number of Schedules and Management Plans (e.g. Groundwater Management Plan, Irrigation Environmental Management Plan). Of note is Schedule 3 to the Production Land Use consent, which sets out the requirements for monitoring and modelling the effects of land use on surface water groundwater quality, farm management plans, and nutrient loss and leaching.
- The consents were issued for a period of 35 years from the date the consents were granted. The consents have a 10-year lapse date.
- HBRIC Ltd applied in November 2015 to change Schedules Two and Three of the consents, to add conditions to include Macroinvertebrate Community Index monitoring and reporting. This change was granted in March 2016.
- In December 2015, HBRIC Ltd also applied for two new consents to use water and productive land. These consents sought to allow for the use of water across new areas of productive land not originally included in the original applications and subsequent consents.
- The proposed new production land use areas have a total area of approximately 25,000 ha. The new areas are predominantly located over the Ruataniwha Basin, within tributaries of the upper Tukituki and Waipawa Rivers. An exception is the proposed area adjacent to Zone M, which is located within the Papanui Stream sub-catchment.
- The consents were granted in January 2016. The decision to process these applications on a non-notified basis was the subject to of a Judicial Review taken by Greenpeace to the High Court. This judicial review was discontinued in February 2017.

A summary of the RWSS resource consents is set out in appendix 23A.

3 Ruataniwha Water Storage Scheme Review Findings

3.1 Legal Issues

Issue for review: # 1

Assessment of the prospect of DoC/HBRC succeeding in the Supreme Court land swap appeal and any consequential impacts on the ability to acquire conservation land under the Public Works Act. *Comment: Completed and presented to the Council meeting of 30 November 2016.*

Advisor: Lara Blomfield, Sainsbury Logan and Williams Ltd

Issue for review: # 2

Advice on the process steps available to HBRC, and any associated legal risks, to withdraw or shelve the RWSS in the event HBRC determines that either the Conditions Precedent are not met, or as a result of any other policy matter determined by HBRC. *Comment: Some legal advice may need to be provided under privilege and not provided for public disclosure.*

Advisor: Lauren Hibberd, Sainsbury Logan and Williams Ltd

Issue for review: # 3

Advice on all anticipatable costs and liabilities for both HBRC and HBRIC arising from abandoning or shelving the RWSS in the event HBRC determines that either the Conditions Precedent are not met, or as a result of any other policy matter determined by HBRC. Advice on the residual value of RWSS-related assets, including intellectual property, in the event HBRC abandons or shelves the scheme. *Comment: Some legal advice may need to be provided under privilege and not provided for public disclosure.*

Advisors: Blair O’Keeffe, Hawke’s Bay Regional Investment Company (HBRIC); Hugh Kettle, Bell Gully

Summary of Findings for Legal Issues

This section of the Review relates to legal process and liability matters on which the Council has sought further clarity and advice. Legal questions and advice on Plan Change 6 compliance matters are addressed in the Environment Chapter of the Review on page 42.

Process to Abandon or Shelve the RWSS

Advice from the Council’s legal advisors has confirmed that the Council is entitled to withdraw from the further development of the RWSS should it wish to do so (see appendix 3). The Conditions Precedent set by the Council have not all been met and there have been ongoing delays in these being fulfilled, so the Council has not yet committed beyond ‘the point of no return’.

A decision to abandon or shelve the scheme would be contrary to the current intentions contained in the 2015-2025 Long Term Plan and to the Statement of Intent for HBRIC Ltd.

Should the Council determine that it is in the best interests of the region that the scheme be abandoned or shelved for reasons other than the Conditions Precedent not having been met, then it will be necessary to consult the Hawke’s Bay community on this course of action; either through the 2018-2028 Long Term Plan or through the Special Consultative Procedures of the Local Government Act. Consultation would also need

to include a proposal to amend the HBRIC Ltd Statement of Intent, which also requires consultation with the Company's directors under Schedule 8 of the Local Government Act.

Such decisions and consultation require consideration of the options, costs and benefits, and appropriate analysis. This Review may form a useful body of analysis on which to support such a consultation but further analysis of alternative options may be required.

It should be noted that the Council is not required to carry out all of its intentions under its Long Term Plan. However, in light of the significance of the RWSS to the Council's strategic objectives and balance sheet, and in light of the Council's Significance and Engagement Policy, consultation on a decision to abandon or shelve the scheme for reasons other than the Conditions Precedent having not been met will require a meaningful public process with a willingness to consider the community's views.

As the Council's commitment to invest in the RWSS was always dependent on the Conditions Precedent being met, a decision not to proceed on the basis of non-achievement of the Conditions could be considered consistent with existing policy and therefore not require further public consultation. However, in light of the ongoing extensions granted to HBRIC Ltd to meet the Conditions Precedent, as well as resolution of the Conditions Precedent being an active matter while the land exchange is resolved, it is recommended that any decision to withdraw from or shelve the scheme at this point be subject to public consultation. Such consultation will reduce the risk of successful judicial review of the Council's decision and be more consistent with the Council's Significance and Engagement Policy.

Legal Challenge

Any decision the Council takes could be subject to legal challenge by any entity or member of the public. The Council's legal advisors have advised that they are not aware of any contractual commitments that would give rise to a successful claim. The likelihood of successful damages or compensation from a civil claim based on HBRC abandoning the scheme, such as by farmers who have signed up to the scheme, is judged to be low as long as the Council follows due process in decision making. Importantly this due process involves meaningful public consultation, and to minimise the risk of successful legal challenge the Council should be compliant with the decision-making provisions in sections 77-79 of the Local Government Act.

During the course of the Review, at the suggestion of the Community Reference Group, further legal advice was sought on whether the Council faces risks from Plan Change 6 submitters (see appendix 4). The suggestion is that submitters representing farming interests in the catchment may have taken different positions on the provision of Plan Change 6 during the Plan Change 6 process had they known that the Council would subsequently not proceed with the scheme. The advice received is that the likelihood of success of such litigation is judged to be low given that the Board of Inquiry was explicit that Plan Change 6 stands on its own from the RWSS (para 102 BoI Final Report and Decisions).

Notwithstanding the aforementioned legal opinion, the Review has identified that based on the Council's strategy of developing the RWSS and Plan Change 6 together there are expectations in the Central Hawke's Bay community that PC6 and the RWSS were a 'package deal'. Documents produced by HBRC, such as those in appendix 3, may have created expectations that the Council will need to address, at least in respect of public communications, should the Council decide to abandon the RWSS.

Costs and Liabilities

A decision to direct HBRIC Ltd, by way of a Council resolution to modify the Company's Statement of Intent under Schedule 8 of the Local Government Act, to stop progressing the development of the scheme will have commercial implications for the Company. HBRIC Ltd has been consulted on these matters during the course of the Review and has advised that there are no contractual obligations it has entered into that would create liabilities for the Company in the event it is directed by the Council to cease the development of the scheme.

The primary cost to HBRIC Ltd and the Council would be the write down of the intangible assets of the scheme's development costs to date of approximately \$19.5 million. The residual value of the scheme to HBRIC Ltd in the event the Council decides not to proceed will be the RWSS resource consents. A \$6 million loan taken out by HBRIC Ltd for the development of the RWSS will also need to be paid down by HBRIC Ltd, through Port dividends in due course.

While significant investment has been made by the preferred design and construction consortium there is no contractual obligation remaining that has yet to be fulfilled. Payments were made in 2016 to settle any outstanding obligations. HBRIC Ltd's financial advisors for the scheme have been operating on a success fee basis and there is no liability to them, over and above any advisory services associated with this review or wind up of the scheme, unless the Council decides not to proceed and then changes its mind within 18 months.

The Crown has invested around \$7 million to date in the RWSS through the Irrigation Acceleration Fund and Crown Irrigation Investment Ltd. There are no contractual provisions that requires the return of these funds to the Crown in the event the Council decides to abandon the scheme. However, there is a possibility Crown Irrigation Investments Ltd will ask for their funds to be returned in the event of the scheme not proceeding. There is a further possibility that in the event the Council is unwilling to refund the Crown that the matter could be pursued as a civil claim through the courts on the grounds of a breach of good faith. The probability of such a claim being successful is considered to be low. However, it should be noted that withdrawal from the scheme may have impact on the Crown's willingness to make future investments in water storage in the region, particularly with the Regional Council as a partner.

The institutional investor is understood to have incurred between \$1 million and \$2million in due diligence costs. There is no contractual obligation to this party but it is possible that they could also pursue a civil claim through the courts on the grounds of a breach of good faith. The probability of such a claim being successful is also considered to be low.

Proceeding with the RWSS

If the Council determines that HBRIC Ltd should continue with the development of the RWSS then technically no further resolutions are required given that the existing resolutions of the Council endure and commitment to the scheme is currently provided for in the 2015-2025 Long Term Plan. The moratorium on further expenditure on the scheme agreed by the Board of HBRIC Ltd in December 2016 expires on 31 May 2017 and after which the company reverts to previous policy settings, unless the Board determines any other course in the intervening period. However despite this, and given the uncertainty for water users, investors and the wider community around the Council's commitment to the scheme it would be beneficial for the Council to formally resolve to continue with the development of the scheme if indeed that is what it determines following this Review.

In the event of proceeding the scheme's prospects of progressing to construction remain dependent upon the renewal of water users agreements to meet Conditions Precedent volumes, formal capital commitments from investment partners, a satisfactory fixed-price design and construction contract, and bank loan approvals. These matters would be resolved by HBRIC Ltd prior to financial close.

In addition to the commercial matters, confirmation of resource consent approvals for Tranche 2 groundwater will also be important for the scheme securing enough water to meet its reliability commitments to water users in sufficient volumes to fulfil the revenue projections on which the business case is based. Resource and building consents on final detailed design, including review by an independent dam engineering panel, will be necessary once the design and construction contract has been executed and detailed design undertaken. These matters are not expected to introduce material uncertainty as to whether the scheme can proceed.

Land Exchange

A further matter for resolution for HBRIC Ltd before the scheme can proceed to construction is the decision of the Supreme Court on the proposal to change the legal status of 22 hectares of conservation land and exchange it for 170 hectares of private forest land. As part of the Review independent legal advice was sought on the prospects of the Court upholding the previous decision by the Director-General of Conservation to recommend approval of the land exchange to the Minister of Conservation.

The legal advice is that there are substantive merits to the case mounted by HBRIC Ltd and the Crown and a reasonable prospect that the Supreme Court will uphold the ability of the Minister of Conservation to approve the reclassification of the 22 hectares of land in question. Should this be upheld the Director-General would subsequently be able to reconsider the exchange of this land for the 170 hectares of private forest land being offered by HBRIC Ltd.

The Council's legal advisor was also asked to comment on the implications of the Supreme Court decision on the possibility of the Public Works Act being used to acquire the 22 hectares. The advice received indicates that the decision does not have a direct bearing as the case related solely to Conservation Act processes. However, acquisition via the Public Works Act does require the approval of the Minister of Conservation and the Court's judgement may influence his or her decision on the merits of such an acquisition.

At the time of writing, the timing of the Court's decision was unknown and the Council's legal advisors have noted that it would be imprudent to proceed with the scheme until this matter is resolved.

RWSS Consents

In the course of the Review concerns were raised about the extent to which the RWSS has varied in practical detail since the RWSS was considered by the Board of Inquiry. In response to these concerns comment has been provided by Mr Malcolm Miller, the Regional Council's Consents Manager, attached in appendix 23, which outlines the various additional consenting processes the RWSS needs to traverse. None of these processes are considered to introduce material uncertainty as to whether the scheme can proceed.

Legal Key Conclusions

The Council is entitled to withdraw from further development of the RWSS.

It will likely be necessary to consult the Hawke's Bay community on a decision to abandon or shelve the RWSS project, either through the 2018-2028 Long Term Plan or through the Special Consultative Procedures of the Local Government Act.

Any decision the Council takes could be subject to legal challenge by any entity or member of the public but the likelihood of successful appeal, or award of compensation, is judged to be low as long as the Council follows due process in decision-making.

HBRIC has no contractual obligations that would create liabilities for the Company in the event it is directed to cease the development of the scheme. The primary cost to HBRIC and the Council would be the write down of the investment to date of approximately \$19.5 million. There is a risk that the Crown will seek the refund of its approximately \$7 million investment to date.

There are expectations in the Central Hawke's Bay community that PC6 and the RWSS are a 'package deal' and the Council will need to address this should the Council decide to abandon the RWSS.

If the Council determines that HBRIC should continue with the development of the RWSS then technically no further resolutions are required. However, it would be beneficial for the Council to formally resolve to continue.

There are substantive merits to the land exchange case and a reasonable prospect that the Supreme Court will uphold the ability of the Minister of Conservation to approve the reclassification of the 22 hectares of land in question. The Council's legal advisors have noted that it would be imprudent to proceed with the RWSS until the land swap matter is resolved.

There are a number of further consents and consent variations that the RWSS will need in finalising the detailed design and operation of the scheme. These are not considered to present material uncertainty to whether the scheme can proceed.

3.2 Financial Issues

Issue for review: # 4

Review forecast revenue and expenditure (including levels of debt, finance and insurance costs) for RWLP, and dividends, returns on equity for HBRC and private investors arising from the scheme's cashflow model based on: a) current contracted volumes of water, and b) low, c) medium and d) high uptake contracted rates of remaining volumes and consequential impacts on spot market sales, over first 35 years of the project. Advice on the return on, and terms of, debt provided by Crown Irrigation Investments Limited.

Advisor: John Palairet

Issue for review: # 5

Assessment of impacts on a) HBRC's Long Term Plan, b) HBRC's balance sheet and c) the Port of Napier from scenarios of HBRC dividends to HBRC falling below 6% cash returns for estimated periods.

Advisor: John Palairet

Issue for review: # 6

Peer review of forecasts of contracted water uptake and spot market demand, taking into account any new information available from existing water user agreements.

Comment: This information is expected to be necessarily aggregated to protect commercial information provided in confidence. Lewis Tucker are proposed as provider as they have undertaken due diligence on this report for the institutional investor and therefore rework is limited.

Advisor: Chris Morrison, Lewis Tucker

Issue for review: # 7

Advice on the barriers to faster uptake and/or reasons for landowners in the command area not contracting water, acknowledging the HBRC Condition Precedent threshold of 40Mm³ is deemed by HBRC to have been met.

Comment: This information is expected to be necessarily generalised to protect commercial information provided in confidence.

HBRC Management: Duncan MacLeod, Hawke's Bay Regional Investment Company (HBRC)

Introduction to Findings for Financial Issues

This section summarises the review of the RWSS financial model that was developed for HBRC Ltd by BNZ Advisory, now Waterview Capital Advisors, and the water uptake assumptions modelled to forecast revenue for the RWSS. The financial model has been extensively reviewed and refined over the development phase of the scheme, and has subsequently been peer reviewed by Deloitte, PWC, Lewis Tucker Ltd and in-house financial advisors at both Crown Irrigation Investments Limited (CIIL) and the Institutional Investor.

The analysis in the financial model has been partly built on assumptions around the affordability of RWSS water and land use options in the irrigation command area, and therefore rates of expected uptake. These assumptions were derived from advice from Macfarlane Rural Business Ltd, Baker and Associates, and AgFirst, which was further evaluated by Castalia Ltd, and then more latterly by Lewis Tucker Ltd.

As a key part of this Review, and to provide further independent assurance to the Council, Mr John Palairet was commissioned to review the RWSS financial model and provide commentary on the analysis supporting the case for investment (see appendix 7). Mr Palairet was assisted in undertaking this work by Mrs Sarah Park.

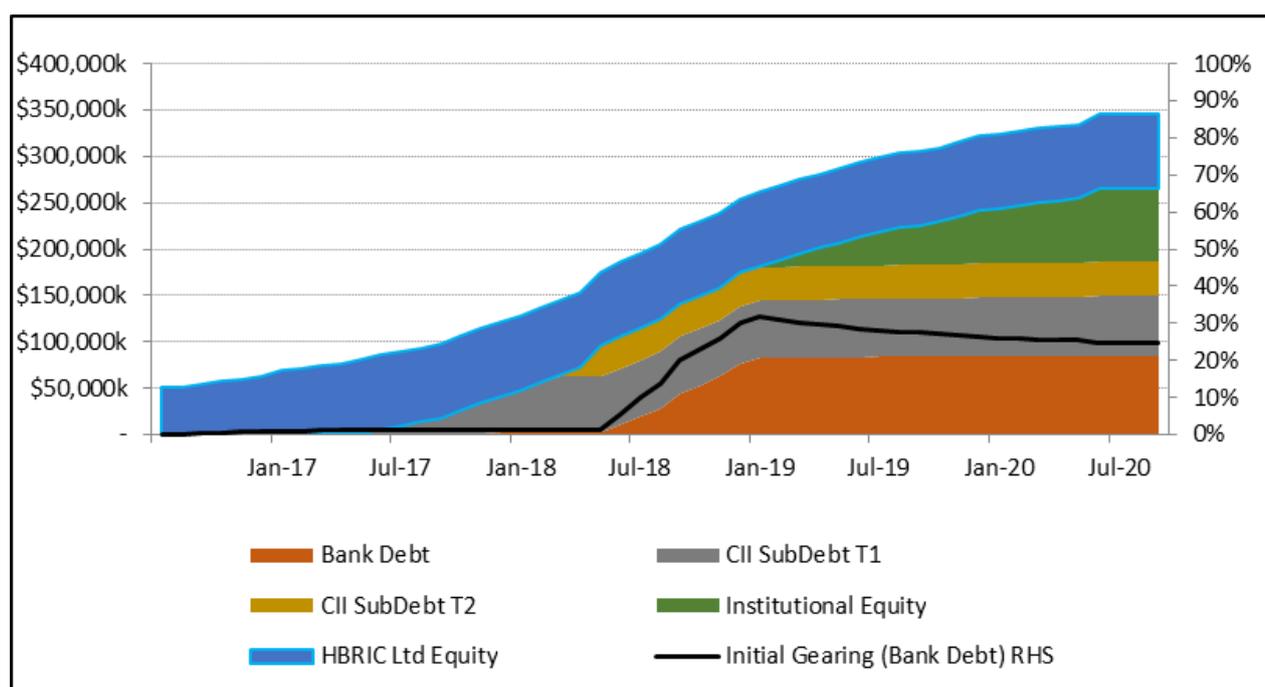
Capital structure

The proposed capital structure for the company to build and operate the RWSS, Ruataniwha Water Limited Partnership (RWLP), through the development and build phase is summarised in the graph below. Funding for the scheme is premised on 47% equity and 53% debt. As Mr Palaret notes in his report the drivers for investment differ for different investing parties, which is reflected in their differing investment horizons and required returns.

CIIL provide ~\$95m debt financing to the scheme at lower than commercial rates in order to bridge the scheme's capital requirements in the early phases of construction and during early uptake once the scheme becomes operational. This low cost financing helps support the viability of the scheme when revenue from water users is lower. As CIIL's objective is to get optimally sized water storage for irrigation built they seek to exit the scheme early and swap out their lending to the scheme for a combination of commercial bank debt and new equity from farmers, tāngata whenua or other investors. In this sense CIIL are enablers, not long-term investors in the scheme.

The Institutional Investor's interest is purely commercial and they seek to secure reliable cash returns over a long horizon. They provide their capital, currently forecast at around \$80m, last in the construction phase and have negotiated terms that assure a level of ongoing cash returns (an investor 'fee') and a preferential share of cash surpluses in the early years. After the later of 75% uptake or Year 15, known as the 'Trigger Date', they revert to having the same pro rata share of returns as other investors, including HBRIC Ltd. At Year 70, the end of the 'Concession Period', the Institutional Investor's remaining equity is cancelled and the asset returns to HBRC (any original Tukituki or Iwi equity may endure – see below). The Institutional Investor has secured an option to purchase up to 20% of HBRIC Ltd's equity within the first 5 years of operation at a 'fair value'.

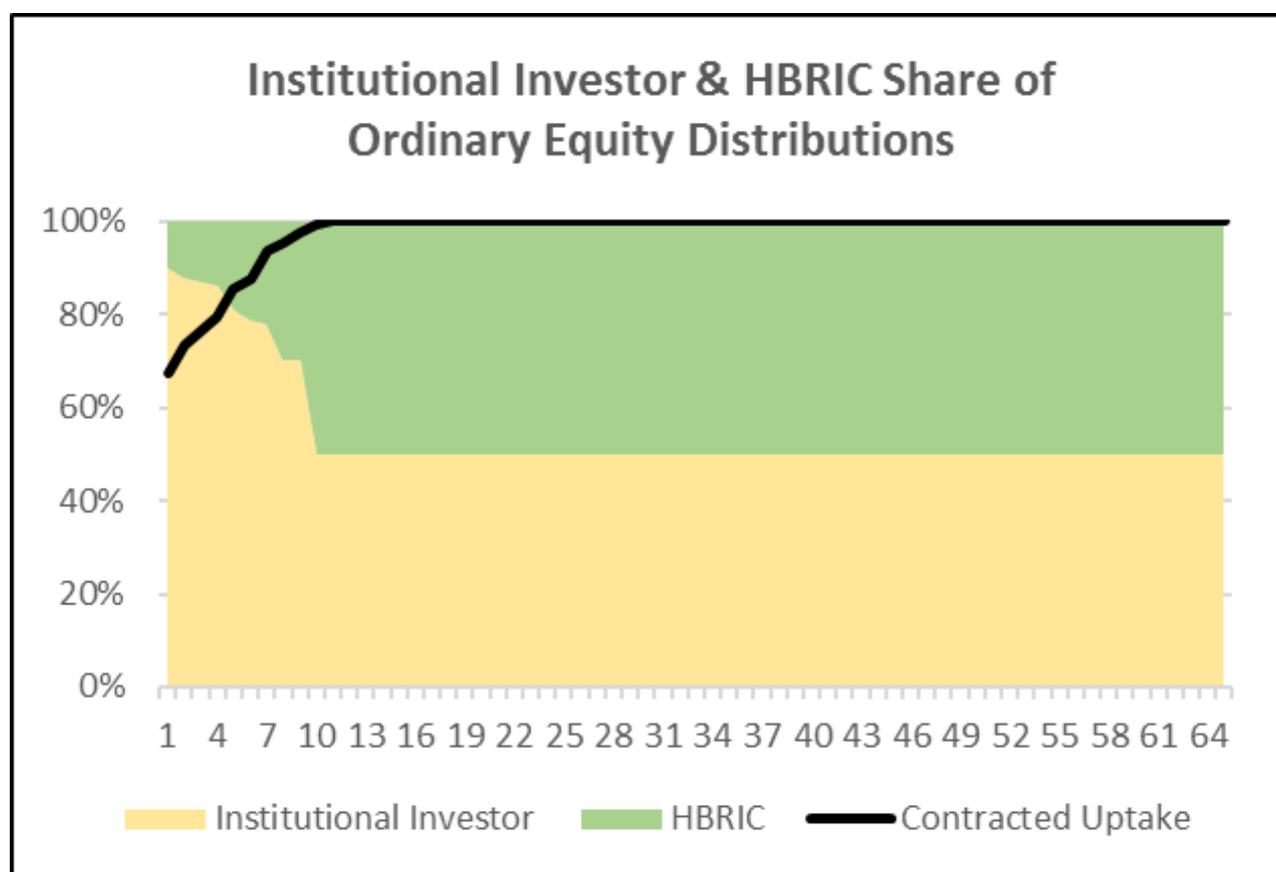
Figure 2 – Funding Waterfall during Construction Period



HBRC, through its investment arm HBRIC Ltd, has already invested approximately \$20 million in capital in the development phase and is expected to place a further \$60m into the scheme's construction. The driver for HBRIC Ltd has been to get the scheme established in order to deliver the environmental and regional economic benefits intended to be delivered by the scheme. As such the returns to HBRIC Ltd are less assured and more dependent on rates of water uptake – these are explored in some detail in Mr Palairet's advice and covered further below under implications for the Council's balance sheet. The key message is that the financial risk of low uptake in the scheme is principally borne by HBRIC Ltd, and in turn HBRC (albeit CIIL potentially bears some risk through extended repayment terms), in the form of returns potentially being at the lower end of the range modelled. However, this risk apportionment may arguably be offset, at least in part, by the ownership of the RWSS and associated revenues substantially reverting to the Council and the Hawke's Bay's community from Year 70 as well as the broader regional economic and environmental benefits on which the Council's investment has been predicated.

A further class of equity capital, up to \$35m, is proposed that would enable farmers, iwi or other investors to share in the scheme. It is proposed that this capital would be called following financial close and would be used to repay CIIL lending to the scheme. This capital is referred to as the Tukituki Convertible Note and would yield a coupon return of up to 5%, subject to confirmation. This coupon would be paid to investors until the Trigger Date, the later of 75% uptake or year 15, at which point the Note converts to equity and receives the same pro rata share of returns as other investors.

Figure 3 – Institutional investor and HBRIC Ltd share of ordinary equity distributions



A key question for the Council is whether it considers the role of its capital within the overall capital structure appropriately reflects its interests in, and objectives for, the scheme.

Construction and Operating Financial Risks

The draft design and construction contract for the scheme, which includes the dam and distribution network, is almost entirely (98%) fixed price. The indicative contract, which has yet to be signed, reflects that construction risk resides with the constructor. As a consequence the construction phase and the possibility of cost overruns does not represent a significant risk to the Council. The greatest risk of this phase is with constructor's financial strength to undertake the project. Therefore, constructor balance sheet strength and appropriate insurances are key requirements of all capital providers to the scheme. Mr Palairet has noted that "The Directors will need to provide assurance that the consortium is financially fit for purpose."

It should be noted that owing to delays in the scheme proceeding to financial close, principally due to the legal dispute on the land exchange, the construction contract has not been finalised and signed. Therefore, this will need to be reconfirmed, and may be subject to adjustment in price. If this adjustment is substantial then this may impact on water pricing with subsequent impacts on uptake assumptions.

Annual operating and maintenance costs, including comprehensive scheme insurance, are forecast to be \$7.7m in Year 1 and then are inflation adjusted throughout the operation period. Replacement capital items have been identified and costed, and built into future cash flow forecasts. Based on the contracted level of initial uptake the scheme will have sufficient revenue to meet its operating costs, including servicing bank debt, in the first year. Therefore, the scheme can be considered to 'break even' in Year 1, that is having met its immediate financial obligations. Mr Palairet concludes, "even in the highly unlikely scenario there is no further uptake beyond what is currently contracted in the FWUA, the scheme would breakeven at this level in Year 1."

The ongoing operating costs of the scheme have been reviewed by Mr Palairet who notes there has been "a very rigorous approach to cost estimation with input from independent experts where appropriate." In his view, "Overall there can be a high level of confidence in the cost estimation process." Given the generally predictable nature of the operating assets there can be assumed to be a low risk of operating costs varying significantly and having a material impact on HBRIC Ltd's returns.

Mr Palairet notes that:

"the introduction of third party shareholders and funders has brought an additional level of scrutiny. An institutional investor seeks good commercial returns in line with its risk appetite, and has a number of competing investments for its investment capital. Therefore, their commitment to invest in RWSS is an endorsement of the business case. The business case has accordingly, through its phases of development and review, had a high level of scrutiny and consistent validation. This should bring considerable comfort to HBRC as a major investor and scheme promotor via HBRIC Ltd., its 100% subsidiary."

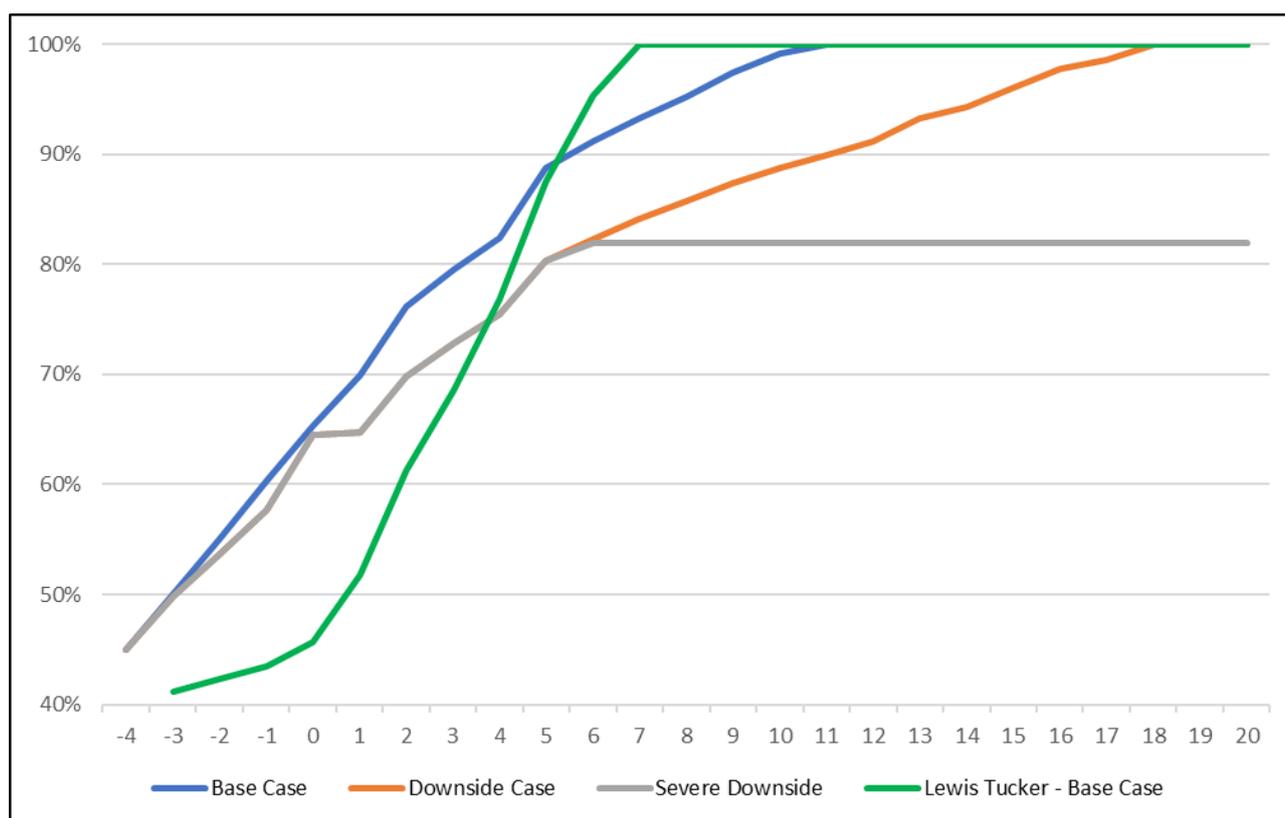
Overall, the analysis undertaken by numerous advisors working to different capital providers confirms that the financial model built for the scheme is fit-for-purpose based on the assumptions made through expert input. The Council can take considerable comfort that these processes have been thorough and the risks have been identified, and where appropriate mitigated.

Financial Returns for HBRIC Ltd from the RWSS

Given the uncertainties around the timing, and even the eventual quantum, of water uptake the financial analysis for this review has relied upon multiple uptake scenarios in order to test sensitivity. These are set out in Mr Palairet's advice and commented on further below in the Forecast Uptake section. It should be noted that the total volume of water available to be sold for these modelling purposes is 100 million m³, which is 5.5 million m³ less than the total volume predicted by HBRIC Ltd. to be available to the scheme. This maximum modelled volume represents conservative assumptions and, coupled with the severe downside case of sales flat-lining at 82 million m³, provides useful sensitivity testing of scheme finances in the event that HBRIC Ltd's Tranche 2 deep groundwater consent is not approved or hydrological inflows to the RWSS reservoir and/or distribution capacity, and in turn scheme reliability, has been overestimated

The different uptake scenarios modelled naturally deliver variable returns to HBRIC Ltd. The cash return on investment for the first 35 years to HBRIC Ltd ranges from 7.3% (Extreme Downside) to 10.8% (Base Case.) The Internal Rate of Return (IRR) for the life of the project in all demand scenarios is estimated to be within a range of 5.8% (Extreme Downside) to 7.1% (Base Case).

Figure 4 – Financial return scenarios for HBRIC Ltd



Mr Palairet provides his view on the returns thus, "Overall, the return to HBRC as an investor is an acceptable infrastructure return at all levels. Further, importantly there is no additional capital required from HBRC as the cash flows support all operational and financing requirements under each scenario."

A key question the Council needs to consider is whether it believes the rates of return on the Council's capital, including the risks around the timing and quantum of these returns, are acceptable in light of the Council's broader strategic economic and environmental objectives of the investment in the RWSS. Achieving the

development of such large and complex infrastructure to address significant environmental management and the regional economic objectives at not only no cost to the ratepayer, but also at a commercial return commensurate with other infrastructure assets, was always an ambitious goal.

While questions of appropriate risk and return would normally be expected to be determined by the board of directors of HBRIC Ltd on the Council's behalf, the scale of capital involved and the implications for the Council's balance sheet and future revenue are such that it is important that the Council as shareholder understands and supports any decision to invest. It is important that the Council clearly identifies its objectives for the RWSS and can therefore determine under what circumstance these will be achieved and when they will not.

Implications for the Council's Balance Sheet

The Council, via the Statement of Intent, has set HBRIC Ltd a target of achieving a 6% cash return on its RWSS investment in order to fund Council services. In respect of the RWSS this amounts to \$4.8m annually. As outlined in Mr Palairet's advice, cash dividends from the RWSS to HBRIC Ltd are not expected to yield \$4.8m for some time, first being completely achieved in year 20-22 under the Base Case scenario. Therefore, to deliver the required returns to HBRIC Ltd. will be required to borrow against its equity in the RWSS and effectively against future earnings from the scheme. To minimise this borrowing HBRIC Ltd could potentially require higher dividends than might otherwise be expected from the Port of Napier, although this may be complicated by future capital needs of the Port.

Mr Palairet has described this arrangement of borrowing so heavily against future earnings as "unorthodox". He forecasts the debt required for HBRIC Ltd. to satisfy HBRIC's 6% requirement ranges from \$7.6m to \$44.5m in year 10 depending on uptake, \$32.2m to \$52.8m in year 20 and \$55.2 to \$80m in year 30. As a percentage of the value of HBRIC Ltd's assets (including the Port of Napier Ltd) this debt ranges from highs of 6% to 13%. Mr Palairet comments, "The amount of debt on HBRIC Ltd.'s balance sheet is not at an unacceptable level of gearing. However, it does illustrate the balance sheet impact of requiring a return over an extended period long before the scheme reaches that level year on year and commits HBRIC Ltd. to an extended level of debt than would otherwise be required in a more orthodox situation. This will impose a constraint on HBRIC Ltd. on investment in other capital projects."

Another option available to the Council is to reduce the required returns from the RWSS project, in recognition of the wider strategic benefits, and possibly offset this by a required higher level of return from the Port of Napier Ltd. For example if the required return on equity for the RWSS was reduced to 4% then the \$1.6m shortfall created could be sought from the Port of Napier Limited (representing an additional return on the Council's equity in the Port of around 0.5%). A policy change of this type could significantly reduce the borrowing needs of HBRIC Ltd over time and increase balance sheet equity for funding other investments.

At present it is assumed that the RWSS operator, RWLP, will be required to repay its bank debt in full by year 30 at the expiry of resource consents, which is common where banks seek to reduce their exposure to consents not being renewed. Mr Palairet suggests that "in time RWLP should (if current banking dynamics persist) be able to get to a point that does not require full repayment of all remaining debt at the end of the first consent period. This has the potential to reduce the level of debt carried by HBRIC Ltd to finance the enhanced return required by HBRIC." This suggests some upside potential for the Council but given the

uncertainties around this it cannot be relied upon. Therefore, substantial borrowing by HBRIC Ltd should be anticipated by the Council if it is to deliver the 6% annual cash return currently required.

A key question the Council needs to consider is whether it is prudent to require HBRIC Ltd to borrow in this manner or to this extent, and whether the strategic objectives for investment, being the intended economic and environmental benefits, provides a sufficient 'social and environmental dividend' until the RWSS delivers sufficient cash returns. If the Council determines it does not want HBRIC Ltd to borrow in this way and instead accept a shortfall in expected regional income then a reduction in Council services or further rate increases are likely to be required.

Revenue and Forecast Uptake

Forecast uptake is a critical driver of scheme revenue and is the key risk variable around the economic viability of the scheme and the performance of investment capital, including that of the Council. Mr Palairet describes it as "the major risk issue influencing the success and viability of the project".

Forecasting uptake involves inherent uncertainties and professional judgement is required. Global and national economic conditions, including variables such as commodity market prices and exchange rates, will have influences that cannot be readily predicted. Therefore, it is not possible to be certain as to the rate at which demand for RWSS water will grow. Commentary on the affordability of RWSS water at farm level is provided in more detail in the Economic Issues section of this Review as the focus in this section is on how uptake drives revenue to the scheme.

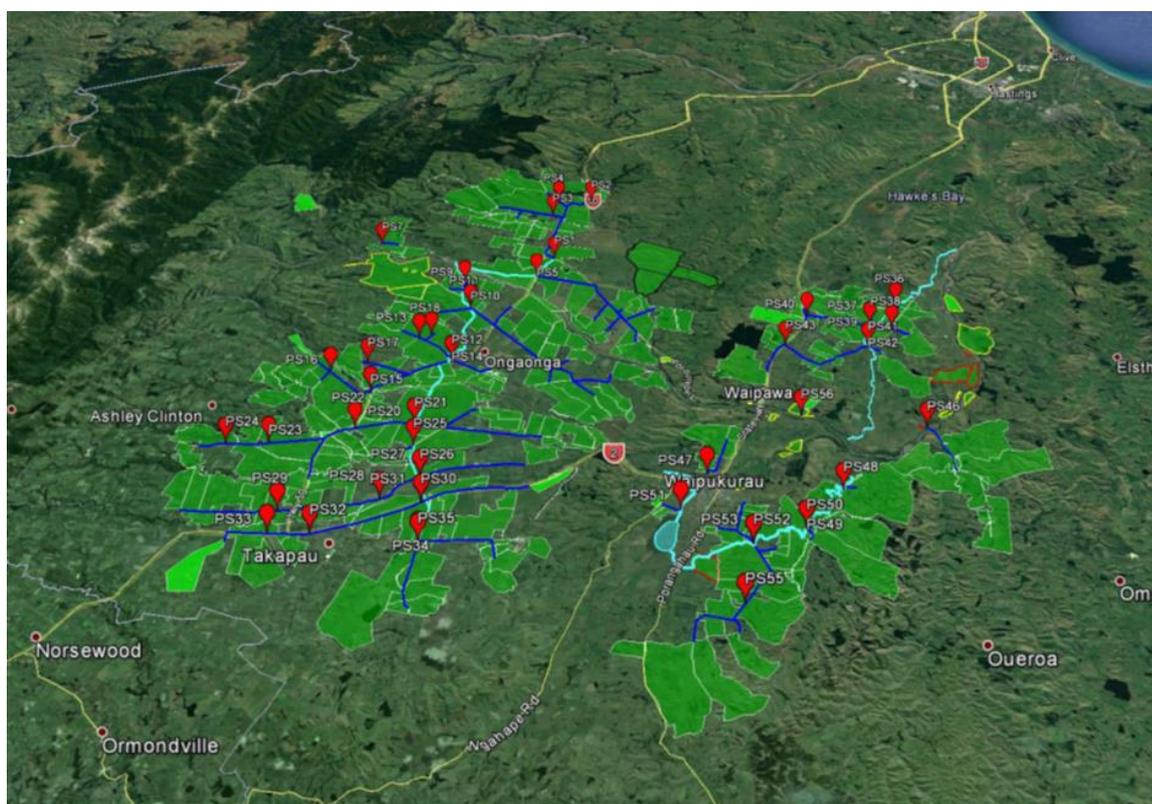
As noted above, several scenarios representing more or less optimistic assumptions about the rate of uptake have been modelled to quantify the level of financial risk associated with the scheme. Uptake scenarios have previously been developed and modelled by HBRIC Ltd's financial advisors (BNZ), who developed a water 'Demand Model' and ran 3 main scenarios known as the 'base case', 'downside case' and 'extreme downside case'.

As part of this Review, agribusiness advisory firm Lewis Tucker Limited were commissioned to build on their previous work for both CIIL and the Institutional Investor in reviewing these demand forecasts and provide advice to the Review (see appendix 8). Lewis Tucker was specifically chosen given the timing and budget constraints of the Review to minimise the re-work required and leverage their previously established knowledge of the scheme.

Lewis Tucker have expressed concerns about the robustness of assumptions in BNZ Demand Model's. However, they state that "the Demand Model's forecast water demand at an aggregated level did not materially disagree with Lewis Tucker's analysis using information collected from the FWUA signed by farmers." Lewis Tucker consider that uptake will initially be slower than forecast by BNZ during the construction and early operational phases, but then ramp up more quickly than BNZ have forecast. This is based on their analysis and understanding of likely farmer decision-making and farm systems development.

A key conclusion for Lewis Tucker is that the 186 contracted Foundation Water Users represent a significant proportion (61%) of the ownership of the irrigable land in RWSS command area (see map below showing signed up properties in light green). However, at the same time on average these contracted farmers have committed to purchasing sufficient water to irrigate only a minority of their irrigable land.

Figure 5 – OHL-Hawkins Proposed Primary and Secondary Distribution Networks



The reasons for this are canvassed in Lewis Tucker’s advice and reiterated in the section below on barriers to uptake. In essence, Lewis Tucker believe farmers are managing their financial risk by buying enough water to begin the process of developing their businesses and confidence about their long-term options and water needs. The initial level of uptake by these farmers should not be seen as meeting their longer-term demand from the scheme but rather gives insight into how much further demand is likely to come from already committed scheme participants. Lewis Tucker believe that this should give the Council considerable comfort that greater uptake can be achieved in relatively short order and does not demonstrate a lack of interest in the scheme, nor a lack of confidence that the water is affordable for farm production. In fact, they believe the reverse to be so.

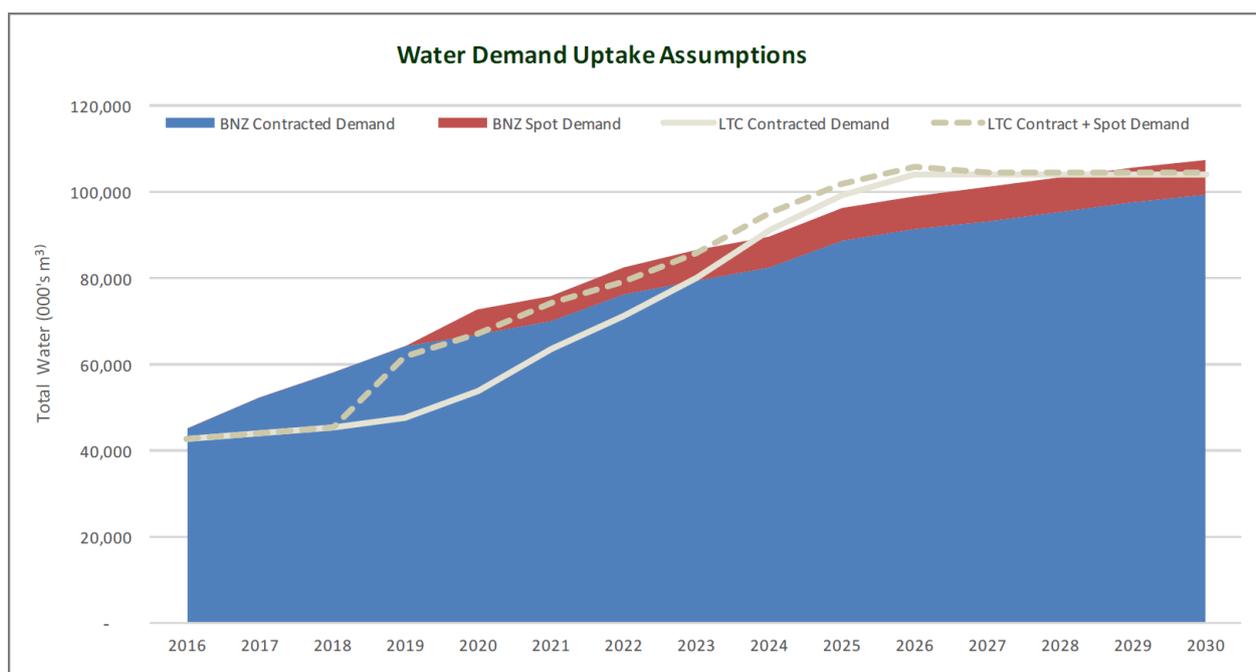
To illustrate the point, properties already committed to the scheme have 25,755 ha of irrigable land area and if these farmers decide to irrigate an additional 50% of their land at the ‘optimal’ level identified by Macfarlane Rural Business Ltd then this would account for 77% of the RWSS’s water capacity. If all of this land was irrigated at the ‘optimal’ level it would account for about 98% of RWSS’s water capacity.

Feedback from existing irrigators suggests uptake will not accelerate until such time as irrigators understand how much water is required to optimise their farming systems, and a realisation that RWSS capacity could quickly become fully contracted. In Lewis Tucker’s opinion, this dynamic could be leveraged by the scheme operator to advance uptake through innovative pricing structures, tactical use of spot water (that is one-off purchase of water for a particular season) and a targeted communications strategy.

Lewis Tucker note that “making the transformational change from farming systems built around a dry summer to all year round production will take time.” As noted in the section below on barriers to uptake

Lewis Tucker consider it is important to acknowledge that the decision by farmers to enter into a 35 year take-or-pay contract is a significant obligation. Lewis Tucker consider the achievement by HBRIC Ltd in securing 40% contracted water materially reduces the uptake risk for investors. In the view of both Mr Palairt and Lewis Tucker Ltd the forecast uptake scenarios used in the financial modelling can be considered conservative.

Figure 6 – Water demand uptake assumptions



Barriers to uptake

As part of the Review HBRIC Ltd's management and water sales team were asked for their assessment of barriers to uptake based on the scheme's design principles and farmer feedback to date. These views are outlined in appendix 9. The HBRIC Ltd team felt farmers had responded to the Condition Precedent target of 40 million m³ to support the scheme proceeding to financial close but have not gone further at this stage. The majority of farmers talked to by HBRIC Ltd have advised that uncertainty surrounding the scheme has limited their willingness to make further commitments to water purchases. A number of farmers have indicated that they may seek to acquire more water once the scheme is confirmed as proceeding. HBRIC Ltd has always planned to make a final push to sell more 'foundation water' immediately prior to and just after financial close.

As noted by Lewis Tucker farmers opting to purchase only a portion of the water required to meet their irrigation potential reflects conservative investment planning and risk management. Many farmers are trialling the scheme for a portion of their operation to ascertain their demand and return profiles. This is reflected in the uptake curves used for business case revenue modelling and used by HBRIC Ltd's advisors, Lewis Tucker for CIIL and the Institutional Investor, and by Mr Palairt for this Review.

The HBRIC Ltd team also notes that the only RWSS 'product' on offer at this point is a 35 year fixed price take-or-pay commitment. This offer comes with a discount, but also requires a large long-term financial commitment. The 'Foundation Water User' contract was specifically designed to provide start-up cashflow

security for investors. Once different water contract offers are presented with more flexibility in terms of start date, tenure and price, it is expected that these will appeal to farmers, including those who have hedged their uptake by securing only a portion of the amount they may need. Similarly as the scheme is expected to offer spot water, HBRIC Ltd management believe the market is likely to be waiting to see the price point for this before committing to take or pay arrangements.

At this point farmers have also not seen the full distribution plan, which will identify where water will be available as well as the output capacity of each zone and pipe. It is HBRIC Ltd's view that once presented with a finite resource, farmers will make more water sales commitments to avoid the risk of 'missing out' on access or facing restricted supply.

HBRIC Ltd also believe that some farmers have hedged their position for the future, by acquiring a base take of water to maintain current farm practices, with a view to selling their farm at a later date, with the potential for farm development under new ownership. The uptake curve assumptions used in the financial model anticipates some farm turnover and increased uptake over time.

Lewis Tucker Ltd argue that the major impediment of uptake is neither affordability nor indebtedness. They consider the major impediment to uptake of RWSS water is "farmers understanding the change that is required to capture the many benefits irrigation offers, or the ability to access the requisite expertise to make a rational (economic) decision." Lewis Tucker Ltd conclude that, "Access to expertise on-farm is an important driver that will influence the speed of uptake."

Ultimately uptake is a function of business and land use transformation that will be determined more by human drivers than necessarily by the availability of financial capital, technology or markets (with these still being important). The scale of transformation enabled by the RWSS is significant and the community in which it is proposed will need to take time to adjust. Skills and knowledge will evolve and new landowners, land managers, and advisors will arrive. All of this will take time and goes to the heart of the case for public investment in such schemes for ensuring the infrastructure is future-proofed by building for future demands and opportunities, not just meeting those in the near-term.

Minimum required uptake

Mr Palairt advises that the "Council needs to be satisfied that the uptake momentum is demonstrated." The Council had previously set a Condition Precedent uptake for financial close of 40 million m³. As noted by Mr Palairt the RWSS's commercial bankers have set 45 million m³ as a minimum requirement for their lending. Mr Palairt has recommended a revised Condition Precedent of 48 million m³ pre-financial close. There is no way to assess the perfect initial uptake number. Instead, a range of risk factors need to be considered, including that too high a hurdle may make it impossible for the scheme to begin the process of land use transformation ultimately required to get to full uptake. The Council will need to determine whether, based on changes to the proposed scheme and the analysis contained in this Review, including the costs and benefits and risks and opportunities, a different Condition Precedent uptake figure is warranted before the Council commits its capital to the scheme.

Key Financial Conclusions

The financial model built for the RWSS can be considered to be fit-for-purpose based on the assumptions made through expert input. The Council can take comfort that these processes have been thorough, and the financial risks have been identified and where appropriate mitigated.

Either conservative assumptions, or conservative modelling scenarios (where ranges of outcomes have been forecast), are used throughout the financial analysis of this Review.

The drivers for investment in the RWSS differ for different investing parties, which is reflected in their differing investment horizons and required returns.

The construction phase and the possibility of cost overruns do not represent significant risks to the Council. The greatest risk of this phase is with constructor's financial strength to undertake the project, which is being appropriately managed.

The generally predictable nature of the operating assets mean there is a low risk of operating costs varying significantly and having a material impact on HBRC's returns.

Forecast water uptake is a critical driver of scheme revenue and is the key risk variable around the economic viability of the scheme and the performance of the Council's investment capital.

Based on the contracted level of initial uptake the scheme will 'break even', or meet sufficient revenue to meet its operating costs, including servicing bank debt, in the first year.

The financial risk of low uptake is principally borne by HBRIC, and in turn HBRC, in the form of returns potentially being at the lower end of the range modelled. However, this risk apportionment may arguably be offset, at least in part, by the ownership of the RWSS and associated revenues substantially reverting to the Council and the Hawke's Bay's community from Year 70 as well as the broader regional economic and environmental benefits on which the Council's investment has been predicated.

The forecast cash return on investment for the first 35 years to HBRIC ranges from 7.3% (Extreme Downside) to 10.8% (Base Case.) The Internal Rate of Return (IRR) for the life of the project in all demand scenarios is estimated to be within a range of 5.8% (Extreme Downside) to 7.1% (Base Case). Mr John Palairt considers that the "the return to HBRC as an investor is an acceptable infrastructure return at all levels."

(Continued on next page)

Key Financial Conclusions (continued)

The Council should anticipate substantial borrowing by HBRIC if it is to deliver the 6% annual cash return on the RWSS investment currently required. This borrowing is forecast to represent between 6% and 13% of HBRIC's assets, which Mr Palairet considers is "not at an unacceptable level of gearing" but "will impose a constraint on HBRIC Ltd. on investment in other capital projects."

At present it is assumed that the RWSS operator will be required to repay their bank debt in full by year 30 at the expiry of resource consents, which provides some upside potential for the Council as this may not be eventually be required and thereby enhancing returns. The future value of water and ability for the RWSS to generate higher than forecast revenues also represents upside potential.

Forecasting uptake involves inherent uncertainties, however the 186 contracted Foundation Water Users represent a significant proportion (61%) of the ownership of the irrigable land in RWSS command area and yet on average these contracted farmers have committed to purchasing sufficient water to irrigate only a minority of their irrigable land at this point. This is expected and gives confidence in significantly greater uptake by farmers already committed to the scheme.

Lewis Tucker consider the achievement by HBRIC in securing 40% contracted water materially reduces the uptake risk for investors. In the view of both Mr Palairet and Lewis Tucker Ltd the forecast uptake scenarios used in the financial modelling can be considered conservative.

The Council had previously set a Condition Precedent uptake for financial close of 40 million m³. The RWSS' commercial bankers have set 45 million m³ as a minimum requirement for their lending. Mr Palairet has recommended a revised Condition Precedent of 48 million m³ pre-financial close.

The Council needs to determine whether, based on changes to the proposed scheme and the analysis contained in this Review, including the costs and benefits and risks and opportunities, a different Condition Precedent uptake figure is warranted before the Council commits its capital to the scheme.

The Council needs to determine whether it considers the role of its capital within the overall capital structure appropriately reflects its interests in the scheme, including the strategic regional economic and environmental objectives on which the Council's development of the scheme has been based.

It is important that the Council clearly identifies its objectives for the RWSS and can therefore determine under what circumstance these will be achieved and when they will not.

3.3 Economic Issues

Issue for review: # 8

Peer review and sensitivity analysis of the RWSS Farm Profitability (Macfarlane Rural Agribusiness) Report, taking into account any new information available from existing water user agreements.

Comment: This report is recommended for peer review in light of the extent of critical comment it has drawn. Lewis Tucker are proposed as provider as they have undertaken due diligence on this report for the institutional investor and therefore rework is limited.

Advisor: Chris Morrison, Lewis Tucker

Issue for review: # 9

Summarise Butcher Report conclusions, scenarios and assumptions.

Comment: This report relies in part of the above report and so may need some updating following the peer review above. The previous version of this report was peer reviewed by Nimmo Bell and therefore it is not recommended that this report be further peer reviewed but rather the range of outcomes forecast, assumptions and limitations in the analysis be summarised for reporting to councillors and the public.

Advisor: Grant Pechey, Principal Economic and Legal Advisor, Hawke's Bay Regional Council (HBRC)

Issue for review: # 10

Collation of views of downstream production demand from major regional meat, dairy and horticulture processors and exporters, as well as impacts on Port of Napier, from RWSS related production.

Comment: Given dynamic market conditions it is recommended that the most recent views on the value of the scheme be canvassed with major supply chain participants. This work will have broader benefits of engaging these businesses in a discussion on the value of water.

Advisor: Tom Skerman, Economic Development Manager, Hawke's Bay Regional Council (HBRC)

Issue for review: # 11 – recommended not proceed

Summarise conclusions, scenarios and assumptions in Nimmo Bell Report on alternative investments.

Comment: It is not proposed that this work be redone. HBRC and HBRIC commitments to the RWSS are such that the primary focus of this review is on costs and benefits of the scheme, not alternative investments

Introduction to Findings for Economic Issues

The RWSS project involves the transformation of a significant area of land and a significant number of farm business to a range of different production systems over time. These changes will be driven by, and have flow on effects to, a wide range of industries off-farm. This section seeks to describe and where possible quantify these wider economic dynamics beyond the internal financial workings of the scheme itself covered in the previous section. Forecasting long-term changes in land use, the financial workings of new production systems, and associated down-stream economic activity is necessarily speculative and requires assumptions, modelling and professional judgement. Therefore, the results in this section should be treated as indicative and can only give a broad sense of likely on-farm financial and broader economic impacts of the RWSS.

Farm Profitability

Understanding farm profitability under irrigation is an important consideration in understanding whether the price of RWSS water is affordable, and for understanding what land use options are available to farmers who have, or might, sign up to the scheme. These land use options flow into forecasts around economic impacts of the scheme, as set out below. The analysis can also help indicate whether land uses that have a lower environmental footprint are likely to be profitable within the scheme.

Previously Macfarlane Rural Business Limited, Baker & Associates and AgFirst (MBA) provided assessments of RWSS farm profitability, the last of which was updated in early 2016. For the purpose of this Review Lewis Tucker Ltd were commissioned to provide peer review of MBA's assessments, as they had already done so for CIIL and the Institutional Investor (see appendix 8).

Lewis Tucker adopted a different approach to MBA, with the latter having determined affordability of RWSS water by calculating the return on assets (RoA) in 6-8 years' time using 2016 on-farm production assumptions. This offered a static, or 'a point-in-time', perspective and it also assumed the farmer was a 'top 20% performer'.

Lewis Tucker instead used ten different discounted cash flow (DCF) models (across 18 different land uses, which includes horticulture) to test the affordability of RWSS water over a 20-year period. This enabled an assessment of affordability in both the immediate and outer years of RWSS's operation, as well as to incorporate year-on-year change that reflects the transition from dry to irrigated farming systems, including the cumulative effect of on-farm productivity gains (1-1.5%). A summary of the returns from the discounted cash flow models is below.

Figure 7 – Summary of returns from the discounted cash flow models

Land Use	IRR (unlevered)	ROA ¹	ROA ²	\$Water Cost/EBIT	Real water price escalation (% EBIT)
S&B Extensive	8.5%	4.7%	2.7%	39%	1.4%
Arable	11.5%	6.7%	3.5%	42%	2.4%
Dairy heavy soils	8.2%	4.6%	4.0%	49%	1.5%
Dairy light soils	9.9%	6.1%	4.4%	43%	1.5%
Pipfruit	10.6%	24.8% (Yr. 5)	17.7% (Yr. 6)	4% (Yr. 5)	N/A
Demand weighted average ³	10.1%	8.0%	5.31%	38.2%	1.6%

¹ MRBL uses EBIT ÷ Total Assets as a proxy for its Return on Assets calculation

² Lewis Tucker uses NPAT ÷ (Op. Assets + Cl. Assets/ 2) for its Return on Assets calculation (28% corporate tax rate)

³ Weighted average based on MRBL May 2016 figures

Productivity gains on farm over time are very real and are demonstrated by a strong empirical base. Genetics, new technologies and tools, and ongoing adaptation of management give good scope for productivity gains. Lewis Tucker describe a dynamic land use scenario where irrigation promotes ongoing change and development that seeks to optimise returns.

Overall, Lewis Tucker conclude "that RWSS water is affordable from the outset but becomes more affordable in the outer years due to the impact of on-farm productivity gains. Sustained annual incremental productivity gains progressively drive higher output (per hectare) but also enable farmers to produce higher value crops more reliably."

Lewis Tucker point to a range of generic benefits that irrigation delivers, such as less variable production and more reliable and bankable cashflows. They argue that, "irrigation provides farmers with the ability to reliably grow more crops or pasture throughout the growing season, in particular, during the summer months when

sunshine hours are high and the soil temperatures optimal. In doing so, farmers reduce their reliance on the spring and autumn months as is currently the case in many Central Hawke's Bay farming enterprises."

Climate variability and the impact this has on investment and production in Central Hawke's Bay is an important consideration. At present production practices are heavily weighted toward minimising risk from dry summers. Increased climate variability and greater extremes brings challenges that water storage and irrigation can, in theory, help mitigate. The storage needs to provide reliability when it is needed, and both scheme and on-farm economics need to be able to withstand the demands on the water resource, while also operating within an acceptable nutrient loss envelope.

In Lewis Tucker's opinion, affordability is not the primary impediment to uptake. They consider that a range of farming systems are viable under the RWSS enabling farmer choice based on soils, climate and market conditions. Lewis Tucker consider that irrigation unlocks more opportunities and the ability to capture value by de-risking production otherwise susceptible to dry conditions.

As with other parts of this Review the Lewis Tucker analysis assumes a high level of management skill and performance by RWSS farmers. It also doesn't take into account the kinds of constraints on production or required mitigation, over and above that already assumed in RWSS farm budgets that might be required as per Review workstream 12. However, their advice does support the contention that the RWSS provides considerable potential to drive land use change, as well as enhanced skill and management practice, for better environmental outcomes with economic upside.

Regional economic impacts

Given that regional economic benefits are a key strategic outcome sought by the Council from the development of the RWSS, the Review has sought to update the earlier analysis from the 2016 Butcher Partners Ltd Report with information gleaned from the course of this Review (see appendix 10).

The updated analysis undertaken by Butcher Partners assumes that total annual water sales by the RWSS will be conservatively capped at 100Mm³ (the scheme plans to sell 105.5 Mm³). This achieves consistency with the approach adopted in the Financial Model (Review Item 4). Spot uptake rates are based on Lewis Tucker forecasts, and a 'base case' land use mix consistent with recommendations in Review work stream 6 have also been used. Scenario testing includes an evaluation of a land use mix/uptake broadly consistent with Review work stream 10, but also considers additional scenarios specifically requested by some Councillors with no further orchards or vineyards over the life of the scheme.

Butcher Partners were asked to model the following scenarios.

- (a) Base case (applying the land use mix assumed in the Review of Farm Profitability Report (2016).
- (b) Base case but with no difference in future productivity between existing orchards under the RWSS and under current deep groundwater irrigation.
- (c) Slower conversion to the Base case assumed area in orchards and vineyards (25% in years 1-10; 75% in years 11-20).
- (d) Scenario (b) with no additional viticulture or orcharding or similarly intensive land uses.
- (e) The results of these scenarios are summarised in the table following.

Figure 8 – Butcher model scenarios (continued below)

	Base Case	Existing orchards same productivity	Slower conversion to orchards and vineyards	No new orchards or vineyards
NPV Project life 35 yrs @ 7% discount rate	\$105m	\$63m	-\$83m	-\$65m
NPV Project life 70yrs @ 5% discount rate	\$690m	\$601m	\$368m	\$188m
Ongoing economic impacts at full development: Regional GDP (\$m/yr)	\$380m	\$366m	\$380m	\$141m
Ongoing economic impacts at full development: Regional Employment (FTEs)	3,580	3,450	3,580	1,130

The Review of Farm Profitability (2016) assumed the reliability of water supply to RWSS irrigators would be at least 95%. MacFarlane Rural Business have reviewed a range of RWSS dam supply scenarios, and where applicable, estimated EBIT reductions associated with the less than 95% reliability outcomes.

Annual average EBIT reductions range from 5-15% with the more severe reductions associated with the absence of the Tranche 2 (10GL) groundwater facility. These EBIT outcomes have been evaluated in conjunction with the scenarios described above. The impact of the 5% EBIT reductions on these scenarios are shown in the table below.

	Base Case adjusted for 5% lower EBIT	Existing orchards same productivity	Slower conversion to orchards and vineyards	No new orchards or vineyards
NPV Project life 35 yrs @ 7% discount rate	\$61m	\$17m	-128m	-\$98m
NPV Project life 70 yrs @ 5% discount rate	\$609m	\$519m	\$287m	\$132m
Ongoing economic impacts at full development: Regional GDP (\$m/yr)	\$374m	\$360m	\$374m	\$137m
Ongoing economic impacts at full development: Regional Employment (FTEs)	3,580	3,450	3,580	1,130

There has been debate in recent years about an appropriate project life and discount rate to use in financial analysis of the project. These issues were covered in the 2016 Butcher Report, which argued for the use of a 5 per cent discount rate and 70 year project life. Financial results in the updated report produced for this Review assesses project lives of both 35 years and 70 years, and discount rates of 5%, 6%, and 7%.

Provided the anticipated land profitability is reached, then under all scenarios tested the project generates a net benefit from a financial perspective, ignoring non-market considerations, provided it continues for 70 years. This is the case even if a discount rate as high as 7% is applied. The project also generates a net benefit if it has a lifetime of 35 years, except where there is a long delay in the conversion of land to orchards, vineyards, or some other similarly profitable land use AND the discount rate exceeds 5.9%. As indicated

earlier, Butcher is of the opinion that a discount rate of 5% is appropriate for assessing long-term projects of this type.

If the anticipated profitability is not reached (i.e. if EBIT is less than has been predicted), then obviously the project's financial benefits decline. If the project has a 70 year life, then at a 5% discount rate all scenarios tested still have a positive NPV, even with a 15% decline in EBIT. However, if the discount rate is increased to 7%, then the scenarios which have slower or zero additional conversion to orchards and vineyards have a negative NPV.

It should be noted that there is a significant amount of uncertainty associated with the key assumptions used in the current and previous Butcher reports. These uncertainties include, but are not limited to:

- Budgets for individual farms;
- Land use mix;
- Rate of uptake;
- The source of inputs and the location where outputs are processed;
- If processing activities occurs locally, whether they will be high or low value;
- Whether there is spare capacity (particularly labour) in the regional economy;
- RWSS capex costs at Financial Close and the extent to which they may affect the conclusions in the updated 2017 Butcher Report.

No direct assumptions have been made in the Butcher analysis with respect to environmental/regulatory constraints. However, it is recognised that these restrictions, if realised, could exclude certain types of farming systems within parts of the RWSS footprint or increase the costs associated with specific farming enterprises.

Although these environmental issues are considered in Review Item 12, it has not been possible quantify these at a farm level and so they did not influence the findings of the updated 2017 Butcher Report. In this regard, it is noted that the 2016 Review of Farm Profitability assumed good farm management practice, but, beyond that no additional measures involving higher capital costs were applied to reduce nitrogen loss. In general, reductions in nitrogen losses may result in a reduction of farm profitability (EBIT). These reductions in profitability of farming systems, should they eventuate, could slow uptake and reduce Project NPV, eroding the benefits of the project and challenging its viability. These issues are explored in greater detail in the Environmental Issues section.

The Community Reference Group has highlighted that the analysis undertaken in this section has not quantified the impacts on the community more broadly in terms of wider business confidence and opportunities, and social and cultural outcomes.

Downstream demand

To test assumptions about supply chain and market demand assumptions underpinning the farm profitability assessments in the 2016 Macfarlane Rural Business Ltd (MRBL) report, HBRC's Economic Development Manager, Mr Tom Skerman, met with a wide range of agriculture related businesses during the Review to seek their views on potential production from the RWSS.

The companies interviewed are detailed in Mr Skerman's report in appendix 11 and represent each of the major primary sectors operating in the region.

Determining the likely allocation of particular quantities of land area to particular land uses, and in turn estimating likely production, involves inherently high levels of uncertainty, and investment drivers external to the economics of the scheme. However, the overwhelming majority of interviewees believe that, subject to prevailing market conditions, modelled land uses in the MRBL report represent realistic profitable land use options over time in the RWSS irrigation zones.

Technically a wide range of fruit, vegetable and arable crops can be grown on the Ruataniwha Plains. Often these require management regimes that are more intensive or involve more risk than in other regions or parts of Hawke's Bay, particularly because of a later spring or more frequent frosts. Apple production is a good example where conditions are not as favourable as the Heretaunga Plains but apples can be and are grown profitably on the Ruataniwha Plains with appropriate management. Proximity to processing infrastructure can also be an issue. In general, interviewees highlighted the importance of water security to enabling more production options but that research and development would then follow.

The interviews revealed strong interest from processors in expanded irrigated vegetable production and for high value small seed production in the region. Meat processors also see benefits for more consistent and stable supply of livestock from irrigated pasture, although recognise that expanded irrigation will generate more competition for land use away from livestock production. The RWSS is of particular importance for Silver Fern Farms in reinforcing long-term water security and future-proofing their Takapau operations.

Existing large-scale operators expressed strong reservations about the likelihood of significant pipfruit or viticulture development in the short to medium term. Land use change to greater horticulture and viticulture can be considered to be likely in the medium to long term, given the lower cost of land combined with the adaptive land management practices that have seen industries expand into non-traditional production areas (e.g. grape production in Central Otago, kiwifruit production in Hawke's Bay).

Significant expansion of horticultural production is expected to be less likely in the short-term and in the medium-term may be at the lower end of production scenarios. As the Butcher Report considered both higher and lower horticultural production scenarios, weight should be given to the lower production scenario when evaluating economic impacts.

Land use change over time is dynamic. In the life of the RWSS project new land use options have emerged that represent scale opportunities (e.g. small seed production). Competition for land use on the Heretaunga Plains naturally tends to see land use change in favour of 'highest and best use', which is currently pipfruit. This is causing growers of other crops to look beyond the Heretaunga Plains for land, with the focus areas being Northern and Central Hawke's Bay.

In terms of increased irrigation availability, industry leaders appear to place equal (if not greater) value on the reliability of production compared with increased productivity. Reliability is seen as an essential driver of increased efficiency, reduced waste and ensuring meeting the supply commitments demanded by higher value markets.

It should be noted that market demand downstream of irrigation is non-linear and typically 'lumpy', therefore changes in land use in response to market drivers is likely to happen in waves rather than any continuous and easily predictable process over the long-term. Investment in processing capacity and post-farm gate services will arrive at various economic tipping points.

Reliable supply of water to underpin reliable production can be expected to make downstream investment more attractive. However, over time changes in market demands driven by commodity prices, exchange rates, technology and competitor production will still result in external forces that can place pressures on farm profitability, which in turn can be amplified by greater capital investment on farm. The balancing act this creates is by reducing vulnerability to climate variables through capital-intensive irrigation it is possible that greater economic vulnerability could be created. However, the analysis conducted for this Review collectively suggests that the on-farm production benefits, particularly in terms of flexibility and predictability, are sufficient to offset this financial and economic risk, especially when considered over the longer-term.

Key Economic Conclusions

Lewis Tucker conclude “that RWSS water is affordable from the outset but becomes more affordable in the outer years due to the impact of on-farm productivity gains.” They further consider that affordability is not the primary impediment to uptake, but instead management skill and understanding, as well as access to expertise, will be the limiting factor.

Discounted cash flow modelling by Lewis Tucker suggest RWSS water is affordable for sheep and beef, arable, dairy and pipfruit production.

Determining the likely future land uses under the RWSS involves inherently high levels of uncertainty, and drivers external to the economics of the scheme. However, the overwhelming majority of agribusiness leaders interviewed believe that modelled land uses represent realistic profitable land use options.

Agribusiness leaders interviewed place equal (if not greater) value on the reliability of production compared with increased productivity arising from irrigation.

There is strong interest from processors in expanded irrigated vegetable production and for high value small seed production in the region.

Meat processors also see benefits for more consistent and stable supply of livestock from irrigated pasture, although recognise that expanded irrigation will generate more competition for land use away from livestock production.

Existing large-scale horticulture operators expressed strong reservations about the likelihood of significant pipfruit or viticulture development on the Ruataniwha Plains in the short to medium term.

Land use change to greater horticulture and viticulture can be considered to be likely in the medium to long term, given the lower cost of land combined with the adaptive land management practices.

Significant expansion of horticultural production is expected to be less likely in the short-term, and in the medium-term may be at the lower end of production scenarios, and therefore weight should be given to the lower production scenario when evaluating economic impacts.

Under all scenarios tested including the base case, slower conversion to orchards and vineyards, and smaller final areas in orchards and vineyards, the RWSS project is predicted to generate a net benefit from a financial perspective provided it continues for 70 years and is assessed using a 5% discount rate.

Butcher Partners forecast the RWSS at full uptake will increase Regional Gross Domestic Product by \$130m - \$380m and create between 1,130 and 3,580 jobs. The bottom of these ranges are based on the exceptionally conservative assumption that the RWSS results in no increase in orchards or vineyards and instead this land is used arable farming.

The Community Reference Group has highlighted that the analysis undertaken in this section has not quantified the impacts on the community more broadly in terms of wider business confidence and opportunities, and social and cultural outcomes.

The financial and economic analysis collectively suggests that the on-farm production benefits, particularly in terms of flexibility and predictability, are sufficient to offset financial and economic risks, especially when considered over the longer-term.

3.4 Environmental Issues

Issue for review: # 12

Assessment of on-farm management practices, including stocking levels and associated land-use constraints, required to meet the nutrient leaching and groundwater water quality requirements of Plan Change 6 and the Regional Policy Statement. Estimate of current compliance within existing land uses and the extent of headroom for intensification and land use change will be provided. Estimate implications for the RWSS in meeting consent conditions relating to scheme water users and nutrient limits. *Comment: This has been the subject of ongoing work but a complete picture has not yet been assembled. It is recommended that this work be built upon further and have ongoing value to support PC6 implementation. This workstream is HBRC staff led.* **Advisors: Ned Norton (LandWaterPeople), Lachie Grant (LandVision), Ian Millner (Rural Directions), Andy Hicks, Environmental Scientist, Hawke's Bay Regional Council (HBRC)**

Issue for review: # 13

Assessment of high-level implications for HBRC resources and approach to implementing PC6 should RWSS not proceed, including for the management of Tranche 2 water. *Comment: Extensive analysis and forecasting of detailed PC6 implementation resource requirements will be undertaken in 2017 in preparation for the next Long Term Plan. It is only proposed to undertake a high level assessment for the purposes of this review, building on an earlier assessment undertaken for the 2015-2025 LTP.* **Advisor: Nathan Heath, Acting Manager Land Management, Hawke's Bay Regional Council (HBRC)**

Issue for review: # 14

Assessment of the impact on irrigation security and resultant farm-gate production in the Tukituki catchment arising from the increased minimum flows in PC6 if the supplementary flows required under RWSS consents are not available. *Comment: This work has been undertaken previously and it is recommended that it be reviewed and updated. The work will have ongoing value given that 2018 increases in minimum flows will occur without the scheme regardless of the outcome of this review.* **Advisor: John Bright, Director: Research & Development, Aqualinc Ltd**

Issue for review: # 15

Assessment of the production systems, techniques and technologies for dry land farming, without irrigation, in the Tukituki catchment. **Advisor: Barrie Ridler**

Issue for review: # 16

Review efficacy of flushing flows and associated estimated impacts of losses to groundwater within the river course. *Comment: This work has been undertaken previously for HBRIC. It is recommended that HBRC science staff peer review this and provide comment to councillors.* **Advisor: Richard Measures, Hydrodynamics Scientist, NIWA**

Issue for review: # 17

Legal advice on the status of the PC6 DIN limits as they apply to RWSS farmers relative to other farmers in the catchment. *Comment: This legal advice has been previously sought. It is proposed that legal advice procured by HBRC, HBRIC and Fish and Game / Forest and Bird / EDS be reviewed by relevant HBRC teams and advice be provided to councillors in order to develop a Council position.* **Advisors: Simpson Grierson, Tom Skerman Economic Development Manager & Shane Lambert Senior Planner**

Issue for review: # 18

Clarification of the obligations of RWSS supplied farmers versus other farmers' in the catchment to meet the requirements of PC6.

Comment: This legal advice has been previously sought. It is proposed that legal advice procured by HBRC, HBRIC and Fish and Game / Forest and Bird / EDS be reviewed by relevant HBRC teams and advice be provided to councillors in order to develop a Council position.

Advisors: Simpson Grierson, Tom Skerman Economic Development & Shane Lambert Senior Planner

Introduction to Environmental Issues of the Review

The RWSS and Plan Change 6 were developed in tandem by the Council as an integrated strategy to improve environmental and economic outcomes in the Tukituki catchment. This approach was predicated on high levels of periphyton (algae and slime) and low river flows in summer, and ground and surface water abstraction in the catchment, being the primary driver of detrimental environmental, social, economic and cultural effects. The storage of winter rainfall for summer flow enhancement and reduced groundwater abstraction to improve aquatic habitat and dilute nutrients, and flushing flows to move sediment and periphyton, along with improved irrigation security and capacity, were all intended to provide net benefits over the risks of increased nitrogen losses from more intensified land use. The Council intended that land management improvements across the wider catchment would be complementary with the RWSS in achieving better water quality outcomes.

The largest and most complex component of this Review has been in relation to determining and quantifying the implementation challenges of PC6 and the exercise of the land use resource consents for the RWSS, both of which were finally determined by a Board of Inquiry, not the Council. The Board modified PC6 and resource consents for the RWSS, as proposed by HBRC and HBRIC Ltd, to take a more stringent approach to managing nitrogen losses from land use and created a new regulatory challenge for the Council in progressing with its investment in the RWSS.

This is challenging for two principal reasons. The first is that the PC6 construct involves two parallel mechanisms for managing nitrogen (natural capital LUC leaching rates and in-stream DIN limits and targets which are explained below) that do not align and have an imprecise relationship with the Plan's objectives, and as such make the PC6 implementation pathway ambiguous at best. The land use resource consent for the RWSS adds an additional complexity to this ambiguity because it operates differently to the nutrient management framework for non-RWSS farms.

The second reason this area of the Review is exceptionally challenging is that there is limited data available on current land use and management practice across the catchment on which to quantify what might be required to meet both PC6 limits and objectives, and RWSS consent conditions, in anything other than general terms.

To address these issues legal advice has been sought and debated to gain the clearest possible understanding of what PC6 and the RWSS resource consents require. Expert freshwater science and land management advice was also sought to analyse the implications of these legal requirements in practice and estimate what may occur in the catchment both with and without the RWSS proceeding, including for the water security of

existing irrigators. A further area canvassed in this section is a review of the RWSS consent conditions for 'flushing flows' within Makaroro, Waipawa and Tukituki rivers.

At the conclusion of this section the Reviewer has provided commentary on what risks and opportunities the sum of this analysis may pose for the Council.

Environmental Issues Not Reviewed

It should be noted that this section of the Review has not sought to re-assess on the environmental impacts of the construction of the dam itself within the Makaroro River Valley.

The process of constructing the dam will certainly involve significant modifications to the aquatic and terrestrial environment at, and surrounding, the dam site. These impacts were a particular focus for the Board of Inquiry, which concluded these impacts to be significant and worthy of concern, but "that the adverse effects of the dam construction can be mitigated to an acceptable degree." [Para 1026, BoI Final Report and Decisions 2014]

The Board also noted that, "Substantial changes to the flow regime downstream of the dam will result from the RWSS" [Para 912, BoI Final Report and Decisions 2014] and that "[1011] Clearly the RWSS will have significant adverse ecological effects on terrestrial fauna and flora" [Para 1011, BoI Final Report and Decisions 2014]. In response to these impacts HBRIC Ltd has proposed a package of mitigations and offsets known as the "Integrated Mitigation and Offsetting Approach (IMOA)".

The IMOA was subject to criticism from a number of submitters to the Board of Inquiry process. However, after considering the evidence presented the Board expressed comfort with the proposed approach which it described as "appropriate" and would produce "no net loss as a result of the RWSS". The Board stated:

"The Board accepts that where possible the effects of the RWSS on the environment will be mitigated. But the reality is that environmental effects within the footprint of the dam and reservoir cannot all be avoided, remedied or mitigated. Therefore offsets become an essential part of the IMOA...The Board views the proposed offsets involving habitat protection and enhancement, and the control of predators and weed species, as positive effects that counterbalance the inevitable loss of existing terrestrial habitat, flora and fauna." (Para 1207-8 BoI Final Report and Decisions)

This overall net benefit and offsetting approach is not accepted by some community environment groups and is a key driver of the Supreme Court litigation in relation to the conservation land exchange.

The Review has also not re-evaluated the effects of flow augmentation required of the RWSS during low river flows in summer time. In addition to the increased river flows for conveyance of irrigation water to downstream abstraction points, and expected additional irrigation 'losses' through groundwater to surface water, the RWSS is required to assist with low summer flows as conditions of its consents. These conditions require the scheme to contribute an additional 1.9 million m³ of water, on average each year, to the low summer flows in the Makaroro, Waipawa and Tukituki rivers. Much more is provided in dry years, and to demonstrate, the 2013 drought year would have required 6.77 million m³ in flow augmentation.

There will be a range of environmental benefits from this flow augmentation, including improved aquatic habitat at times of water stress. These flows can also be expected to improve recreational and cultural outcomes during very dry summer conditions.

Plan Change 6 Objectives

Plan Change 6 has key environmental policy *objectives* relating to freshwater. These are:

OBJECTIVE TT1 To sustainably manage the use and development of land, the discharge of contaminants including nutrients, and the taking, using, damming, or diverting of fresh water in the Tukituki River catchment so that:

- (a) Groundwater levels, river flows, lake and wetland levels and water quality maintain or enhance the habitat and health of aquatic ecosystems, macroinvertebrates, native fish and trout;
- (b) Water quality enables safe contact recreation and food gathering;
- (ba) Water quality and quantity enables safe and reliable human drinking water supplies;
- (c) The frequency and duration of excessive periphyton growths that adversely affect recreational and cultural uses and amenity are reduced;
- (d) The significant values of wetlands are protected;
- (e) The mauri of surface water bodies and groundwater is recognised and adverse effects on aspects of water quality and quantity that contribute to healthy mauri are avoided, remedied or mitigated; and
- (f) The taking and use of water for primary production and the processing of beverages, food and fibre is provided for.

OBJECTIVE TT2 Where the quality of fresh water has been degraded by human activities to such an extent that Objective TT1 is not being achieved, water quality shall not be allowed to degrade further and it shall be improved progressively over time so that OBJ TT1 is achieved by 2030.

OBJECTIVE TT4 To manage the abstraction of surface water and groundwater within a minimum flow regime and allocation limits that achieve OBJ TT1 while recognising that existing takes support significant investment.

OBJECTIVE TT4A To recognise that industry good practice for land and water management can assist with achieving Objectives TT1, TT2 and TT4.

OBJECTIVE Subject to Objectives TT1, TT2 and TT4, to enable the development of on-farm storage and Community Irrigation Schemes that improve and maximise the efficient allocation and efficient use of water.

As a key tool to achieve the above objectives PC6 imposes regulatory requirements on all farms in the Tukituki catchment (defined as >4Ha). These include the requirement to prepare and implement a Farm Environmental Management Plan (FEMP) that ensures farms identify and address critical source areas of phosphorus loss, and meet prescribed nitrogen leaching rates based on rates set out in the Plan.

The nitrogen leaching rates are based on assessments of Land Use Capability (LUC). The LUC tool was not designed for nutrient allocation but was adopted by the Board of Inquiry as a proxy for 'Natural Capital', or the carrying capacity of the land for certain uses. These 'Natural Capital' LUC leaching rates are derived from the Overseer nutrient modelling tool and are set out in PC6 Policy Table 5.9.1D and in the RWSS consent conditions.

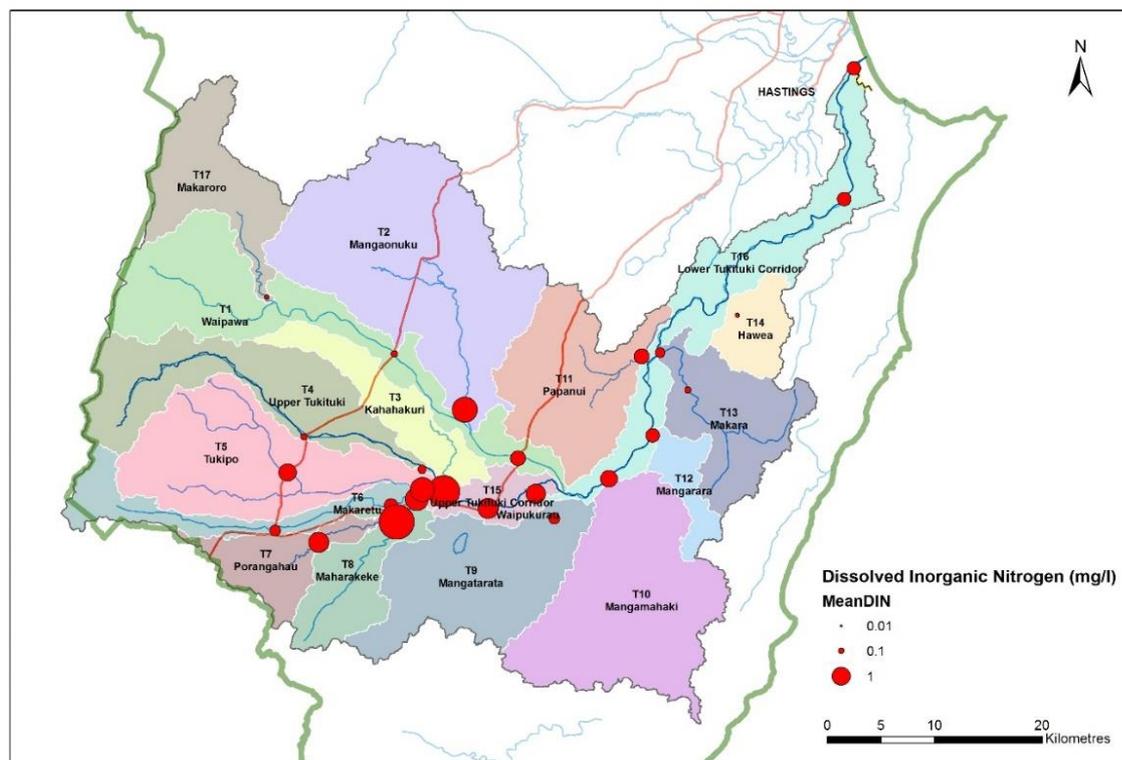
The Plan also includes numerical in-stream water quality limits and targets for Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus. Where these numerical values are exceeded they are known as targets and where they have yet to be exceeded they are known as limits. The practical implications of these mechanism and their limitations are explored in further detail in the section below. However, before exploring the science it is important to clarify the legal framework first.

As part of this Review HBRC planning, consents and compliance staff have jointly considered legal advice from Simpson Grierson, Dr Royden Somerville QC, and a joint submission to the review from the Environmental Defence Society, Royal Forest and Bird Society, and Fish and Game NZ. Council staff are required to form a judgement on the legal interpretation of PC6 and the RWSS consents because it is the Council’s responsibility to monitor, implement and enforce the relevant provisions. Council staff interpretations need to be able to withstand scrutiny, to the extent possible, by the courts. HBRC staff interpretation is set out in appendix 21 and is summarised below.

PC6 Legal Requirements

Non-RWSS farmers must prepare their own FEMP by 31 May 2018 and update these every three years. After 2020 non-RWSS farmers are required to ensure their individual property or farm enterprise complies with the ‘Natural Capital’ Land Use Capability leaching rates set out in Table 5.1.9D of PC6 in order to operate as a permitted activity, otherwise they require resource consent. If the farm is located in a tributary sub-catchment where in-stream DIN concentrations are over 0.8mg/L in 2020, or later if the exceedance occurs later, then a resource consent will be automatically required. The 0.8 mg/l DIN limit is currently exceeded at 6 monitoring sites, all within or immediately downstream of the Ruataniwha Plains and RWSS command areas, as shown in the map below.

Figure 9 – Tukituki catchment current DIN (mg/l) levels



Where the DIN limit is triggered and non-RWSS farmers are required to apply for a resource consent, HBRC expects to impose mitigation conditions to reduce their nitrogen leaching if they can be demonstrated to be causing or contributing to the exceedance of the DIN limit. The extent and nature of these conditions is not known at this time but the possible implications are explored further below.

The RWSS, by contrast, already has resource consent for land use on properties or enterprises that sign up with the scheme, and through this has the ability to aggregate the leaching of its members collectively in defined Surface Water Management Zones. The scheme has the ability to manage any higher leaching properties towards the LUC leaching rates, and if necessary lower, through the proscribed FEMP process set out in the scheme's production land use consent conditions.

While RWSS farmers are required to prepare a FEMP, it is the scheme operator who manages them as a tool to ensure the scheme remains in overall compliance with its existing consent. A RWSS farmer must submit a FEMP to the scheme operator who can require changes to the FEMP to ensure overall compliance with scheme consents. Each FEMP must be independently audited annually for the first 3 years following water delivery and three yearly thereafter. Under the Water User Agreement, failure to comply with the FEMP risks the suspension of the delivery of irrigation water with a continued obligation to pay for the water not-delivered.

In general the RWSS is required to operate and manage nitrogen loss from RWSS farms "in a manner consistent with" achieving the DIN limits and targets in Table 5.9.1B by 31 December 2030. HBRC considers that if leaching from RWSS-supplied farms is found to be a material contributor to exceeding the DIN targets in any sub-catchment then the scheme must identify additional on-farm actions necessary for the consents to be managed in a manner consistent with achieving the DIN limits. These actions must be relayed to the affected farmers and the scheme has the ability to review the farms' FEMPs to reflect those changes.

If the RWSS has taken the actions it has identified, but in managing both the RWSS consent and consents of non-RWSS farmers the Council has not succeeded in reducing DIN to the level in the Plan, then the RWSS may be determined to have complied with the conditions of their consent even though the catchment is over the target. This is because condition 12A literally requires the RWSS consent holder to annually assess their contribution to DIN level exceedances, to identify specific actions required by landowners supplied by the scheme, and then to advise the landowners of the specific actions they are required to take.

The RWSS consent requires the actions described above but it doesn't require absolute compliance with the specific DIN limit. If by 2030 the RWSS remains a material contributor to exceedances the scheme would still have a responsibility to work on further reductions. The degree of exceedance and the state of the environment (using MCI and other indicators) would be relevant in determining what further action is required in response.

Whether the scheme and its water users will be material contributors in the future is not something that can be determined definitively at this point as it will require scientific assessments, which may be inconclusive or contested. A further assessment of the likelihood of this is provided in the sections below. Should the RWSS proceed HBRC plans to work with the scheme operator to have them develop procedural guidelines for the material contributor test and the further mitigations process that apply to the RWSS scheme and its farms to ensure all parties understand and agree the process and their obligations. These guidelines will likely involve complex science and modelling that HBRC will have reviewed. Guidelines such as these are unprecedented in New Zealand and will be refined over time, as the science develops and improves.

In essence exceedance of the DIN limit in any tributary catchment effectively represents compliance limits for any non-RWSS farmers, beyond which they will be in breach of permitted activity rules, and thereby would be placed into a consenting framework. Meanwhile the DIN threshold for RWSS farmers represents a point at which a prescribed set of management actions must be undertaken. In both cases the DIN limit acts as a trigger for certain actions. The measure for those actions in terms of the scheme remaining compliant with its consents is that the RWSS is operating “in a manner consistent with achieving the DIN limits and targets in Table 5.9.1B by 31 December 2030.” The measure for non-RWSS farmers beyond meeting the LUC leaching rates and adopting industry good management practice has yet to be determined.

The treatment of “in a manner consistent with achieving the DIN limits and targets in Table 5.9.1B by 31 December 2030” by HBRC is essentially the same for RWSS and non-RWSS farmers. The distinction is that the RWSS has responsibility for its farmers to collectively meet the scheme’s consent conditions, while HBRC has a separate responsibility to require non-RWSS parties to work towards compliance with the limits by 2030.

There are some complications with DIN limits and the way they relate to the LUC leaching rates in the Plan. Nitrogen leaching, as determined through nutrient budgets, can be summed across each farm property or enterprise (which can involve multiple separate land units) within each surface water management zone. It is possible, indeed in some instances likely, that a farm may be compliant with the LUC requirements, but could be in a catchment that does not comply with the PC6 DIN limits. You could also get a situation where a farm may cross the tributary catchment boundaries that DIN applies to and be compliant in one catchment and not the other. These matters will need to be worked through with landowners in due course.

Assessment of farm nutrient losses is dependent on the use of Overseer and this model is under ongoing development and refinement based on continuing scientific research. The LUC leaching rates in PC6 are based on version 5, which has been superseded and is currently up to version 6.2.3. (Nov 2016). New versions will continually become available throughout the implementation of PC6. It is appropriate for the Council and farmers to use the latest versions to ensure assessments benefit from the latest science, and the Council is developing a procedural guideline for Overseer updates. However, in practice the evolution of Overseer means that farm level compliance and the extent to which farm management can be assessed to be contributing to achieving the PC6 limits or not will be a ‘moving beast’ that contributes greater uncertainty.

A further complication arises from the typically long lag times between when particular land uses lose nitrogen to ground and when this appears in-stream. As a consequence it may be argued by both RWSS and non-RWSS farmers that their farming activities at any given point are not materially contributing to a DIN exceedance appearing at that time. This may present a particular management complexity where some farmers have taken actions to reduce nitrogen losses and others have not, and the effects of this variable management are not able to be measured for some years. Even once measured attribution to individual properties or practices is likely to be extremely challenging.

In the case of land use change enabled by the RWSS the effects on in-stream nitrogen concentrations are unlikely to be seen for years, or even decades in some cases. The Council will therefore need to decide whether to assess the materiality of the RWSS’ contribution based on forecast nitrogen losses and their expected future effect, or to wait until the effects can be demonstrated to be occurring in-stream before requiring action, or to take a more simplistic approach (similar to that envisaged for non-RWSS farmers in DIN exceeding catchments) of requiring nitrogen losses at the outset to be sufficiently low on a *pro rata* basis to be consistent with achieving the DIN limits when that nitrogen is expected to appear in stream. This latter approach appears to be closest to that envisaged by the Board of Inquiry but may not be entirely consistent with a literal interpretation of the RWSS consents. The procedural guideline will need to clarify these matters

and it may be necessary to seek a declaration from the Environment Court on the interpretation of PC6 and the RWSS consents on this matter should there be disagreement between stakeholders.

PC6 Resource Consents

What specific actions or conditions, beyond meeting the PC6 LUC nitrogen leaching rates, might be imposed upon both RWSS and non-RWSS farms in tributary catchments exceeding the 0.8 DIN limits is uncertain at this point in time. The Council will need to develop a view of what needs to be achieved and what can practicably be done, by what means and by when.

Existing policy indicates a strong reliance on industry good practice measures. Conditions over and above good practice will need to be scientifically justifiable and proportionate and in all likelihood will be subject to legal challenge. It is likely that making decisions to impose more strict performance measures or mitigation ‘consent by consent’ in the absence of catchment or regional-based policy to guide decisions about cumulative impacts will be very challenging.

It is important to note that the Resource Management Act (RMA) does not enable councils to easily dictate land management practice or land use. Being ‘effects based’, the Act requires a clear link between an activity and an adverse effect that it causes, which is readily identifiable and measurable. Such links do not always exist or are often not clear when managing diffuse sources of contamination over wide areas.

Once an activity has been determined to be not compliant with provisions in a Plan a consent is required and a process of application and assessment commences. As recently declared by the Environment Court, in the ‘Horizons One Plan’ case, an Assessment of Environmental Effects will be required for each farm consent with as-yet unknown practical challenges, costs and implications. Theoretically this assessment will need to quantify the effects of each farm to inform what mitigations are required. There are also various provisions in the RMA that require existing uses and investment, and the economic and social consequences, of any consent conditions to be considered.

The more restrictive the consent conditions for non-RWSS farms, and additional requirements imposed on the RWSS, beyond requiring best management practice, particularly in terms of controlling land use, the more likely these will be contested. For these reasons, including the developing jurisprudence in this area, it is not possible to be definitive about what consent conditions may be legally justified to meet PC6 requirements at this point.

As canvassed previously in this section PC6 gives no particular mechanisms to the Council with which to manage land use in the event of DIN limits being exceeded in a tributary catchment beyond requiring LUC leaching rates to be met. The practical implications of this for resource management are explored below. However, suffice to say resolving this issue in time will be critical to effectively managing both RWSS and non-RWSS farming operations to achieve reductions in nitrogen losses to freshwater in the Tukituki catchment.

It should be noted that if the Council considered there was a sufficient need, it could consider a further plan change at any time to further develop the consenting framework for nitrogen, or to re-calibrate how the regulations manage the relationship between DIN and the LUC leaching rates. Council staff consider that the procedural guideline for updating the LUC-leaching rates enables the Council to update the LUC rates to reflect newer versions of Overseer on a ‘like for like’ basis. However, staff consider that a Plan Change would likely be required to introduce a mechanism to amend the rates downward to achieve lower farm nitrogen losses in DIN exceeding sub-catchments, or upward to enable more nitrogen losses should it be contemplated (albeit this would likely contravene the NPSFM).

The Board of Inquiry appears to have clearly intended for the DIN limits to “serve as a check as to the effectiveness of the LUC leaching rate control” (Para 136 BOI Final Report and Decisions) and used as a trigger

for modifying the LUC leaching rates where necessary to achieve compliance with the DIN limits. In their final decision the Board stated:

“it is the responsibility of HBRC to avoid the exceedance of DIN limits in the receiving water by regulating the level of nitrogen discharged at the root zone by the farmer and monitoring the subsequent DIN concentration in the receiving water. If observed DIN levels are too high then future adjustment by HBRC of the LUC root zone leaching rates may be required; and it is then clear that the responsibility of the farmer is simply to comply with the LUC root zone leaching rates set in a resource consent or as permitted by Rule TT1.” (Para 449 BOI Final Report and Decisions).

The Board had a stated goal of simplicity for PC6 implementation and clearly saw the LUC leaching rates as the principal regulatory tool to influence land use and the DIN limits and targets to be a management trigger for HBRC amending the LUC nitrogen leaching rates. However, as stated PC6 provides no mechanism in the Plan for adjusting the LUC limits and most likely necessitates a further plan change. Furthermore, a 2015 High Court decision overturned the Board of Inquiry’s approach of deeming farms that meet the LUC rates in DIN limit exceeding sub-catchments to be compliant with the permitted activity status of the Plan, and instead require a resource consent. This requirement for resource consents, with no clarity on what conditions might be required, appears to undermine the simplicity of what had originally been intended and creates a more ambiguous and uncertain regime, particularly for land owners in DIN limit exceeding sub-catchments.

The discontinuities within PC6 will doubtless need clarifying at some point. PC6 is required to be re-evaluated by law, generally within ten years of becoming operative, and it is notable that this will need to occur before the 2030 target date for DIN limit compliance. Furthermore, ongoing revisions to the National Policy Statement of Freshwater management and requirements, such as regional swimmability targets (noting the *E.coli* results outlined at the front end of this report), are likely to necessitate Plan review sooner rather than later.

Farm Management Practices to meet PC6 and RWSS Consent Conditions

To understand what the PC6 and the RWSS legal requirements mean for practical resource management, an expert freshwater scientist, Mr Ned Norton of LandWaterPeople Ltd, was commissioned to assess the current state of freshwater in the catchment and provide an assessment of how this relates to the requirements of PC6. Mr Norton was also asked to provide advice on the implications for land management in meeting the requirements of PC6, including what ‘headroom’ may or may not exist for increased nutrient losses from land use (see appendix 12).

Mr Norton’s advice was complemented by further expert advice from Mr Lachie Grant of LandVision Ltd and Mr Ian Millner of Rural Directions Ltd, both experienced farm management advisors familiar with PC6 and farming operations in the Tukituki catchment. Messrs Grant and Millner were asked to provide an assessment of what farm management practices would be required to meet the water quality requirements of PC6 (see appendix 13). This analysis was necessarily limited by the lack of quantitative data on current farm management across the catchment, and the lack of time and resources to undertake any detailed surveying of this. However, based on what is known, high-level conclusions can be drawn about the nature of the risks and opportunities that exist.

PC6 Water Quality Objectives and Targets

As noted above PC6 contains both fresh water quality *objectives* - the management outcomes the Council and its community are trying to achieve - and numerical management limits and targets that guide or trigger management action in support of achieving the Plan's objectives. To understand where we are at today in meeting both of these objectives and limits/targets Mr Norton was asked to comment on whether these are being exceeded and if not how much scope exists for further change in environmental state.

At the outset Mr Norton has noted that there are regular excessive periphyton growths (i.e., growths that exceed the numeric biomass limits) at many sampling sites in the catchment. He states that there is "no headroom" for further deterioration in periphyton *target* levels because the PC6 *objective* is to reduce the current frequency and duration of these growths.

Mr Norton also notes that only 10% of monitoring sites currently meet the Macro Invertebrate Community Index (a common measure of ecosystem health) *target* scores and many sites currently regularly fail. Therefore, Mr Norton advises there is also "no headroom" for further deterioration of this indicator because of the PC6 *objective* to maintain or enhance ecosystem health.

So as a starting point the management of water, land and associated nutrient loss in the catchment, coupled with all other relevant interventions, must deliver improvements in both periphyton levels and MCI scores. This is a primary imperative of PC6 in terms of water quality.

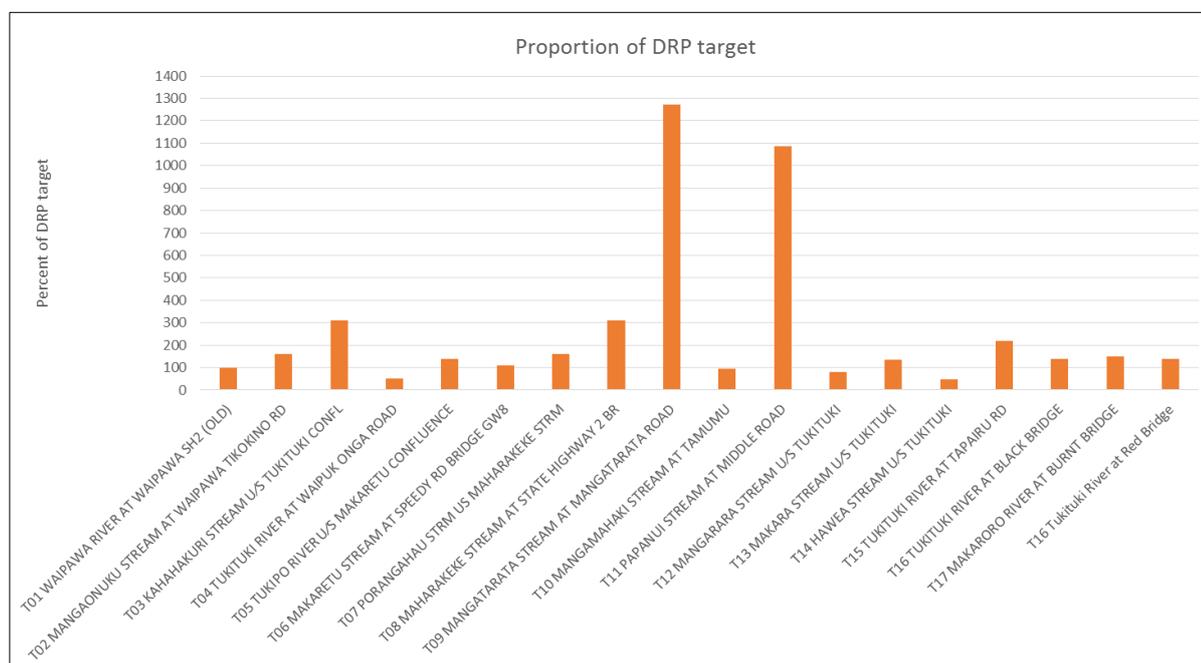
When considering whether the RWSS is compatible with achieving the objectives of PC6, the required improvements in both periphyton levels and MCI scores are critical. PC6 does not set objectives for any particular level of nutrient, as these are not an end in themselves, but as noted by the Board of Inquiry the Plan uses numerical nutrient limits and targets to monitor risks to water quality and to trigger further actions for achieving the plan objectives.

The two most significant nutrients of management concern, and of greatest significance to the question of the RWSS's compatibility with achieving the Plan's objectives, are Dissolved Reactive Phosphorus (DRP) and Dissolved Inorganic Nitrogen (DIN).

Dissolved Reactive Phosphorus

Mr Norton notes in his report that only 25% of monitoring sites currently meet the instream DRP limit (see figure 9). He advises "there is no headroom to increase DRP at a whole catchment scale; rather there is a need to reduce DRP in order to i) meet PC6 instream DRP limits and ii) as part of a multi-pronged approach to achieve periphyton and MCI objectives." Two particular catchments greatly exceed the DRP limits: the Mangatarata is currently 12 times the limit and the Papanui currently 10 times the limit.

At this point in time DRP losses from farms cannot be allocated quantitatively with any precision, therefore the limits set in PC6 are targets for HBRC and the Tukituki farming community to work to where these are exceeded. The limits help to prioritise effort in tributary catchments where intervention is a higher priority and help determine when ongoing effort is required.

Figure 10 – Proportion of DRP target

Messrs Grant and Millner note that quantifying the amount of DRP removed from any intervention at farm scale is “extremely difficult” and there can often be uncertainty about sources within a catchment. They advise that achieving DRP limits “will depend on the accurate identification of critical source areas and implementation of appropriate mitigations.” While it may not be possible to determine with any precision how much reduction in DRP losses to water can be achieved with any given set of interventions Messrs Grant and Millner advise, “Assuming farm plans in the Tukituki are completed and implemented in a competent manner progress toward the instream DRP target should be expected.”

Minimising phosphorus losses to water in the form of DRP will need to be a focus of all RWSS farmers’ FEMPs and there are opportunities for improved management of Olsen P levels on RWSS-supplied farms. However, the focus on reducing DRP for the Council is much wider and includes other mitigatable sources such as hill country and stream bank erosion, and cultivation of steeper non-irrigable land. Given the land proposed to be irrigated by the RWSS is of limited slope and management of Olsen P will be a focus on RWSS FEMPs, phosphorus losses from such land are a lower priority focus for Council land management staff. The level of fencing and riparian planting proposed by the RWSS, both directly and through FEMPs, can be expected to reduce stream bank erosion in the RWSS command area.

The RWSS land use consent requires the scheme to be “phosphorus neutral or reducing” via the FEMPs of RWSS-supplied farms whereby critical source areas of phosphorus are identified and managed to reduce losses to water. Where RWSS properties or enterprises also have land that is prone to erosion outside of the irrigation zone treatment of this land will also be required as part of the Phosphorus Management Plans embedded within FEMPs where this is an issue of concern. Overall, the RWSS consent provides for more prescriptive and intensive management of phosphorus of RWSS-supplied farms than exists in the permitted activity provisions of PC6 for the wider catchment.

DRP remains the largest management challenge for the Council in implementing PC6. This is not only because of the management complexities of identifying critical sources and attributing cause with effect, but because of the scale and geographic distribution of the issue and the fact that it is strongly correlated with sediment that drives additional detrimental effects to freshwater ecology and community values.

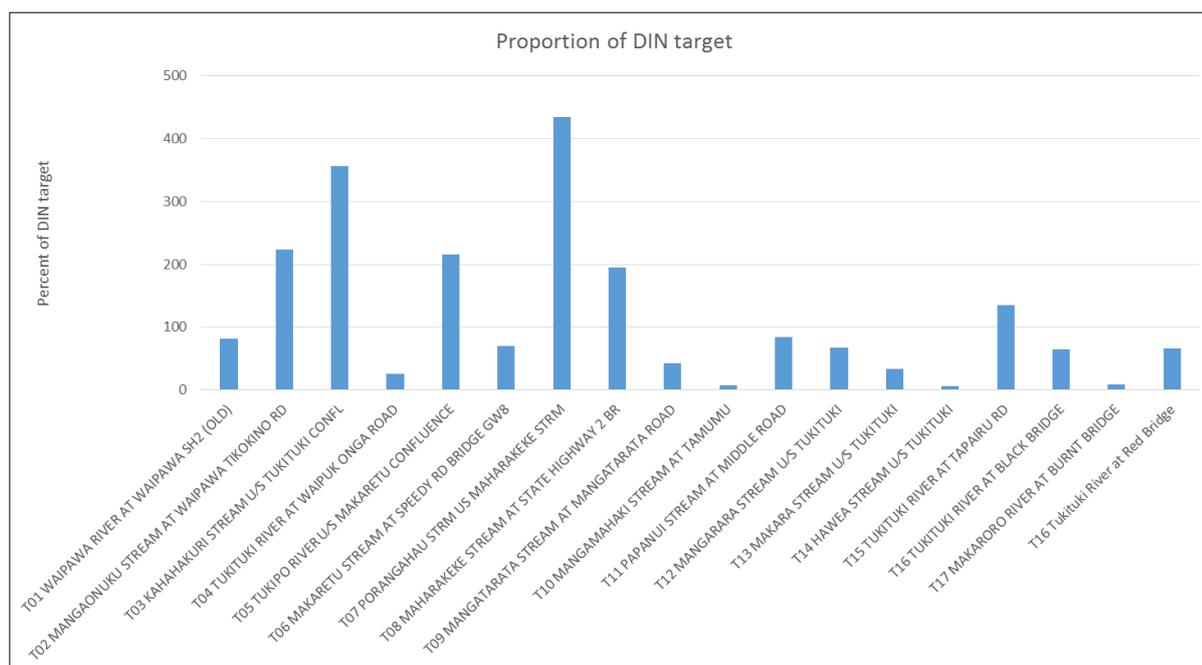
Dissolved Inorganic Nitrogen (DIN)

The question of headroom for any increase in in-stream DIN concentrations is a more complex question. Mr Norton notes that approximately 65% of monitored sites currently meet the relevant DIN limit and therefore the amount of potential headroom or negative headroom varies spatially. He states that “in general there is negative headroom in the upper catchment (i.e., above the Shag Rock monitoring site, with a few sub-catchment exceptions), but due to attenuation that reduces DIN concentrations further downstream there is theoretically limited headroom downstream of Shag Rock.”

Mr Norton cites the estimate by the Board of Inquiry of headroom of around 69 tonnes/year of DIN at Red Bridge, which is approximately equivalent to a 6.5% increase on current nitrogen losses from land in the catchment above that point.

Mr Norton advises that in practice if the DIN limit of 0.8 mg/L is to be achieved everywhere then in round terms there is no headroom for further increases in nitrogen losses in the catchment above Shag Rock, which includes the RWSS Command Area. Indeed reductions in nitrogen losses are required to meet the DIN limits in the 6 currently exceeding sub-catchments of the Ruataniwha Plains, where the RWSS is principally focussed (see figure 11 below).

Figure 11 – Proportion of DIN target



Managing DIN

As highlighted earlier in this section of the Review the principal tool for managing nitrogen across the catchment is through the LUC leaching rate restrictions tied to permitted activity rules and the need for resource consents where these are exceeded. A potential flaw within PC6 is that based on the allocation of these LUC leaching rates there is considerable headroom for further nitrogen losses across the catchment. Based on his review of the evidence before the Board of Inquiry and further interrogation of NIWA’s TRIM model that has been built for the Tukituki catchment, Mr Norton estimates this headroom allows for an increase on current nitrogen losses to be in the order of 30-50% on a whole catchment basis (e.g. above Red Bridge). Therefore, while there is no headroom available for nitrogen losses to increase in order to meet DIN levels above Shag Rock, and only minor headroom above Red Bridge, the primary tool in the Plan for

managing nitrogen actually enables significant increases in nitrogen losses at farm scale. This presents a major resource management challenge to HBRC both with and without the RWSS.

This issue is summarised by Mr Norton in the following statement from his report:

“I note that it seems the disconnect between the LUC-based nitrogen leaching rates in PC6 Table 5.9.1D and the instream DIN limit of 0.8 mg/L in Table 5.9.1B is ultimately untenable for planning and management purposes in the long term; one or the other or both will need to change. Until then, HBRC is in the position of trying to manage to achieve an instream DIN concentration of 0.8 mg/L under circumstances where all land users, irrespective of whether they are in the RWSS or not, are allowed to emit nitrogen at the LUC-based rates, which if taken up in total could not achieve the instream DIN concentration of 0.8 mg/L.”

Messrs Grant and Millner completed a high-level analysis comparing DIN limits in sub-catchments and leaching rates required to meet these limits as a proportion of the PC6 LUC leaching rate allocation. This theoretical approach calculated what nitrogen load could be lost from each sub-catchment and still meet the 0.8mg/l instream DIN concentration based on water flows and associated dilution, as well as an assumed average level of nitrogen attenuation. This theoretical nitrogen loading limit was then compared with what would be permitted according to the existing LUC allocation framework. Using the Mangaonuku (Tikokino area) sub-catchment as an example, according to the analysis achieving the DIN limit using the LUC framework would require reductions in allowable nitrogen per hectare to approximately 30% of the full allocation tabled in PC6. They note allocation at this level “would severely limit any intensive or semi intensive land use (including tree crops) and would require wide spread forestry establishment to allow even moderate areas of intensification.”

The analysis also suggests the Maharakeke, Porangahau and Mangatarata sub-catchments would require severe land use restrictions as in each case allowable nitrogen losses would need to be 80% reduced from the LUC allocations. Conversely the DIN target could theoretically be met in the larger Waipawa and Tukipo catchments with 90% of the PC6 LUC allocation, suggesting that the larger catchments provide more dilution and attenuation. Of interest, the Tukipo is currently exceeding the instream DIN targets (216% of target) whereas the Mangatarata is well below (42%), which highlights the significant disconnect between existing land use, the LUC allocation framework and instream DIN targets. Messrs Grant and Millner conclude that “to try to manage the allocation framework to achieve DIN across the whole catchment would introduce severe management and equity obstacles for all parties.”

The numbers presented by Messrs Grant and Millner in the analysis above are necessarily high level and use generalised assumptions and should be treated as indicative. Further confidence in the assessment will be possible when all FEMPs within the catchment have been lodged, and Overseer nitrogen loss estimates can be based on actual land use and practice. However, at this stage there is enough confidence in the analysis to advise the Council that achieving the 0.8 mg/l DIN target in all Tukituki sub-catchments, including and particularly those in the Ruataniwha Plains area, will require land use restrictions – probably severe in some areas – that is not explicitly provided for in the existing PC6 policy.

Achieving the DIN limit by 2030 in all sub-catchments with or without the RWSS is considered by Council staff to be highly improbable, and likely to be physically impossible due to the lag effects of nitrogen loadings from past land use moving through soils and groundwater. Even if new policy was developed and implemented to control land use to the extent necessary as per the modelling, lag effects in nitrogen can be expected to preclude actual achievement of the 0.8 DIN limit in all sub-catchments by 2030.

Current land use

To assist Messrs Grant and Millner in assessing farm management implications of PC6, HBRC provided a database for all the FEMPs (96 in total) that had been prepared in the Tukituki catchment in the last 18 months, along with a small sample of completed plans. The 96 plans covered 30,114 ha (approximately 12% of catchment) with an average property size of 317 ha (range of 5 ha to 1,537ha).

From this dataset Messrs Grant and Millner estimate that only 71% of the permissible nitrogen losses under the LUC leaching rate framework was being utilised. Hence for these 96 properties there was overall 'headroom' of 29%. Caution should be used in generalising this level of headroom across the whole catchment as no signed up or potential RWSS properties have completed a FEMP under PC6. Anecdotal evidence also suggests early FEMP adopters may also be more environmentally conscious operators. But while care needs to be taken when using the data from a sub-catchment where only one or two plans exist the Papanui sub-catchment contained 31 properties with plans covering 4,394 ha (about 25% of the sub-catchment) and collectively have headroom of 44%.

This indicative level of headroom enabled by the LUC leaching rates demonstrates the wider risk for the Council of relying on this tool in its current PC6 form for achieving compliance with the DIN limits. This was noted by Mr Norton who remarks, "I understand from the assessment provided by Lachie Grant that even if the RWSS did not go ahead it is quite plausible that significant intensification could occur within the PC6 LUC-based rates that would frustrate achievement of the instream DIN 0.8 mg/L limit."

The challenge of livestock

Of the 96 properties sampled 14 properties (10 sheep and beef and 4 dairy properties) do not comply with their permissible LUC nitrogen losses. Of these 14 properties, 4 have estimated nitrogen leaching 30% or more above their LUC allocations and therefore have non-complying status in the Plan, and are all sheep and beef farming operations. The other 10 properties are less than 30% over their allocated nitrogen loss and would be treated as restricted discretionary (that is a resource consent is required with a prescribed set of matters the Council must consider). Of these 10 properties, 4 are dairy units and the rest were sheep and beef properties. One of these sheep and beef properties with less than 30% over their nitrogen allocation also had irrigation.

Overseer runs (version 6.2.3) from sheep and beef properties by LandVision Ltd and Rural Directions showed that for intensive beef operations and lamb finishing, these operations were generally slightly above or just at their permissible nitrogen losses. For less intensive sheep and beef properties they were up to 30% under their permissible nitrogen losses and the extent of the gap was more often dependent on rainfall or whether there was any fodder cropping associated with the property as both higher rainfalls and increased areas of fodder cropping lead to increased nitrogen leaching.

Evidence presented to the Board of Inquiry on historical land use patterns showed that between 1970 and 2000 the number of cattle stock units (RSU's) carried on the average sheep and beef farm increased by 62% with a change from 35% to 80% male. This data reflects the trend in bull beef farming as a flexible and profitable land use. While data was not able to be obtained for the period since 2000 as part of this Review, Council land management staff believe this trend in trading and finishing of livestock on the Ruataniwha Plains has continued.

Messrs Grant and Millner note that sheep and beef land use comprises approximately 74% of total land area and 90% of the productive land area in the catchment (or approximately). They state that:

“When this area is multiplied by a very conservative rootzone N loss the total amount of N contributed to the catchment is 62% of the full catchment loading, applying a less conservative rootzone loss (10kg N Ha) results in a contribution of 65%(approximately). As most of this land use will operate within its allocation the opportunity for HBRC to actively reduce N loss from this portion of the catchment is small. This will have corresponding limitations on the achievement of any DIN reductions as the weighted average effect is very difficult to overcome and the N loss from the sheep and beef sector is already relatively low and therefore is unlikely to achieve meaningful reductions. A simple way of looking at this issue is to understand the relativities between land uses. A 1Kg N Ha increase in N loss from the sheep and beef sector (74% of catchment) will equate to 187 tonnes of N. A 10kg reduction across the dairy sector (4% of catchment) will result in a 100 tonne reduction. Minor shifts in N loss from the majority of the area outweigh substantial movements in N loss from minor land uses.”

Within the Tukituki Catchment there are about 40 dairy farms and from a sample of 28 dairy farms about 70% will have either permitted activity status due to being below their PC6 LUC allocation or manageably close to a restricted discretionary consent (where the loss exceeds the limit but by less than 30%). Within these 28 dairy farms, 10 currently have irrigation and significantly the level of compliance with the LUC leaching rates is also 70%.

This suggests the primary livestock management environmental issue in the Tukituki catchment, including in the RWSS command area, is most likely to be intensive beef production. This has become the production system of choice, complemented by winter cropping and focused on maximising live weight gain from winter rainfall-assured, spring growth to minimise production risk from dry summers.

These systems are generally high in nitrogen loss and from the limited FEMP sample appear to be pushing the LUC nitrogen allocations. Ironically the very strategies being employed to manage dry climate conditions without irrigation are driving a substantial proportion of the nitrogen loss in the catchment.

PC6 LUC leaching rate restrictions can be expected to moderate these more intensive livestock systems at the greater extremes on a property specific basis. However, under the allocation framework these systems can expand on land where current losses are currently short of the LUC leaching rates. While it cannot be determined definitively at this point, given how few FEMPs have been completed, the early sample suggests that the effect of the LUC leaching rate mechanism at a catchment scale probably allows more increases in nitrogen leaching than it reduces.

The Board of Inquiry rejected the prospect of increased nitrogen losses under the PC6 LUC leaching rates on the basis that, “outside the areas to be irrigated the majority of the farmers in the catchment will already be maximising non-intensive production. In the absence of a secure water supply it would probably be difficult for stocking rates or intensification to be lifted to any significant extent. Thus it is unlikely that there will be significantly higher leaching rates in areas that are not irrigated” (para 423, BoI Final Report and Decisions).

Messrs Grant and Millner advise that the experience of the Horizon’s region would suggest otherwise, and it appears winter cropping systems and intensive sheep and beef operations are continuing to be optimised across the Ruataniwha Plains from a production perspective. Given this is enabled by the LUC leaching rates and these systems are the most profitable form of farming without irrigation this potentially puts current production, even without the RWSS, on a collision course with the DIN limits and targets of the Plan.

Alternative land uses

Livestock farming is far from the only land use in the catchment and there are numerous other current land uses, which deliver lower nitrogen losses. These land uses include arable farming, vegetable cropping, apple and grape production, and forestry. These land uses present land owners with access to water with choices when requirements to reduce nitrogen losses may impact on their ability to farm with more nitrogen intensive systems, such as intensive beef and sheep or dairy.

It is important to note that the PC6 LUC leaching rates don't preclude any particular land uses and as indicated above can enable intensive beef and sheep or dairy on land suitable for such uses, regardless of the nutrient state of proximal water bodies, up to the point consents are required. As also explained at the top of this section of the report, the DIN limit trigger of a requirement for resource consents in a sub-catchment may necessitate consent conditions that may make some land uses unprofitable and effectively limit certain land uses. However, Council staff believe the ability to impose such conditions appears to be severely constrained by PC6 and will likely require policy change. The extent of these constraints cannot be determined definitively in the absence of any Environment Court declaration.

Based on current land uses it is probable that greater restrictions on nitrogen losses, and in turn livestock production, will over time encourage greater use of arable farming on the Ruataniwha Plains. This is supported by the fact that a significant area of the RWSS contracted area has arable production as a portion of the farm system (approximately 63% of footprint).

As such Messrs Grant and Millner provide particular comment in their report on arable systems and cite a recent paper by Norris et al (2017) looking at nutrient losses under irrigated cropping rotations. This research showed that the nitrogen losses measured using drainage flux meters on sites in the Tukituki were significantly lower than the permissible LUC leaching rate limits. They state:

"It is acknowledged that this research is in its early days (after two years) and requires further repeatability, particularly around different cropping regimes and soil types. The initial results give confidence that cropping or arable systems are likely to be currently complying. The same trials also were modelled using Overseer. The modelled results, in some cases but not all, were significantly higher than that observed in practice.... When modelling was first done for the RWSS feasibility study the science underpinning the N loss from arable systems was limited. This led to some very large N losses from modelled arable systems. Significant new work has since been done on arable systems to allow better alignment between modelled and actual. The Norris paper is an example of this. Well managed arable systems (of the type found in the Tukituki) with modern irrigation monitoring techniques are now generally modelled as comparatively low N loss systems."

From these observations it is reasonable to conclude that greater shifts in land use from intensive livestock to irrigated arable production would reduce catchment nitrogen losses, not only in terms of what the RWSS may have originally been forecast to lose, but also over losses from current land use.

RWSS and DIN

The Review has established that the LUC leaching rates enable 'head room' in nitrogen leaching across a range of land uses, including within the RWSS command area. It has also been established that current in-stream DIN levels already exceed the 0.8 mg/l limit set by PC6 in 6 sub-catchments. It has been further established that these exceedances are likely to trigger the requirement for:

- a) non-RWSS farmers in these tributary catchments to apply for resource consents to farm with as yet unknown consent conditions to reduce nitrogen losses, and;
- b) for the RWSS to require its member farmers to undertake on-farm management actions sufficient to demonstrate to the Council that it is operating in a manner consistent with achieving the 0.8 DIN limit by 2030.

This therefore raises the question of what freedom the RWSS has to operate with respect to supplying farmers that may be materially contributing to nitrogen loss exceedances. This question was put to Mr Norton who is of the opinion that “it would be relatively straight forward for the RWSS to operate with any of a wide range of possible land uses, using currently available good on-farm management practices, and meet its current consent conditions relating to LUC leaching rates, albeit with considerable management effort.”

However, Mr Norton goes on to state that “in contrast I think it would be very difficult for the RWSS to operate within the significantly smaller nitrogen losses implied by the instream DIN limit of 0.8 mg/L.” To do so Mr Norton notes the RWSS would need to change land use to significantly lower nitrogen losses and/or ii) innovate to find new nitrogen loss technologies and/or catchment-scale mitigations such as a network of wetlands. He also notes the possibility of HBRC reviewing PC6 and revising the DIN limit upwards.

The potential for the two strategies identified by Mr Norton is noteworthy. Given the distinct possibility of RWSS-supplied farms being deemed material contributors to tributaries exceeding the PC6 DIN limits the scheme’s role in driving land use change and innovation becomes an important consideration. On this issue Messrs Grant and Millner state:

“Before the RWSS accepts any FEMP as the conditions within a supply contract it will need to fully evaluate the impact of any additional farm within any particular sub catchment. The need for this is well reflected within the RWSS consent conditions with various conditions requiring continuous management and avoidance of hotspots within the catchment. The RWSS has several methods available to achieve this outcome the most important being the ability to coordinate land use activities before the scheme is commissioned. This action will need to be carried out with close coordination with HBRC and will seek to place the most appropriate land use on the most appropriate land type. This pre-commission review may take place over entire farms or may be actioned at block level within farms. An example might be the inclusion of a viticulture operation on a gravel terrace as part of a larger mixed arable enterprise.”

Failure to meet DIN limits

As noted in the earlier legal section the DIN limits are a means and not an ends in themselves. If the Council fails to, or simply cannot, ensure both non-RWSS farmers, and the RWSS in managing its members, do not operate in a manner that actually achieves the 0.8 DIN limit in any one or more sub-catchments then the consequences for achieving the objectives of PC6 should be understood.

In the course of this Review Mr Norton was asked for his opinion of whether the water quality objectives of PC6 could still be achieved in the event that the PC6 DIN limit of 0.8 mg/L is not met by 2030. His answer was “Yes maybe, but it is undeniably and unavoidably uncertain; there are risks that periphyton and ecosystem health (MCI) objectives will not be achieved everywhere. Achieving them would rely on many things in addition to the effects of the RWSS total nitrogen loads and associated instream DIN concentrations.”

Mr Norton notes that the broader, multi-pronged strategy proposed by RWSS would need to be relied on, that includes:

- a) reducing instream DRP from both diffuse sources and community wastewater treatment plant point discharges,
- b) provision of flushing flows from RWSS storage to manage the frequency and duration of nuisance periphyton in some river sections (see review Issue 16),
- c) riparian habitat enhancements that could improve habitat quality, shading and reduce fine sediment loss to streams,
- d) an ability for the RWSS to adaptively manage local hotspots for nutrients by requiring extra phosphorus mitigations and lower than LUC-based nitrogen leaching rates in parts of the scheme area, in response to any monitoring that shows local breaches of periphyton and/or MCI outcomes, and
- e) improved flows in some stream sections due to i) PC6 higher minimum flows, ii) migrating some current groundwater extractions onto RWSS stored water, and iii) the potential for providing some flow augmentation to some stream sections from RWSS storage.

Given the inherent uncertainties around impacts and outcomes of the components outlined above, which include actions beyond the responsibility or influence of the RWSS, it is not possible to be definitive about the relationship between PC6 objectives and a failure to meet the DIN limits in one or more catchments. However, it is quite clear that failure to meet DIN limits does not necessarily equate to failure to meet PC6 objectives. Conversely, achievement of DIN limits in any sub-catchment also won't necessarily ensure the Plan objectives are met in that sub-catchment.

How much focus needs to be placed on nitrogen to achieve the plan's objectives relative to other management components is a matter of judgement and risk management. The Review has highlighted that while nitrogen reduction needs to be a focus for the Council and farmers, other management components are likely to be as important, or more important, than nitrogen. It is further concluded that achieving the 0.8 DIN limit should be seen as part of the whole management strategy and given relative weight.

An example of how instrumental DIN is in achieving the PC6 objectives is discussed below.

MCI and DIN

The BOI set the DIN limit concentration of 0.8 mg/L based on a model provided in the evidence of Professor Russell Death to the BOI hearings, which was based on correlation relationships between desired MCI scores and DIN concentration data. Mr Norton states that he was not "able to find any statements in the BOI evidence or in related material that demonstrate the strength or statistical significance of the correlation relationships used between MCI and DIN data in the Tukituki or other catchments."

Mr Norton cites a recent peer reviewed paper by a group of New Zealand's leading freshwater scientists, Young and Clapcott (2015), who considered New Zealand research on the relationship between MCI and DIN that states:

"the ecological health of waterways is dependent on multiple factors including temperature, sunlight, nutrients, sediment, organic matter, flows and upstream-downstream connectivity, which in their turn are influenced by climate, catchment and riparian vegetation, land use,

geography, stream morphology and the presence or absence of fish barriers. There is minimal scientific evidence to suggest that a [DIN] concentration of 0.8 mg/L represents a threshold between healthy and unhealthy ecosystems”.

Mr Norton concludes that the 0.8 mg/L DIN concentration is not a defensible threshold between healthy and unhealthy ecosystems. He describes it as “a point on a risk spectrum, where increasing concentrations mean increasing risk of uncertain negative effects on periphyton blooms and macroinvertebrate community health (e.g. MCI).”

In paragraphs 357-358 of its final 2014 decision the Board of Inquiry notes “as water quality science advances a different DIN limit may emerge as a more appropriate level” and “In the meantime the Board sees the DIN limit of 0.8 mg/L as a pragmatic level that appropriately protects ecological health while enabling more intensive land use.”

If it is inferred that the Board equates ‘intensive land use’ with increased nitrogen losses then it is noteworthy that the Board had intended the level set to enable some increase in nitrogen loss within the catchment. It is presumed that the Board had in mind the 6.5% increase on current nitrogen losses from land in the catchment above Red Bridge and as such were setting the RWSS a challenge to manage nitrogen losses from the scheme’s footprint downward over time. Given the delays in progressing the RWSS it is quite possible that the target date of 2030 seemed more achievable in this regard than it does today.

Mr Norton’s advice, that of Young and Clapcott, and the decision of the Board of Inquiry reinforce the view that the 0.8 DIN limit needs to be seen as a management trigger in the context of the whole resource management effort and not an objective in its own right. So the primary question becomes less one of whether either the RWSS, or non-RWSS farmers, can operate within the 0.8 DIN limit, but whether they can collectively manage overall land use effects, including through reduced nitrogen losses, sufficiently to achieve the Plan’s objectives. Based on the real-world uncertainties involved, this is something that can only be determined over time with ongoing monitoring of land use and water quality.

Flushing flows

As previously outlined PC6 has the reduction of periphyton as a key objective through the control of nutrients in the catchment. A key element of the RWSS proposal is for the scheme to provide ‘flushing flows’ from stored water to complement the nutrient management of periphyton downstream of the dam and assist the Council in meeting key PC6 objectives. This is another important element of the combined approach of PC6 and the RWSS.

The RWSS has the capacity for four flushing flows per year of up to 30 m³/s for 9 hours (or 25 m³/s for 11 hours when the dam is at lower levels and it is not possible to discharge 30 m³/s). These flushing flows have the added feature that as well as assisting to mitigate some direct effects of the scheme, they have wider beneficial effects for pre-existing water quality issues that the RWSS is not responsible for. However, concern was raised within the Community Reference Group that dislodged periphyton may accumulate in the river environment offsetting some of the benefits of flushing.

As part of the Review, Dr Richard Measures of NIWA, was contracted to undertake an independent peer review of the efficacy of these proposed flows, and assess the impact of losses to groundwater on flush effectiveness. Estimating the effectiveness of flushing flows on a variable environment along extensive river stretches is fraught with uncertainty so Dr Measures used four different methodologies to test his estimates. His report is attached in appendix 20.

Dr Measures concludes that the proposed flushing flows of 30 m³/s for 9 hours should provide for effective flushing in the Makaroro and Waipawa rivers. However, he is more uncertain of the effectiveness in the main stem of the Tukituki. Dr Measures acknowledges that HBRIC Ltd's advisors to the Board of Inquiry acknowledged this flow alone will not be completely effective and he notes the proposal to 'piggyback' flushes onto natural freshes to increase their effectiveness.

Dr Measures has also expressed concern in his report that the effect of losses of flow to 'bank storage' (losses to the river bed) has not been assessed and could significantly reduce flush peak flow, to the extent that flush effectiveness would be impacted. As such Dr Measures has recommended that the model of losing reach behaviour which has been developed and calibrated for the Waipawa/Tukituki system should be used to investigate the effect of losing reaches on the proposed flushing releases.

Dr Measures has also suggested that it would be valuable to give some consideration to modifying dam design to allow greater flexibility to release larger flushes if required, or at least whether it would be possible to modify the dam to do this at a later date should it be required. In his report he notes the recommendation of a flushing flow of 50 m³/s for the Tukituki at Red Bridge by HBRIC Ltd's advisors to the Board of Inquiry.

Dr Measures cites the Opuha Dam as a case where the structure does not allow for sufficient volumes for flushing flows. In the case of the RWSS only 13 m³/s is required for irrigation but 30 m³/s has been built-in to provide for the flushing flows at a cost to the scheme. While the RWSS could include more capacity to increase the volume of flushing flows to deal with potential future issues (such as a didymo infestation), any estimate at this point about what might be required would be arbitrary.

In 2016 HBRIC Ltd provided HBRC with an opportunity to purchase additional water for wider catchment benefits (the so called 'HBRC flows'). Similarly if the Council saw merit in additional flushing flow capacity, then provision could also be made for it to fund additional outlet capacity within the dam structure. Higher rates of flushing flows over shorter duration within the current envelope of 4 million m³ may give greater environmental benefit than purchasing more stored water for the environment. This suggestion has been put to the dam design consultants who have estimated that to provide the infrastructure (larger screens, valves, tunnel and penstock under the dam) to increase the flushing flow capacity to 40 m³/s would cost an additional \$1.3m and to 50 m³/s would cost an additional \$2.95m.

Irrigation Security Under PC6 Without the RWSS

PC6 imposes increased 'minimum flow' requirements on surface and designated 'stream depleting' groundwater takes from 2018 (up to +25%) and 2023 (up to +50%) based on flows at Red Bridge, Waipawa and Taiparu Rd monitoring sites. These minimum flows are the level at which irrigation restrictions are imposed on surface and stream-depleting groundwater takes. PC6 requires that water take restrictions be determined by the most restrictive flow at any of these three sites on any given day. These water take restrictions are imposed by PC6 regardless of whether the RWSS proceeds or not.

Dr John Bright of Aqualinc Research Ltd was commissioned to review the evidence prepared for the Board of Inquiry and any subsequent available information to assess the impacts on irrigation security and farm-gate production arising from the increased minimum flow levels if the supplementary flows required under the RWSS consents are not available (see appendix 18).

Dr Bright's report highlights the fact that irrigation demand is typically less than the maximum consented rate of take for much of the irrigation season and that restrictions tend to be for very concentrated periods of the irrigation season. Due to the high variability in summer conditions in the Tukituki catchment the new

minimum flow restrictions from 2023 are expected to have no practical effect on irrigation in 1 of every 2, or 48%, of irrigating seasons. This gives an average of 16 days of restricted irrigation per year overall, which risks giving an overly reassuring picture of the impacts in drier years.

Severe restrictions, defined as continuous water take restrictions for more than 10 consecutive days, are forecast to occur 6 times in every 10 years (6 times the PC6 objective of 1 in 10 years). The reason that this is more than the 52% of years as stated above is because in very dry years it is predicted that there will be more than one severe restriction in a given season. Restrictions of this duration are expected to have a material impact on farm production because of the limited ability for crops and pasture to endure sustained soil moisture deficit.

Dr Bright estimates that “the economic impact of PC6 from 2023 onwards [in respect of reduced irrigation security] is to reduce weighted average Cash Farm Surplus by about 23% and the total on-farm economic output, expressed as Earnings Before Interest and Tax, by about 18%.”

Further analysis of the impact of RWSS stored water not being available for farmers for irrigation nor for maintaining mean annual low flows in the Makaroro River is a reduction in Cash Farm Surplus of about 35% and Earnings Before Interest and Tax, by about 27%. The reduction in farm earnings in the catchment is estimated to be approximately \$900,000 per annum on average, although this is forecast to be more severe in dry years. In the worst years Dr Bright estimates the reduction income to be \$4.7 million.

Dr Bright’s analysis is essentially a static one and takes a linear approach of assuming less water availability and therefore less production. This was realistic given the limited time and resources available for review. The analysis does not take into account the wholesale changes in production that might arise from less irrigation security such as farmers ceasing production of certain crops or changing to different land uses, or the effect that reduced confidence and production certainty may have on down-stream industries and communities. Equally, Dr Bright’s analysis is not able to predict changes in crop species or management practice that might be used to mitigate the impacts of the reduced irrigation security.

Given the dynamism of management responses and the inherent uncertainties associated with predicting future outcomes this analysis can only give the Council a sense of the possible magnitude of economic impacts on existing irrigators should the RWSS not proceed. These impacts should be considered significant for farm profitability and land use options, with consequential negative impacts on incomes and economic activity within the mid and lower reaches of the Tukituki catchment.

Dry Land Farming Options

Mr Barrie Ridler, an experienced farm management advisor, was commissioned to provide advice on production systems, techniques and technologies for dry land farming, without irrigation, in the Tukituki catchment (see appendix 19). The focus of Mr Ridler’s report is on pasture and fodder crop systems for livestock.

Mr Ridler makes the case for more systemic management of farm businesses that integrates a wider range of variables than is often considered in farm management decision-making. His report describes gains to be made from adapting farm systems to better align with the soils and climatic conditions of the region, and to carefully monitor inputs to ensure that marginal costs do not exceed marginal returns in order to improve profitability and identify constraints. The aim, Mr Ridler states, is to avoid diminishing returns and achieve system balance.

Mr Ridler identifies “many different pastures and forage options that are available but need to be chosen in a more informed manner to ensure compatibility within a system and the specific farm environment.” He is critical of forms of agronomic and agricultural advice that he describes as “component services” offering “generalised” advice.

He states, “The aim is to save water in the soil rather than in dams. This can be achieved with correct management of pastures and animals. Such management will improve plant and root growth (more organic matter build-up in the soil which also retains moisture and minerals), reduce evapotranspiration and soil loss from wind, and increase productivity of the animals and crops.”

Mr Ridler considers his advice to be applicable across both the flat and hill country and in his words “requires minimal risk or capital expenditure”. It has a particular focus on stocking and grazing policies that broadly aligns with the ‘Natural Capital’ Land Use Capability leaching rates used in PC6.

Mr Ridler sees advantage in low cost farming structures to “ensure that the extra revenue earned will be retained in the area with reductions in both farm debt and interest payments to overseas banks.” This is a more financially conservative approach than that envisaged by the RWSS proposal and does not seek to draw in external financial capital for step changes in gross production. In this sense Mr Ridler’s approach could be described as a lower risk strategy predicated on better resource utilisation with existing physical resources rather than greater use of introduced natural and financial resources for increased output.

Mr Ridler sees particular benefit from “resource allocation systems modelling technology to minimise costly trial and error” as farm systems are evolved for production inputs to be used more efficiently. He sees the application of this approach as being “key to stabilising the farm environment and improving profit.”

Mr Ridler argues that “if the profitable and environmentally beneficial systems of dryland farming were encouraged and supported more widely in the region there would be less emphasis on irrigation and most Plan 6 changes would be profitably met.” HBRC staff agree that there are benefits in promoting dry-land farming techniques across the Tukituki catchment but feel that the claims about achievement of PC6 targets are possibly overstated, as evidenced by the scale and complexity of the PC6 implementation challenges highlighted in other parts of this section.

The kinds of risks in managing intensive livestock production systems without a high degree of attention to the nitrogen balance, as commented on by Mr Ridler, are evident on the Ruataniwha Plains today. This forms part of the management challenge for PC6, both with and without the RWSS. Mr Ridler correctly notes the diminishing returns of excessive use of nitrogen in the farming system and this provides further economic weight to the notion that limits to nitrogen application can make both economic as well as environmental sense.

If the RWSS does not proceed the approaches outlined by Mr Ridler can be useful additions to the tool kit of managing production on the Ruataniwha Plains while also reducing environmental impacts. Water and nutrients will need to be applied with high precision and conscientious management so as to minimise losses from the farm system. His message around greater applied research and advisory services is very much supported by HBRC staff, who see this as an essential part of the PC6 implementation imperative.

Mr Ridler argues that “pre-system modelling should become a standard operational procedure”. Farmers are increasingly adopting tools for such approaches but this is far from universal and there are perceived limitations by many farmers on relying upon modelling.

PC6 FEMPs have the potential to be much more than a regulatory compliance tool and HBRC promotes them being a more integrative plan of whole farm system management. The regulatory compliance drive to getting FEMPs produced by May 2018 is potentially at odds with this more considered approach, but it is hoped that as FEMPs are reviewed they are also enhanced and become a primary tool for farm planning with economic as well as environmental benefits.

If the RWSS is to proceed important principles of the farm management philosophy promoted by Mr Ridler will also remain important, particularly ensuring that marginal costs do not exceed marginal returns. And also that integrated and holistic farm management is used to ensure soil, nutrients and water use are optimised to minimise losses to the environment. Modelling of farm systems will be critical for RWSS farmers to succeed and manage their environmental footprint.

Regardless of the fate of the RWSS many of the approaches (e.g. dry-land forage crops, widely spaced trees) promoted by Mr Ridler are likely to have benefits in the wider catchment beyond the Ruataniwha Plains. These approaches sit well with the challenge for the catchment's farmers in complying with PC6 targets along with other strategies such as the use of tree crops and no-till cropping.

One note of caution is that Mr Ridler's analysis for this Review seeks to optimise resource use within livestock systems. The approaches he outlines can be expected to bring benefits for nutrient uptake and reduced nutrient loss, and in turn deliver benefits to water quality. However, as noted in other places in this Review, to achieve sufficient reductions in N and P losses in order to make substantial progress toward meeting in-stream limits for DIN and DRP, it will likely be necessary for changes in land use that preclude the use of land for intensive livestock in some places even where best practice is applied.

Mr Ridler's analysis highlights the environmental risks associated with livestock farming and indirectly supports an overarching conclusion of this review, which is that alternative land uses to intensive livestock production within the Ruataniwha Plains will likely be critical to PC6 water quality limits being achieved with or without the RWSS. The critical question explored elsewhere in this section of the Review is whether the RWSS can be viable and at the same time be the catalyst for driving land use away from its current weighting toward livestock production.

Climate change

A key further risk for the Council to consider is climate change, although this was not identified as a particular topic area for this Review. The general theme of long-term climate predictions is for further drying in eastern New Zealand. The Tukituki catchment overall can be expected to receive less rainfall and endure greater rates of evapo-transpiration over time. The catchment is likely to experience more extreme weather events, with storms increasing in intensity and droughts increasing in severity. Water storage will help mitigate the adverse effects of such events.

A particular feature of the RWSS is the location of the dam and reservoir at the very base of the mountains that ensures the majority of the inflow is driven by westerly weather patterns, which are expected to remain dominant in winter and then deliver this stored water to the drier parts of the catchment in summer. If water storage is to be located anywhere in Hawke's Bay from a hydrological perspective this type of location is preferable for the reasons above.

There will be significant greenhouse gas emissions associated with the construction of the dam and distribution network, and also as a consequence of decomposition of organic material in the dam reservoir. Increased emissions may also arise from changes in land use and management practice, particularly if there

are significant increases in ruminant animal numbers arising from the scheme (noting the constraints on this imposed by nutrient limits in PC6).

Some of these emissions are likely to be offset by the mitigation and offset package proposed for the RWSS with a range of biodiversity, wetland and riparian enhancements. Treatment of erosion prone land for phosphorus and sediment management on RWSS properties may also bring carbon sequestration co-benefits. More efficient conversion of nutrients to plant matter and more efficient feed conversion for animals as a result of irrigation may also have some greenhouse gas efficiency benefits on an emissions per quantity of output basis. However, a detailed analysis of land use change and supply chain impacts would likely be required to quantify the overall net impact of the RWSS on greenhouse gas emissions, which has been beyond the scope of this review.

The RWSS includes provision for a 6.5 MW hydro electric power plant to be embedded within the dam structure at a future point, which would provide low carbon renewable energy. At present the dam is intended to be constructed with the ability to retrofit the generation equipment at a future date. Inclusion of this generation would likely enhance the overall environmental benefits from the scheme, which could help offset associated greenhouse gas emissions.

Operational Implications for HBRC in Implementing PC6 Without the RWSS

The operation of the RWSS, including giving effect to the scheme's resource consent conditions, will have a significant impact on HBRC's programme of implementation for Plan Change 6. Similarly, if the RWSS does not proceed implementation of the Plan will result in different implementation challenges and requirements for HBRC. In order to inform this Review an assessment of these plan implementation challenges has been carried out by HBRC staff who have been intimately involved in the Tukituki PC6 implementation program (see appendix 21).

Should the RWSS proceed there are resource consents for the scheme that will need to be monitored by the Council. The costs of managing these are able to be recovered from the scheme itself and it is anticipated that the scheme will have, or be able to acquire, the technical skill to prepare the required monitoring reports. As noted further below the scheme operator is required to undertake additional environmental monitoring over and above that already carried out by the Council so monitoring the effects of the RWSS will have limited additional impost on the Council. While land management and land use will change as a result of the scheme these changes are not expected to create significant new environmental management issues for the Council beyond those outlined in other parts of the environment section of this Review.

Approximately 186 landholders, representing 17% of Tukituki catchment properties, have committed to purchasing water from the RWSS. As outlined above the responsibility for their Farm Environmental Management Plans, nutrient budgets, auditing and compliance checking would be with the RWSS, noting these farms are some of the more complex farm systems in the Tukituki catchment. If the scheme does not proceed the responsibility for this task will fall to the individual farmers, and the wider PC6 implementation process, further contributing to the looming bottleneck of 900 FEMPs required for completion in the next 14 months.

Given current in-stream DIN concentrations noted in the above sections, a consequence of the RWSS not progressing is that up to 125 additional resource consents are likely to be required by 31 May 2020. The additional staff required to both issue and monitor these additional consents and to carry out permitted activity checks are estimated to be approximately 2 FTE's from 2018 and increasing further to 3.5 in 2020 at

a total cost of \$77,225 from 2018-2020 and \$148,362 annually from 2020 to the general rate (around a 1% increase).

A significant package of environmental enhancement works and the raising of the minimum flow in the old Waipawa riverbed has been proposed by the RWSS for the Papanui sub-catchment. This area is a key priority sub-catchment for the PC6 implementation process and in the view of Council staff the works proposed would provide significant benefits to supporting the achievement of HBRC and community objectives in the catchment.

DRP concentrations within the Papanui sub-catchment are 10 times over target levels. The greatest influence on achieving PC6 freshwater objectives in the Papanui catchment itself is controlling the proliferation of macrophyte growth through fencing and planting riparian margins in the catchments' waterways. The RWSS has committed to the following in the Papanui catchment.

- 24km of fencing over 5 years @ \$360,000 total cost
- Riparian planting of 85,000 plants over 10 years @ a total cost of \$595,000
- Wetland creation fund over 5 years @ \$150,000 total cost
- The requirement for a constant 50 L/s supplementary flow down the length of the Papanui Stream. This is on top of any flow conveyed down the Papanui Stream to be subsequently abstracted by RWSS customers for irrigation purposes.

This represents a total cost of \$1,105,000 of investment into environmental mitigations and enhancements in the Papanui catchment, and goes beyond the minimum land use requirements for compliance by the catchment's landholders and therefore enables a greater environmental outcome to be achieved.

In addition to the proposed investments in the Papanui, the RWSS proposes a further \$9 million in mitigations and offsets, including predator and weed control, as well as riparian, wetland and habitat enhancement. It should be noted that not all of these proposed investments are current priorities of Council and some will not be necessary without the scheme progressing, as they mitigate scheme impacts.

HBRC staff see a benefit in the RWSS being a single "point source" of information for the approximately 186 landholders that would otherwise need to be managed under HBRC's data management system. The detail of data being collected by the scheme is also significantly greater than that being collected by HBRC. The aforementioned requirement for the RWSS to undertake in-stream monitoring at a range of sites in addition to the HBRC monitoring network and to do ongoing modelling to assist with understanding the effects of the scheme on the catchments, which will add to the understanding of the dynamic interactions between land use and water quality.

The RWSS has an inbuilt incentive to promote water use efficiency and irrigation good management practice, which are not currently a significant priority within existing HBRC work programmes. The RWSS has also proposed to put a detailed monitoring program into place on 5 properties. These monitoring sites will be measuring a range of biophysical parameters including – soil, climate, land use, management practices and soil water drainage. This will enable a comparison to be made of the impact of the scheme on other biophysical factors.

The PC6 rule framework allows for abstraction of up to 15 million m³/year of 'Tranche 2' water from 'deep' groundwater in a limited portion of the Ruataniwha Plains (wells screened > 50 m in depth) provided that the effects of the take are mitigated through augmentation of the Waipawa or Tukituki River. HBRC Ltd has applied for 10 million m³ of this water to add into part of the RWSS distribution network, in order to optimise

reliability and distribution efficiency. By virtue of having stored-water at its disposal, the RWSS is able to meet the surface water augmentation requirement with scheme water at key locations without having to rely solely on groundwater.

If the RWSS does not proceed augmentation will have to occur from groundwater, rather than stored water. This will mean that the 15 M m³/yr available will not be able to be used in full for irrigation, and it is anticipated that ~40 % of the volume taken for irrigation will need to be taken to augment effects of the take (i.e. 6 million m³/yr). This will reduce the efficiency and potential economic benefits of the Tranche 2 water, and will mean that the available allocation will not spread to as many potential users as it might otherwise.

If the RWSS is not to proceed for legal or commercial reasons, or because of a policy decision taken by the Council, it will be necessary for the Council to reconsider the implementation plan for PC6, including the level and nature of resources committed. Based on the findings of this Review, the Council should expect more resources will be required directly from the Council to achieve the objectives of PC6, than will be the case with the RWSS (excluding the Council's investment capital in the RWLP).

The PC6 implementation team notes there is currently confusion within the farming community of the Tukituki catchment in relation to the purposes and intent of PC6. Without the RWSS progressing, communicating the purposes of PC6 and the actions needed to be taken by individual landholders could be enhanced. Once the future of the RWSS has been determined, the Council needs to clarify and communicate its intended longer-term approach to land and water management in the Tukituki catchment.

Concluding remarks

The combined strategy of implementing PC6 and fostering the development of the RWSS was principally predicated on changing the flow regime in the Tukituki catchment to reduce periphyton levels and improve summer low flows. If the RWSS does not proceed then the primary tools remaining for the Council to achieve the PC6 objectives for periphyton control are with on-farm phosphorus and nitrogen management. These nutrients present long-term management challenges with all of the complexities described in this Review, and while their management is an essential imperative for the Council, it is unlikely that on their own they will deliver changes to periphyton levels in the catchment in the timeframes offered by water storage.

This Review has highlighted that there are added risks in relying upon nutrient management to achieve the PC6 periphyton objectives, particularly while there are discontinuities within PC6 between the LUC leaching rates on farm, the in-stream DIN limits, and the objectives the Council and the community are trying to pursue. As the Board of Inquiry noted in setting both the LUC leaching rates and in-stream DIN limits science, technology and understanding will continue to evolve, and these regulatory tools will need to be re-evaluated and refined over time. The objectives of the Plan can be considered more universal and generally more durable. However, for now these regulatory tools are operative in Plan Change 6 and so the Council and community must try to work to them despite their limitations.

The implementation of Plan Change 6 involves a large effort by HBRC and the Review has highlighted the contribution to this effort proposed by the RWSS operators in terms of managing land use under the scheme, supplementary and flushing flows, and mitigation packages such as that proposed for the Papanui sub-catchment. However, notwithstanding these valuable contributions to PC6 implementation there remains a concern within the community that overall these gains will be overwhelmed by environmental degradation arising from increased irrigation and associated nitrogen losses.

It is clear that the responsibility for achieving the DIN limits and targets in PC6 rests with the Council, not the RWSS or individual farmers, and this Review has highlighted that the tools available to the Council within PC6 to achieve these limits are severely limited. The LUC leaching rates do not appear to be an effective tool for stabilising nitrogen losses overall, let alone reducing them significantly over time in catchments where the DIN limit is already exceeded. At best, the LUC leaching rate tool will encourage moderate reductions in nitrogen loss on properties where practices are already highly intensive.

The principal tools available to the Council to manage nitrogen losses across the Tukituki catchment are collectively through the monitoring of the resource consents for the RWSS (should it proceed), through resource consents for farms in sub-catchments where the DIN limit is exceeded, and through ensuring the LUC rates are not exceeded by land users in other parts of the catchment.

Therefore, the key determinant of how likely the DIN limits can be met rests with the conditions the Council imposes on either all farmers across the DIN-exceeding catchments if the RWSS does not proceed, or non-RWSS farmers and the RWSS itself if the scheme does proceed. In essence this means that in its consideration of whether the RWSS should continue to be developed the Council needs to make a judgement on whether implementation of Plan Change 6 will be hindered or helped by the scheme.

The Council and the community face risks either way, both with and without the RWSS. PC6 was developed as part of a dual strategy with the RWSS, and increased flows were intended to complement nutrient management. Without the RWSS this strategy is compromised and appears to make the achievement of PC6 objectives more challenging. The discontinuities within PC6 become even more stark without the RWSS and make the case for a review of the Plan more pressing.

This Review has highlighted the importance of land use change and management skill and practice to the nutrient loss profile of the catchment. It has highlighted that if DIN levels are to be substantially reduced current land use will have to change, particularly with respect to intensive sheep and beef production, stock trading and winter based systems. These are the economic underpinnings of the majority of more profitable livestock farming operations on the Ruataniwha Plains area at present and change will take time.

The Council should expect that the regulatory impositions likely to be required to actually achieve the 0.8 DIN limit across the Plain's sub-catchments without irrigation would have significant economic consequences. Regulation of this type requires robust science, information and extension services, and compliance and enforcement effort to make it work. The cost of this will fall largely to the Council, with potentially little or no economic upside to the community and genuine prospects of failure to meet the target.

For the RWSS to meet its resource consent conditions, even allowing for a range of interpretations of these conditions, it is the opinion of the Reviewer that the scheme will need to incentivise land use change to a greater extent than may have been previously conceived. The Council will need to hold the scheme to account for this through its consent monitoring and enforcement.

Current practices of intensive beef production and winter fodder cropping will need to be reduced and greater volumes of arable and horticultural cropping will be required. Housed and 'cut and carry' systems for livestock may be an option. As noted by Messrs Grant and Millner:

"as farms move from dryland to irrigated you can reasonably expect to see less reliance on winter cropping as production systems move to more efficient summer production and therefore potentially lower concentrations of N in drainage water if they are currently actively winter cropping. This is manageable via the farm plan process. Whereas, any intensification that occurs without irrigation is likely to be significantly more reliant on winter forage crops. It should be noted that management capability has a significant influence on the outcomes from this effect."

Land use and management change to significantly reduce nitrogen losses need not, and indeed cannot, be achieved overnight. It could, at least theoretically, be done in a progressive fashion that works with market conditions to transition winter-based production to lower nitrogen-losing summer-based ones without undermining the viability of the scheme. The question, which cannot be answered with any certainty given the many dynamic factors involved, is how long would it take to achieve the 0.8 DIN limits. It should be clearly understood that even if new policy was developed to enable aggressive regulatory approaches to be taken to constrain and shift land use at sub-catchment scale will take many years. To achieve the degree of land use changes implied by the 0.8 mg/l DIN limits could possibly take decades, and will certainly be beyond 2030.

If the scheme proceeds there are risks that the scheme will be unable to sell water to new users who are unprepared to have their land use constrained by the scheme to the extent necessary for the scheme to be operating in a manner consistent with achieving the DIN limits. However, for farmers in DIN exceeding sub-catchments they may face little choice – to go it alone and have their land use regulated by the Council through individual property resource consents, or to join the scheme, pool their efforts and use reliable water and irrigation as an enabler of farm system change. Overall, it is the Reviewer’s opinion that on balance this situation will likely incentivise farmers to join the scheme rather than deter them.

Where to from here

Given that the 0.8 DIN does not represent a particular threshold for ecological health, coupled with the improbability of achieving the 0.8 DIN limit in a number of the sub-catchments by 2030 - with or without the RWSS – it is concluded that the Council’s focus should be on achieving meaningful reductions in nitrogen losses through continuous improvement in management practice, and appropriate land use change through new policy development where necessary.

With or without the RWSS the 0.8 limit is a useful trigger for precipitating concerted effort on nitrogen reductions in required catchments, but it is concluded that it should not be seen as an appropriate long-term management target around which all else must be ordered. The objectives of the Plan, including better periphyton and MCI outcomes, should be the long-term outcome focus.

It is further concluded that seeking to achieve the 0.8 mg/l DIN limit at monitoring sites across the catchment *by 2030* does not represent a practical or sensible management target. It appears that in determining that the DIN limits should be met by 2030 the Board of Inquiry may have misinterpreted the requirements of the NPSFM. In paragraph 328 of their final report the Board wrote, “water quality should be improved progressively over time so that OBJ TT1 is achievable by 2030 (the year by which the NPSFM is to be implemented).”

This suggests the Board may have believed the NPSFM required the primary policy objectives to actually be achieved by 2030, when in fact the NPSFM only requires the policy to be implemented (i.e. limits and targets to be set and not necessarily achieved). In other regions much longer and more realistic timeframes have been set for achieving water quality objectives, especially in relation to nitrogen where lag effects exist.

A better way to approach the PC6 DIN limits might be to require both the RWSS farmers and non-RWSS farmers, by the year 2030, to be achieving sustained reductions in nitrogen losses and be operating in a manner consistent with achieving the 0.8 DIN *over time*.

There is no known scientific rationale for achieving the 0.8 DIN limit at any particular point in time in the Tukituki catchment, and there are numerous scientific and management uncertainties as well as dynamic

land use factors at play. Therefore, it makes sense to take an adaptive management approach to the issue - that is pursue a rate of progress deemed to be proportionate with the risks being managed and then monitor and evaluate progress as time passes.

As data is collected more-informed decisions can then be made about whether to intensify or relax efforts to reduce nitrogen losses or revisit the Plan settings for more or less stringent limits, or for more effective regulatory tools. The statutory plan evaluation and review processes require this in any event, and it was clearly the approach that was contemplated by the Board of Inquiry. As the Environment Court noted in paragraph 185 of its recent 'Horizons One Plan' decision, "if the Council has a concern or second thoughts about the policy and rule frameworks of any part of the One Plan, the appropriate response is to propose plan changes rather than to adopt an implementation approach that does not accord with the RMA or its Plan."

What constitutes an acceptable a rate of progress toward achieving the DIN limits is a judgement call that will need to reflect the full range of relevant matters under the RMA and is unlikely to be a simple legal or scientific question to answer. The consenting framework under PC6 will require the Council to form these judgements in any event as it works through what is required to be achieved via non-RWSS farm resource consent conditions, and by the RWSS in the operation of its consents should it proceed, in DIN limit exceeding catchments. This process, as described earlier in this section, will take years of rolling measurement and periods of consent implementation and review.

A definition of an acceptable rate of progress for achieving the 0.8 mg/l DIN limit that the Council could possibly consider is: 'as quickly as practicable, while retaining economic viability for land users'. If such an approach outlined is favoured by the Council it will be necessary to get detailed legal advice to determine the consistency of this approach with PC6 as further policy development is likely to be required.

Should the RWSS proceed it is concluded that the operators of the RWSS should work on the basis that given current instream DIN levels RWSS-supplied farms will be at risk of being deemed material contributors to DIN limit exceedances in time. On this basis it is concluded that the RWSS operator should develop the Irrigation Environmental Management Plan required by its consents with an objective of operating in a manner consistent with achieving the DIN limits. The time horizon for achievement could be 2030 as a starting point – noting that achievement in all sub-catchments may be physically impossible - but then be informed by what analysis and data is available to support an assessment of what is practically achievable. The IEM Plan will necessarily need to be developed in partnership with the Council given the Council's role in managing non-RWSS land use consents in DIN limit exceeding catchments. This work could usefully be undertaken through the detailed design and construction phases of the RWSS.

Finally the Council's chosen approach to implementing PC6, particularly in respect of achieving compliance with the DIN limits, will need to be consistent between the RWSS and non-RWSS farmers in DIN exceeding catchments, and consistent whether the scheme proceeds or not. The Council needs to decide whether it is going to attempt to regulate land use (with the limited scientific basis and ambiguous planning provisions outlined in this Review) to achieve a numeric limit of one water quality parameter by 2030. Or instead take a more pragmatic and achievable approach by pursuing what is both possible and ambitious in driving down nitrogen losses through further policy development. If it chooses the latter then the RWSS, managed well and held to account, could be considered to be an enabling part of the approach. If the former approach is preferred then the Council's approach will likely frustrate the exercise of the RWSS land use consents from the outset – as noted by the Board of Inquiry - and maybe *ultra vires* the Resource Management Act.

As it stands the Council and the community cannot afford to 'do nothing'. In addition to deciding whether or not to continue with the RWSS, the Council should also clarify its objectives for the catchment, including and particularly timetables for achievement. In time, it will need to ensure the policy and planning framework is fit for purpose for achieving the objectives in the desired timeframes.

Given that the principal catchment nitrogen management challenge lies within the Ruataniwha Basin, and in light of the RWSS's ability to influence land management and land use in the Basin within the existing legal construct, this Review concludes that it would be appropriate to continue to work through the DIN-limit implementation issues in PC6 over the next four years. Once the Irrigation Operational Management Plan has been developed, during the construction phase, an assessment can then be made of what residual planning issues need reconsideration in order to achieve the Plan's objectives.

However, should the RWSS not proceed this Review concludes that it will be necessary to revisit and review PC6 with some urgency. This will involve significant science and planning resources that will need to be allocated within the upcoming 2018-2028 Long Term Plan.

Environment key conclusions

Plan Change 6 and the RWSS were developed as a dual strategy for managing low summer river flows and associated levels of periphyton, with stored water from the RWSS intended to replace ground and surface water, provide low flow augmentation and flushing flows, and to complement nutrient management aspects of PC6.

If the RWSS does not proceed irrigation security for existing irrigators impacted by PC6 increases in minimum flows will reduce on-farm cash surpluses by an estimated 35% and earnings by \$900,000 on average, although in the very driest years farm earnings are estimated to reduce to be \$4.7 million.

If the RWSS does not proceed there are farm systems modelling approaches to sheep, beef and dairy production without irrigation and using fodder crops that can reduce nitrogen and phosphorus losses while still optimizing financial returns from available inputs.

If the RWSS is not to proceed it will be necessary for the Council to reconsider the implementation plan for PC6, including the level and nature of resources committed, which should be expected to increase.

Construction of the RWSS will have detrimental impacts on biodiversity, which were reviewed by the Board of Inquiry. The Board determined that an appropriate mitigation and offset package was included in the RWSS consents that would achieve no net reduction in biodiversity.

Under Plan Change 6 water quality limits there is “no headroom” for further deterioration in periphyton levels and Macro Invertebrate Community Index scores and improvements of both are primary imperatives of PC6 for water quality.

The flushing flows to move periphyton can be expected to be effective in the Makaroro and Waipawa Rivers but there is uncertainty of their efficacy in the Tukituki River.

There is no scope to increase Dissolved Reactive Phosphorus (DRP) losses in the catchment and in many sub-catchments substantial reductions are required, which is the largest PC6 management challenge for the Council.

The RWSS is required to either reduce or not increase phosphorus losses and the RWSS consent provides more prescriptive and intensive management of phosphorus than permitted activity rules for the wider catchment.

The PC6 Dissolved Inorganic Nitrogen (DIN) limit of 0.8 mg/L is currently exceeded by between 130% and the 420% at 6 monitoring sites, all within the Ruataniwha Plains area.

Achieving the DIN limit in all Tukituki sub-catchments, particularly those in the Ruataniwha Plains area, will require land use restrictions – probably severe in some areas - and likely land use change.

The RWSS is required to operate and manage nitrogen loss from RWSS farms “in a manner consistent with” achieving the PC6 DIN limits and targets by 2030 but its consents don’t require absolute compliance with the DIN limit.

The Land Use Capability leaching rates mechanism in PC6 to control nitrogen gives considerable headroom (30-50%) for further nitrogen losses across the catchment and is not considered an effective means to manage nitrogen where the levels need to be significantly reduced.

PC6 gives no particular mechanisms to the Council with which to manage land use in the event of DIN limits being exceeded in a tributary catchment beyond requiring LUC leaching rates be met.

Expert scientific advice concludes that the 0.8 mg/L DIN concentration is not a defensible threshold between healthy and unhealthy ecosystems but represents a point on a risk continuum.

The 0.8 DIN Limit should be seen as a management trigger in the context of the whole resource management effort and not an objective in its own right, nor seen as an appropriate long-term management target around which all else must be ordered. The objectives of the Plan, including better periphyton and MCI outcomes, should be the long-term outcome focus.

Achieving the 0.8 mg/l DIN limit by 2030 in all sub-catchments with or without the RWSS is considered by Council staff to be highly improbable and likely to be physically impossible.

The Board of Inquiry may have mistakenly interpreted the NPSFM as requiring PC6 objectives to be met by 2030, not that limits must be in place by 2030 with achievement able to be set on a more achievable timeline.

A better way to approach the PC6 DIN limits might be to require both the RWSS farmers and non-RWSS farmers, by the year 2030, to be achieving sustained reductions in nitrogen losses and be operating in a manner consistent with achieving the 0.8 DIN *over time*.

Should the RWSS proceed the operators should work on the basis that RWSS-supplied farms will be at risk of being deemed material contributors to DIN limit exceedances in time and develop the Irrigation Environmental Management Plan with an objective of operating in a manner consistent with achieving the DIN limits in time.

Managed well and held to account, the RWSS can be considered to be an enabling part of the approach to achieving PC6's objectives.

In addition to deciding whether or not to continue with the RWSS, the Council should also clarify its objectives for the catchment, including and particularly timetables for achievement. In time, it will need to ensure the policy and planning framework is fit for purpose for achieving the objectives in the desired timeframes.

Given that the principal catchment nitrogen management challenge lies within the Ruataniwha Basin, and in light of the RWSS's ability to influence land management and land use in the Basin, it would be appropriate to continue to work through the DIN-limit implementation issues in PC6 over the next four years. Once the Irrigation Operational Management Plan has been developed, an assessment can then be made of what residual planning issues need reconsideration in order to achieve the Plan's objectives.

However, should the RWSS not proceed this Review concludes that it will be necessary to revisit and review PC6 with some urgency. This will involve significant science and planning resources that will need to be allocated within the upcoming 2018-2028 Long Term Plan.

3.5 Engineering issues

Issue for review: # 19

High level assessment of the available storage capacity if the scheme is altered to keep the reservoir below the DOC land and not impact on currently approved consents, and associated impacts on capital requirements, distribution, revenue and expenditure. *Comment: These issues have been largely addressed previously by HBRIC and this advice will be reviewed, collated and summarised for councillors and the public.*

Advisor: Graeme Hansen, Group Manager Asset Management, Hawke's Bay Regional Council (HBRC)

Issue for review: # 20

High level assessment of alternative dam sites off river main stems and assessment of specific on-farm storage options, including impacts on distribution costs and revenue, and impacts on primary production output.

Comment: These issues have been addressed previously by HBRIC and this advice will be collated and summarised for councillors.

Advisor: Graeme Hansen, Group Manager Asset Management, Hawke's Bay Regional Council (HBRC)

Issue for review: # 21– recommended not proceed

Assessment of options to reduce consenting costs for on-farm storage in Tukituki catchment.

Comment: This is likely to have a limited effect on decision making in relation to the RWSS.

Issue for review: # 22

Advice on the proposed approach to gravel management within the reservoir, including operating costs and consent compliance, seismic risks to dam integrity, and any issues arising from future decommissioning of the dam.

Comment: These issues have been largely addressed previously by HBRIC on the basis of preliminary design and this advice, including that of Dam Watch, will be reviewed, collated and summarised for councillors and the public.

HBRIC proposes to add to the scope of work for the Dam Design Panel, when it supervises detailed design and construction at the next stage of scheme development, consideration of recent seismic events on the East Coast of NZ and new knowledge of these issues.

Advisor: Graeme Hansen, Group Manager Asset Management, Hawke's Bay Regional Council (HBRC)

Issue for review: # 23 – recommended not proceed

Constraints on reliability of supply for water users arising from constraints in the distribution network and from the dam outlet *Comment: This information is expected to be at the margins of significance in terms of the high-level costs and benefits of the RWSS.*

Issue for review: # 24

Summarise reports and peer reviews of synthetic inflow model and assumed climate forecasts for reservoir recharge, and associated consequences for the timing of post-commissioning revenue, scheme reliability for water users and the minimum annual low flow.

Comment: Most of this work has been undertaken previously by HBRIC and been extensively reviewed. Given persistent questioning over this analysis it is proposed that this advice be peer reviewed once again by Mr Colin Riden and his analysis, along with that of expert advisors to the scheme, be provided to the Council.

Advisor: Colin Riden

Summary of findings for engineering issues

Alternative dam location to avoid Department of Conservation land

Given the ongoing legal dispute over the proposal to inundate 22 hectares of DoC land for the dam reservoir the RWSS Project Manager, Mr Graeme Hansen, was asked to advise on the available storage capacity, and associated financial impacts, if the scheme is altered to keep the reservoir below the DOC land (see appendix 24).

If the dam remains at its current location then in order to avoid inundating the DoC land the dam height would need to be reduced to 51 m height, compared with the 83 m dam structure proposed. Mr Hansen has estimated the lower dam to cost \$111 M, a \$19 M or 15% reduction given many of the costs remain fixed. However, this cost saving is associated with an 80% reduction in the reservoir volume, with the 51 m option providing only 18 million cubic metres (M m³) of storage, clearly making the dam uneconomic.

Mr Hansen went further with his analysis and has considered a site 3 km downstream of the current dam site which would also avoid inundating the DOC land. However, due to the conditions at that location the dam could only be constructed to a maximum height of 72 m and provide 60 Mm³ of available storage (2/3rds of the RWSS). This dam structure would also be substantially longer at 650m, when compared with the currently proposed dam length of 400m. To construct a 72 m high dam at this location is estimated to cost \$165 M, and excludes distribution costs. However, this does not take into account the extra costs which would be required for the redesign, additional consents, landowner approvals and land-taking requirements. The additional construction costs coupled with the reduced storage would likely make the water unaffordable for irrigation.

Mr Hansen's analysis confirms the work completed during the prefeasibility and feasibility phases of the project where a number of potential dam sites were identified and investigated. Reducing the height of the dam, or relocating the dam to a different location, if a technically feasible site can be found, would be expected to have significant negative effects on the project's economics and so is not a viable strategy to address the DoC land issue.

Alternative water storage options

Mr Hansen has provided the Review with a high-level analysis of alternative water storage options using the current Makaroro dam site and Ruataniwha plains distribution system as the benchmark (base case). His advice is set out in appendix 25.

One scenario investigated was for moderate scale storage utilising work carried out during the Advanced Prefeasibility phase of the RWSS that considered a number of smaller (19m to 46m high) dams located in the foothills immediately above the Ruataniwha plains. Six dams were selected to replicate 90Mm³ storage, storing between 8 to 25Mm³ each, 15Mm³ average.

A scenario of on-farm storage was also evaluated with the aim of storing the equivalent volume as the RWSS in on-farm reservoirs. This kind of storage is not to be confused with the small scale dams prevalent on farms for stock drinking water, but rather lined structures that provided sufficient water reliability for irrigation of high capital cost crops. An industry standard design of 5m deep storage with 2.5m below ground and 2.5m above ground was used, and assumed sufficient water could be found in the aquifer or pumped from rivers and streams. This scenario involves significantly higher capital costs per cubic metre of water stored due to

increased construction costs, storage lining significantly more expensive and productive land needing to be sacrificed, and additional pumping costs for water.

A further hypothetical scenario was considered for comparison whereby the Council's remaining \$60m in capital set aside for the RWSS is provided to farmers on 50/50 cost share and interest free basis. This was forecast to store only 24M m³ of water compared to the RWSS's 90Mm³ because in addition to higher storage costs it does not attract external capital.

On-farm storage would have the benefit of not damming a major river course, spread risk over more locations and enterprises, and could be developed over longer time frames as demand grows. However, the additional costs are significant and likely explains why there is no on-farm storage, other than one buffer dam, currently in Central Hawke's Bay. On-farm storage is likely to also be located in lower rainfall zones, be prone to higher rates of evapotranspiration and not be able to take advantage of alpine and westerly driven rainfall nearly to the extent of the RWSS or moderate scale storage options in the foothills of the Ruahine range.

The analysis suggests that real economies of scale exist with the RWSS. The capital cost of building 6 smaller dams to deliver the same volume of water as the RWSS would cost a further \$100 million although it may spread seismic and/or inflow risk. On-farm storage is forecast to cost around \$5 per m³ in contrast to \$1.45 per m³ for the RWSS and would inundate 1800 hectares of higher productivity land in contrast to the RWSS using 400 hectares of low agricultural productivity land, albeit the RWSS land has biodiversity value. Obtaining water from surface or ground water for this volume of on-farm storage would likely be challenging given PC6 constraints on allocations and flows.

However, notwithstanding this analysis there is a view from within the Community Reference Group that smaller scale on-farm storage (including short duration, drought-protection storage from ground water) may provide greater overall benefit when considered over the operating life of the scheme. Even if the water unit costs may be more expensive in financial terms it is argued that reduced impacts on biodiversity, for example, and diversified risk may mean that alternatives to the large dam concept are worthy of further consideration.

Gravel management

Gravel inflow to the reservoir is estimated to be between 12 - 25 million m³ over 100 years. As such, Mr Hansen advises that a midpoint estimate of 0.18 million m³ of sediment infill per year has been used by the scheme for design purposes (see appendix 27). A 'dead' storage provision of 4 million m³ has been allowed for within the dam reservoir capacity to accommodate sediment accumulation, and based on the midpoint estimate of inflows is sufficient for 22 years of accumulation without any extraction.

The gravel that will accumulate within the dam reservoir area has economic value for use in the roading and construction industries. The annual average volume of 180,000m³ broadly aligns with volumes historically extracted from Central Hawke's Bay rivers as part of managing the Upper Tukituki Flood Control Scheme. Current extraction rates are considerably less than this volume, reflecting the lack of economic development within the area at present however this is expected to improve should the scheme proceed. It is also significant that the proposed dam site will trap sediment that contributes to the Waipawa River system and will provide additional security, relief and medium term stability to the upper section of the Tukituki Flood Control Scheme.

Modelling for the scheme has assumed that 25% (45,000m³) of the annual accumulation average of 180,000m³ will be extracted from the reservoir each year. This assumption is modest, readily achievable by volume and sees the life of the dead storage provision of 4 M m³ potentially extended to 89 years. It is estimated that it would take 500 years before the dead and live storage provisions are infilled with sediment

and gravel and decommissioning would need to be considered. This life is obviously further extended with an active sediment management regime in place.

While it is commonly imagined that sediment accrues immediately behind the dam itself the sediment accumulation delta is expected to form mostly in the upper part of the reservoir where the velocity of the contributing tributaries terminates. Deposition at this location is convenient for extraction and improves confidence that this can be managed at reasonable cost. Access to this section of the reservoir has been negotiated as part of reservoir land purchase. If the value of the stored water increases over time, as expected, then the economics of extracting greater volumes of gravel from the reservoir will improve as well.

An assessment has been made of the additional cost for extractors to remove gravel from the proposed dam, compared with current extraction at State Highway 50. There is an additional 50km round trip, with a cost of \$10/m³ for transport to extract the annual budgeted amount of 45,000m³. This equates to an annual cost of \$450,000 and this is a potentially shared cost, on an agreed ratio, between the RWSS and Upper Tukituki Flood Control Scheme, recognising the impediments and benefits to the respective schemes. Provision has been made within O&M budgets for the RWSS scheme for a range of gravel consent and operational management costs.

Seismic risk of dam failure

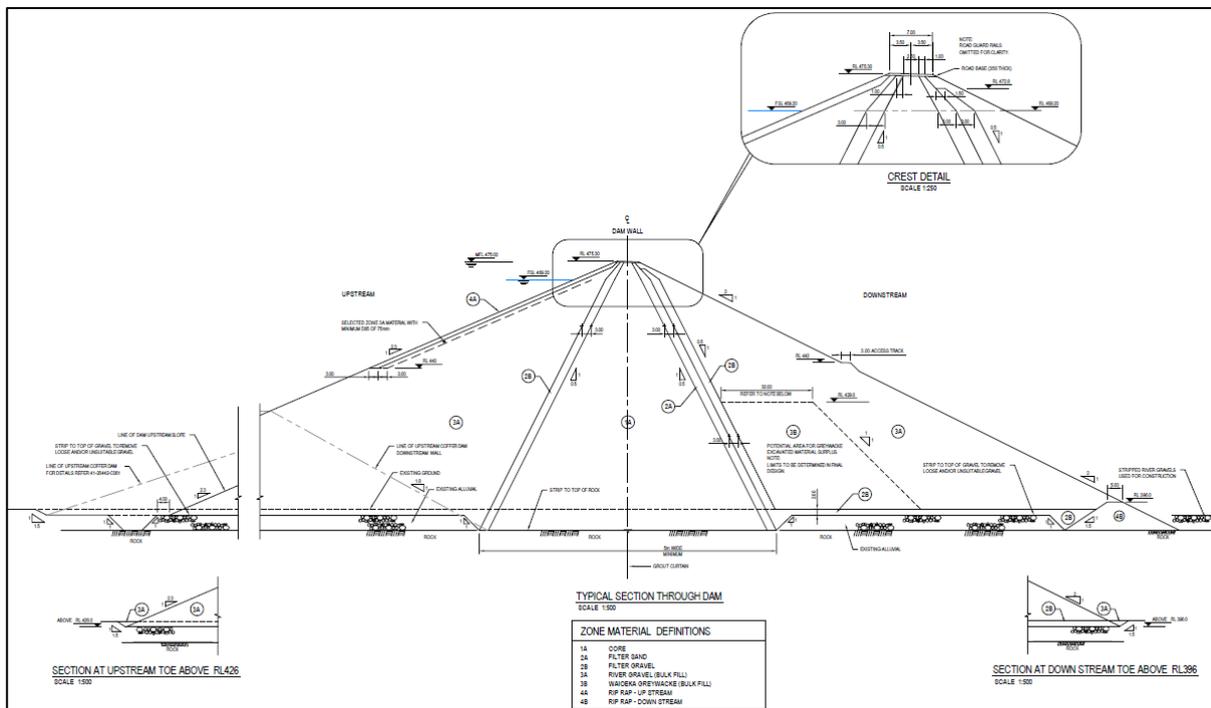
The RWSS has been extensively evaluated for seismic risk (see appendix 27), and this was a particular focus of the due diligence undertaken by the institutional investor. For the dam site the principal 'fault rupture displacement source' is the Mohaka Fault, which crosses the body of the reservoir and passes approximately 600 m upstream from the dam site. This fault has a recurrence interval of 700 - 1830 years (average c. 1125 years) and the last rupture event on the fault is believed to have occurred c. 300 years ago.

GNS Sciences have completed a series of investigations of the potential for rupture of the primary Mohaka Fault and possible secondary fault displacements. They have concluded that a fault rupture along the main active fault is not likely to occur in the dam site area albeit that the dam site would experience severe shaking, and GNS found no evidence for active secondary faulting. GNS have advised that the magnitude of secondary displacements in the dam site, should these occur, could be for up to 0.5m movement for a single event.

The Wakarara Fault is also present within approximately 4.0 km of the dam site. Data from the fault south of Wakarara suggest that there have been 1 - 2 fault movements during the last 10,000 - 14,000 years.

Dam design specifications require the dam structure to be capable of accommodating a 0.5m vertical or horizontal displacement without failure. To meet this requirement a central core rockfill dam with wide core and fillers (see drawings below) is considered the safest dam type for the location. The core provides "flexibility" of the dam body to accommodate displacements caused by faulting during a seismic event. Upstream and downstream filter zones are provided and which will act as "crack stoppers" and filters against erosion of the core respectively.

Figure 12 – Typical section through dam



The RWSS Contractor has appropriately applied an analysis for the Maximum Design Earthquake, which indicates that more rigorous techniques need to be applied to confirm the dam's performance in a MDE seismic event. As such, the RWSS Contractor has allowed for a more sophisticated analysis of the dam at the detailed design stage, which will be reviewed by an independent dam safety panel as part of the building consent process.

Decommissioning

The two most likely reasons for decommissioning for the RWSS would be for dam safety and sediment accumulation (see appendix 27). With respect to dam safety Mr Hansen advises that the RWSS dam and related structures have been designed using state of the art engineering practice and so are anticipated to have a long life and be free of safety issues more common in older dams. The commentary on sedimentation issues for the RWSS reservoir outlined above noted that if unmanaged the sediment load would take approximately 500 years to completely fill the dam. Therefore, decommissioning for sedimentation reasons is not anticipated in the assumed economic life of the scheme or then foreseeable future.

However, in the event that it was no longer considered economic to maintain or repair the dam, then the option of decommissioning would be presented. According to the American Society of Civil Engineers (ASCE), removal costs of dams are around 10 – 20% of the dam construction cost. In some cases the costs for decommissioning can be much larger than this, but this is generally for concrete dams with hydroelectric facilities and in particular, those dams where reservoir sediment contain heavy metals and toxic contaminants. As the RWSS dam is a rockfill dam with no hydroelectric facility (at present), nor an upstream source for pollution, it is unlikely that the removal of the RWSS dam would be in this category.

To estimate costs for a fund which could cover the potential decommissioning of the SMEC Consultants applied two methods:

1. Firstly the ASCE factor for removal costs of 10 – 20% was taken and the higher value of 20% used. As the dam capital cost is approximately \$130 M, this gave a dam removal cost of \$26 M, and

2. the second method was to take the volume of the dam $\sim 2 \text{ Mm}^3$ and apply a rate for bulk earthworks with transportation ($\$15/\text{m}^3$) to estimate a removal cost. This gave a dam removal cost of $\$30 \text{ M}$.

If funding is put aside for 100 years for the cost of the dam removal and assuming a long-term retail deposit rate of 5% and the decommissioning costs are increased by an assumed 2% inflation rate then this amounts to approximately $\$83,000$ per year. Given the nature of these costs and the long expected life of the dam, including the fact that the asset is proposed to transfer to HBRC ownership in 70 years along with sizeable annual revenues, it appears reasonable no provision for funding decommissioning has been made at this time and can be considered in the distant future.

Catchment hydrology

There has been some level of ongoing concern that the hydrology for the Makaroro catchment may have been overestimated, risking the reliability of the scheme to deliver the volumes of water necessary for its viability. These matters were explored during the Board of Inquiry and opposing evidence was heard from, among others, Mr Colin Riden and Mr David Leong of Tonkin and Taylor for HBRIC Ltd. In paragraph 924 of its decision the Board “concluded that Mr Leong’s estimates of river flow at the dam site have been carefully formulated and are accurate”. However, in the interests of putting the matter to rest the Review has sought further analysis from Mr Colin Riden and Mr David Leong.

Since the Board of Inquiry’s deliberations further measurements of both rainfall gauges and river flow monitoring sites has increased confidence of catchment estimates. Of greatest significance is the Burnt Bridge monitoring site that was re-established as a fully-rated flow recording site on 23 July 2011. The recorded mean flow from 23 July 2011 to 10 January 2017 is $6.21 \text{ m}^3/\text{s}$. By using the Tukituki at Tapairu Road as an indicator site, the adjusted long term mean flow (for the period 1987 to 2016) for the Makaroro at Burnt Bridge is now estimated at $6.11 \text{ m}^3/\text{s}$.

This is equivalent to a mean flow at the dam site of $5.83 \text{ m}^3/\text{s}$ and an annual inflow volume 184 million m^3 . This mean flow estimate is about 8% lower than using the synthetically extended Burnt Bridge record ($6.36 \text{ m}^3/\text{s}$) and about 4% lower than the catchment water balance estimate ($6.09 \text{ m}^3/\text{s}$) from the Feasibility Study.

However, Mr Leong (see appendix 28) advises that the reduction in overall mean flow does not translate to a similar reduction in the flow yield of the Makaroro Dam and reservoir. This is because the Feasibility Study flows appear to have been overestimated during medium to high flows and slightly underestimated during low flows. The upshot is that there is in effect a slight improvement in the drought performance of the scheme relative to the pre-Board of Inquiry simulations using the Feasibility Study inflows.

Furthermore advice on rainfall comparisons recently provided to the Review by HBRC Climate Scientist Dr Kathleen Kozyniak show that both the Landcare (1950 - 1980) and NIWA (1981 – 2010) rainfall maps continue to systematically underestimate the catchment rainfall at the headwaters of the Tukituki catchment, including nearly all of the Makaroro catchment. This demonstrates that use of HBRC rainfall gauges and river flow monitoring sites provide a more robust basis on which to estimate Makaroro catchment rainfall rather than national-scale rainfall models.

Additional scrutiny of the hydrology was conducted by DamWatch on behalf of the institutional investor. This review concluded that the estimates provided by Mr Leong to HBRIC Ltd are sound. Mr Colin Riden continues to believe these assessment are flawed and had been contracted to provide his alternative assessment to the Review. At the time of writing his report had yet to be received and no substantive information has been provided that demonstrates the assessments undertaken by the Council hydrology team or Mr Leong are flawed.

As noted in the Financial and Economic sections of this review, conservative assumptions have been used regarding water availability for RWSS sales and revenue, and sensitivity analysis has been conducted on lower final water sales and irrigation reliability being only 90% (instead of expected 95%). Therefore, any downside risk on the hydrological assessments has been well catered-for in assessing the viability and economic impacts of the scheme.

Engineering Key Conclusions

Reducing the height or relocating the dam to avoid inundating the DoC land can be expected to have sufficiently negative impacts on the costs and capacity of the dam to make it uneconomic to construct.

Achieving equivalent water storage in medium sized dams would cost around \$100m more than the RWSS.

On farm storage is estimated to cost around \$5 per m³ (including land costs) in contrast to \$1.45 per m³ for the RWSS, would require on-farm pressurisation and be more challenging to collect comparable water inflows. For RWSS equivalent storage volume on-farm storage would inundate 1800 hectares of higher productivity land in contrast to the RWSS using 400 hectares of low productivity land.

Gravel is expected to accumulate at a manageable rate in upper parts of the reservoir and be economically extractible for the life of the RWSS, posing no safety risk or materially adverse impact on scheme reliability.

Detailed dam structure design will be for Maximum Design Earthquake based on GNS assessments. The current design is capable of accommodating a 0.5 m vertical displacement without failure.

Decommissioning costs for the dam are estimated to be in the order of \$26-30m. Given the long expected life of the dam, including the fact that the asset would transfer to HBRC ownership in 70 years along with sizeable annual revenues, it appears reasonable that no provision for funding decommissioning has been made at this time and can be addressed in the future.

Recent river flow monitoring of the Makaroro has increased confidence of catchment water balance estimates and gives a mean annual inflow volume of 184 million m³, about 4% lower than the estimate from the Feasibility Study. However, this reduction is not predicted to translate to a similar reduction in flow yield and its profile gives a slight improvement in the drought performance of the scheme.

4 Community Reference Group Statement

19 April 2017

The Community Reference Group (CRG) was formed with the following objectives.

8. Advice to Council on 30 November proposed that a small group of appropriately skilled advisors are appointed to assist the Group Manager Strategic Development in overseeing the review. The Group would assist in ensuring a degree of independent scrutiny of the review work programme.
9. It is not proposed that this Group would be required to make any recommendations in relation to the findings of the review, or to reach consensus on any matter. Their primary function will be to provide advice to the Group Manager on the process and their assessment of the adequacy of the review in addressing the packages of work agreed by the Council.
10. It is proposed that the Group meet early in the review process to ensure the necessary questions are being asked in relation to the work programme. Advice of the Group would be sought on review material as it is developed to ensure the questions asked have, in their view, been adequately answered.
11. It is proposed that the Group provide a statement or statements to the Council on their assessment of the matters in the preceding paragraph. This statement or statements will be contained in the review report.
12. It is intended that members of the Group will be Hawke's Bay based wherever possible and include members of the Central Hawke's Bay community. The skills sought include resource management, freshwater ecology, tangata whenua interests, dryland farming, irrigation, infrastructure and business development.

The CRG believes it has carried out these objectives to the best of its ability within the constraints of the process and time frame.

The CRG reviewed the questions received from the Hawke's Bay Regional Councillors and added scope and clarity to questions during discussions. A small number of questions had been removed prior to CRG involvement.

The CRG has reviewed the reports as they have become available and challenged the authors for clarification and explanation of methodology providing suggestions and recommendations to aid clarity to the report findings. CRG notes that while some questions were answered with a degree of factual evidence, some questions were answered through the provision of professional opinion and/or modelling. Where identified necessary, CRG requested additional information to provide depth and clarity to the reports submitted.

The CRG is of the opinion that the question raised by Councillors has been answered and that the authors of the review workstreams were said to be experts in their fields. CRG agreement to the report (answers) was not part of the role and from time to time individual CRG members disagreed with the content of a Reviewer's report.

The CRG has had all information provided that it has requested, but would also note the time frame to consider all material was limited.

The CRG endorses this report by Group Manager Strategic Development in that it does accurately summarise the findings, presented in the individual Reviewer's reports to the questions the Hawke's Bay Regional Councillors have raised.

Signed :

Individual Statement from Dan Elderkamp, as addendum to the combined Community Reference Group (CRG) Statement.

Whilst I agree with the tenor and general conclusion of the CRG Statement, I wish to note that there were a number of personal concerns, as set out below. My agreement with the CRG Statement is therefore a qualified one.

Firstly, and most importantly, there were numerous detailed and voluminous reports presented to the CRG for scrutiny, often issued with not much time available before the meeting at which they were to be discussed. In my opinion, and from my point of view, the time available for the CRG to fulfil its brief was insufficient to do it justice. I'm of the opinion that the same applied to a number of the reviewers, who had difficulty with meeting the specified deadlines.

Secondly, the reports in most cases were quite technical, and as I am not an expert in most of the disciplines involved, it was difficult to fully comprehend much of the information presented, and consequently make an informed decision as to the veracity of the points made. As the CRG was bound by a non-disclosure agreement, members were unable to consult outside expert advice.

Thirdly, a number of the issues were reviewed by persons that have been involved with the RWSS for some time in one way or another and who were, in my opinion, neither independent nor unbiased.

Fourthly, in my opinion a crucial issue was left out of the review, namely the significant negative effects that construction of the RWSS, should it go ahead, will have on biodiversity, native fauna and flora, their habitat, and climate change. In my opinion this should have been one of the main issues for consideration.

Allied to this is the question surrounding the land-exchange process: - how was it initiated, managed and decided upon. In my opinion this has relevance to the review in that it reflects on the decision-making processes (and the quality thereof) within the HBRC and HBRIC Ltd that ultimately led up to the situation in which both entities, as well as ratepayers, now find themselves.

Fifthly, as stated in the List of Issues, no. 11, "*...the primary focus of this review is on costs and benefits of the scheme...*". Although this issue has a specific focus on alternative investments, this statement addresses the broader purpose of the review, and appears to selectively prioritise what issues should be reviewed. I would've thought that the purpose and scope of the RWSS review had a somewhat wider brief than this, in that this statement gives the perception that the downsides and negatives of the scheme are not material to this review, and are not up for consideration.

Sixthly, in the Engineering Issues section (4.5) of the report, it is stated: "*On-farm storage is forecast to cost around \$5 per m³ in contrast to \$1.45 per m³ for the RWSS and would inundate 1800 hectares of higher productivity land in contrast to the RWSS using 400 hectares of low productivity land.*" This gives the perception that the 400 hectares within the dam footprint are worth the sacrifice only in terms of agricultural productivity outputs, and that productivity in terms of conservation, biodiversity and environmental outcomes are considered of lesser value (or not considered at all) than agricultural ones. In my opinion the conservation and environmental productivity and value of the 400 hectare dam footprint far exceed that of 1800 hectares of farmland - it is a matter of values judgement as to which is more important. Given the state of New Zealand's biodiversity, and the HBRC's support for enhancing same through the Biodiversity Strategy, this statement shows an apparent bias in favour of the RWSS, and strikes at the heart of Council's role in environmental protection.

Thank you for the opportunity to participate in this review, and to append this individual statement to the CRG Statement. Dan Elderkamp

Community Reference Group Members:

Dan Elderkamp – Central Hawke’s Bay Branch of Forest and Bird

Emma Buchanan – Central Hawke’s Bay based RMA planning consultant

Graham Anderson - Central Hawke’s Bay farmer and prospective RWSS Water User

Hugh Ritchie – Central Hawke’s Bay farmer and prospective RWSS Water User

Jenny Nelson-Smith – Deputy Chair of Tamatea Taiwhenua

Vaughan Cooper – Hastings-Havelock North Branch of Forest and Bird

Meetings dates:

Wednesday, 15 February 2017 -

Tuesday, 7 March 2017 – Presenter John Palairet – Financial issues

Thursday, 16 March 2017 – Presenter Chris Morrison, Lewis Tucker

Thursday, 30 March 2017 – Presenters Graeme Hansen (Engineering issues) Ned Norton, Lachie Grant, Ian Millner, Shane Lambert and Tom Skerman (Environmental issues)

Wednesday 12 April 2017

5 Glossary of abbreviations and terms

RWSS	Ruataniwha Water Storage Scheme
HBRC	Hawke's Bay Regional Council
HBRIC Ltd	Hawke's Bay Regional Investment Company
DIN	Dissolved Inorganic Nitrogen
LUC	Land Use Capability
DRP	Dissolved Reactive Phosphorus