Far North District Council

Te Kaunihera o Tai Tokerau ki te Raki

Hihi Wastewater Treatment Plant

CAPITAL WORKS BUSINESS CASE

HE WHENUA RANGATIRA

A DISTRICT OF SUSTAINABLE PROSPERITY & WELL-BEING

Project Code:	WWP0655	**Project ID (Finance):**	551302
Objective ref:	A3068094	**Objective version #:**	1

1 Purpose

This Business Case details the investment need and provides the high-level approach for capital investment that will be further specified and developed during the Detailed Design stage.

Recommendation: *Hihi Wastewater Treatment Plant* – Replacement of plant with a Membrane Bio Reactor.

It should be noted that the construction costs are similar for both Membrane Bioreactor (MBR) and Activated Sludge Plants (ASP) and both systems have advantages, disadvantages and risks. With the accuracy of cost estimation at this stage in the process, it is not possible to select between these options on price alone. The recommended option has resulted from an overall analysis of Quality, Time and Cost:

- Quality – MBR produce a very high quality of effluent, even with changes in load and are not susceptible to poor settlement due to Nocardia. While ASP can produce high quality effluent, performance may dip during changing load conditions (which Hihi does experience), particularly on ammonia and suspended solids.
- Time – An MBR plant can be constructed in approximately 3 months less than the activated sludge solution.
- Cost – Both options show similar capital cost and, while operating and Whole of Life Costs are greater for MBR, over the term of the life, this should be weighed against the benefits noted above.

As noted in WSP's Hihi Options Review from 2020, the membrane bioreactor (MBR) option is the most robust and adaptable solution for future performance needs and resource consent demands, as well as offering the most operationally consistent performance. It is this option that appears to best satisfy the project objectives and level of service expectations.

However, there are also risks associated with MBR plants and it is worth noting the following:

- MBR is a new system for FNDC, which introduces a level of risk with regards to ongoing operational costs. Hihi is a relatively small community to be able to withstand uncertain costs. Detailed design should better inform the whole of life cost expectations.
- MBR technology is still relatively new, compared to ASP, and much is still being learned about how best to operate them.
- Whole of life costs are greater due to the requirement for skilled operators and replacement of membranes. Costs also differ significantly depending on the adopted technology and the site conditions.
- MBR plants are susceptible to membrane fouling, which significantly reduces membrane performance and lifespan. Fouling control strategies are still being researched.

In contrast to MBR, activated sludge plants are a familiar system to FNDC, local operators know how to run them and the whole of life costs are lower than for an MBR. But while ASP can produce high quality effluent for the majority of the time, performance and level of service may dip during changing load conditions, which are experienced at Hihi.

2 Problem / Opportunity

Problem:

- The existing plant infrastructure has been assessed as structurally unsound and unsafe, capacity is insufficient for both peak flow and peak load and the plant footprint is not within the designated boundary.
- The constructed wetlands are in poor condition and cannot perform adequately due to blocked pipes and overflowing basins.
- Stormwater infiltration needs to be addressed.
- The plant's poor condition and insufficient capacity is now impacting operation and the environment is at high risk from contamination.

Opportunity:

- Upgrade of existing plant infrastructure to comply across all current and expected consent conditions. The existing Resource Consent is due for renewal in Nov-22 which will include new conditions for compliance.

- Improve quality and performance - upgrade system process to align with the capacity requirements for area of benefit.
- Provide community with safe, reliable wastewater treatment while achieving value for money.
- Upgrade the wetlands poor condition due to lack of maintenance.

Figure 1) Hihi, Te Hiku Ward, Far North District

3 Background

History on site location and community consultation:

Hihi is a small community on the east coast in the Far North ward of Te Hiku, off SH10, see Figure 1. Hihi's population varies throughout the seasons; the approximate population over the winter months is 200 residents, then during the summer months the population increases to around 400. Hihi beach is also a very popular destination for tourists and during the Christmas holiday period (24 Dec to 7 Jan), the peak season of summer, population increases to over 600.

The Hihi Wastewater treatment plant (WWTP), built around 1975, is located alongside the Hihi Marchant Road Reserve which sits within the boundary of residential properties. The wetland marshes are located off Hihi Road, approximately 800m away from the plant. The plant undertakes both primary and secondary treatment processes, then effluent is pumped from the plant to wetland marshes for tertiary treatment. It is then discharged by gravity to Hihi stream, a minor watercourse that runs through the settlement of Hihi before reaching the coast at Hihi beach. This WWTP employs an extended aeration, activated sludge process. The plant consists of two aerations

Figure 2) WWTP shown inside recreational reserve

tanks that operate in series, followed by a sedimentation tank, which collects the clarified wastewater in an effluent storage tank and from here it is pumped through a rising main to a series of wetland cells.

Reports ranging from 2001 through to 2019 provide evidential data that Hihi treatment plant is structurally at the end of its life and has been patched up over the years to keep it operational. More equipment has been added to keep the plant functioning, but this has resulted in a non-functional operating workspace and has not resolved all the underlying issues, which now cannot be resolved unless the plant is replaced. Current consent conditions allow for the condition of the plant, however, when the resource consent is renewed in 2022, the condition of the treatment plant and the wetlands will no longer be acceptable.

During 2006-2011, relocation of the plant was investigated after 79% of the community favoured moving the treatment plant from its existing location due to the environmental impacts the residents were subjected to e.g. odour, noise, general health and well-being. The most favoured option was relocating the plant to the wetlands, with only the adjacent landowner (to the wetland lots) opposing, therefore investigations were initiated. Based on the conclusion of these studies, relocation to construct the new plant (using the MBR system) at the wetlands was unable to be justified on a cost/benefit basis. It was therefore removed as an option and further remedial options required investigation. The community were consulted, and reference was made stating they understood the implications of relocation and endorsed retaining the plant within the existing site.

Feasibility continued by proposing to stage the project, prioritising remediation of the aeration tank. Stage one would be for the aeration tank to undergo further investigations and Stage two would be to upgrade the plant as the final stage of works. Proposals were requested for stage one, but the remedial work estimates received came in well over budget and, due to the unknown outcome of the consent process and a reluctance to fund this, no upgrade to the tank was initiated. The plant has been operated following a reactive maintenance approach only; planned or proactive maintenance and renewals appear to have been deferred due to potential replacement of the plant.

3.1 Key Issues:

The following are key observations made from prior assessments on the Hihi WWTP, listed in Section 18.1 Appendix A - Hihi WWTP Referenced Material. It is important to highlight that these conditions are a direct result of sweating the asset past its use-by date and lack of investment towards operational maintenance:

- The original WWTP at Hihi was constructed over 40 years ago for a lower population approximately 200 people. It has insufficient flow and load treatment capacity for current demand with peak population of 400-600 people.
- The plant is not robust against seasonal variation and suffers poor solids settlement (Nocardia filaments) and insufficient nitrification as a result.
- Peak flows to the site were designed at 2.5 l/s but current treatment pumps deliver approximately 4 l/s. Additionally storm pump will operate in high wet well conditions. Flooding occurs in very high flows as all pump capacity is exceeded. Peak flow to works of 8 l/s is estimated.
- The plant is compromised by the absence of effective screening of influent.
- The consent conditions for ammonia and dissolved oxygen are exceeded periodically in the stream.
- To deal with high flow deficiency, flow bypasses secondary treatment and sand filtration against the consent conditions.
- High sludge levels were identified within the wetland cells indicating substantial loss of biomass from the treatment plant. Poorly disinfected effluent will pass through the stream to a popular bathing beach.
- Five stormwater storage tanks installed at the rear of the plant extends outside of the lawful designated area, which does not meet planning requirements.
- The assets constructed over 40 years ago were a “low budget solution” and have reached the end of their asset life. This includes primary, secondary tanks and a mechanical scraper mechanism of the clarifier.
- Structural failure has resulted in the collapse of an internal baffle in the aeration tank. The concrete tanks are leaking in several places. Significant Leaks will require at least a 2-week shut down of the whole plant to “patch repair”. Catastrophic failure would take the whole plant out of service until a new plant can be built (estimated minimum of 6 months) and would require removal of wastewater to another treatment plant during this time.

- Many assets have poor accessibility that limits maintenance.
- There is insufficient standby equipment to provide continuous high-quality treatment. For example; to change the blower, the roof of the blower building must be removed, and no secondary treatment is possible in this time.
- The plant and wetlands cannot cope with storm events and there are regular reports of overflows and flooding; the potential risk impact is **very high** against financial, compliance and reputation risk categories.
- There have been instances where excessive inflow and infiltration of stormwater have caused the aeration tank to overflow and spill raw sewage and biosolids into the environment.
- The wetland cells have not been maintained and now require remediation; pipe blockages continue to restrict effluent from reaching all cells, resulting in overflows from the first basin directly into open drains adjacent to the basins. The wetland marshes are also overgrown with weeds and unable to perform.
- Land slips are known at the wetland site and there is evidence of further recent movement in the bank. This will impact on treatment and cause loss of wetlands with consequential impact on stream, stream ecology and bathing beach.
- The site is known to cause nuisance odours and noise to the community. The plant has an issue with the bacteria Nocardia, which causes persistent and excessive foaming in activated sludge plants and can lead to effluent quality deterioration, malodour, increased plant maintenance and hazardous working conditions resulting from foam spilling out of the aeration basin. There are also houses in close proximity to this plant.

The Hihi WWTP has received some upgraded features, such as installation of filtration and ultraviolet disinfection processes, as well as an upgrade to the on-site pump station in 2013. However, these upgrades have only masked the larger issues that will eventually result in health, safety, quality and environmental implications.

In conclusion, the existing Hihi treatment plant is at the point of failure; it is structurally at the end of its life and can no longer meet acceptable performance criteria for the community of Hihi Beach.

3.2 Highest Risks arising from the issues

To assist Far North District Council with the business case for the upgrade of the Hihi Wastewater Treatment Plant a Business Risk workshop was held on 4th December 2019, attended by representatives from FNDC, Broadspectrum, Hoskin Civil and WSP. The issues and risks in the workshop focussed on business risk. The workshops aim was to capture all the issues of the Hihi WWTP, and by use of a risk rating (probability and impact) understand the effect of the issues. The highest rated business risks are:

- Site boundary/designation
- Elevated ammonia (NH3), E-coli and high total suspended solids after treatment. Reduced dissolved oxygen (DO) in wetlands discharge
- Bypass sand filters and secondary treatment during heavy rain events
- Unable to control Nocardia presence
- Clarifier and WAS tank capacity insufficient and pump station floods due to insufficient capacity
- Mixed liquor suspended solids (MLSS) uncontrollable
- Unscreened wastewater
- Insufficient flow buffering
- Inadequate aeration (too little and too much)
- Sludge accumulation in effluent tank
- Sludge build-up in wetlands
- Hill stability with history of slips impacting on wetland
- Single UV reactor
- Leaking main reactor
- Clarifier scraper unreliable and poor condition and has worn the base of the clarifier
- All tanks at end of life; Clarifier tank structure poor and Secondary reactor structure poor condition
- No redundancy on blowers (single unit) or sand filters and limited critical spares for blower
- Limited Maintenance access to sand filters

- SCADA (Red Lion) no longer supported
- Building housing sand filter and UV has no air conditioning or venting
- Insufficient water for washdown
- Manual handling of screenings
- Proximity of pumps to electrics

Note; related risks have been combined above to create a clearer picture. For the full risk report refer to Appendix F - Business Risk Assessment of WSP's Hihi Options Report.

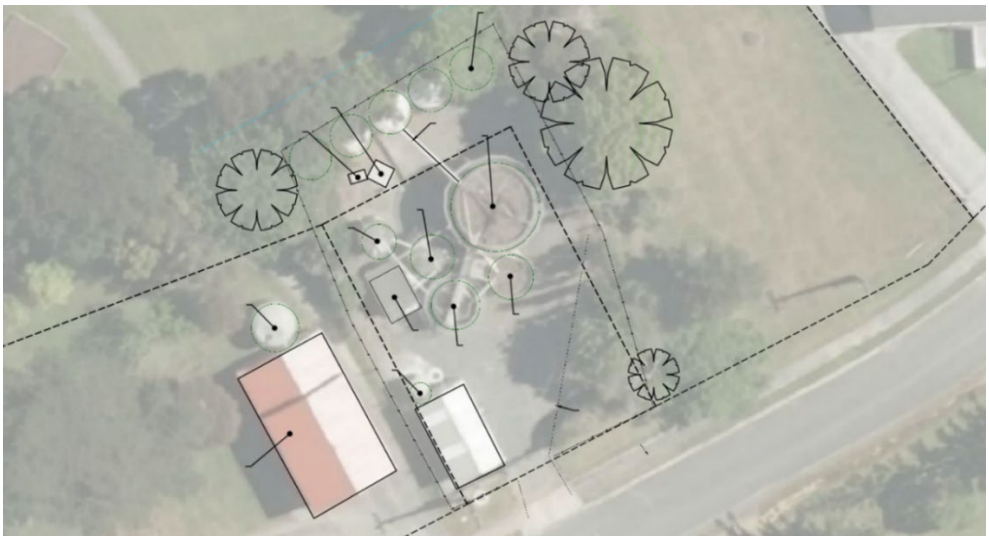


Figure 3) Hihi WWTP, Marchant Road – Site boundary and existing asset layout.

4 Objectives

The objectives for this project are:

- Meet Council's Strategic Priority of affordable core infrastructure by providing the agreed level of service to the Hihi community.
- Achieve Council's Community Outcome of communities that are healthy, safe, connected and sustainable by investing in proven technologies that are safe, have optimal whole of life costs and meet compliance conditions.
- Ensure that the treatment plant complies with the requirements of the Resource Consent to discharge treated effluent and aligns with conditions set under the District Plan.
- Balance the impact on rates with the objectives above to ensure a fair approach to the ratepayers.

5 Benefits

This project will provide:

- A healthy, safe and sustainable community at Hihi through:
    - Avoiding a loss of service through failure
    - Achieving required flow rates, loading and volume capacity
- A wisely managed and treasured environment through:
    - Eliminating overflows and flooding with a system designed to cope with current flows and storm events, as well as expected future growth
    - Construction of a legally compliant plant
- Affordable infrastructure
    - An economic solution which provides the agreed level of service

6 Options

6.1 Options identified

The following long-list options were identified at an Options Engineering Workshop in January 2020;

- Do minimum – refurbishment of aeration tank
- Activated Sludge Plant (ASP)
- Pump to Mangonui
- Moving Bed Bioreactor
- Membrane Bio Reactor (MBR)

The workshop included internal team members from planning, operations, asset management and project delivery, and external representatives from WSP (technical advice), Far North Waters and Broadspectrum (operational team) and Hoskin Civil (Project Managers). These five options were evaluated over a two-day workshop, where project constraints were risk-assessed against the following aspects;

- Affordability
- Land
- Neighbours
- Climate Change
- Consent Conditions
- Amenity
- Land Use
- Nuisance
- Time/Programme
- Maintenance/Operations
- Asset Life
- Wetland Construction
- Quality
- Safety
- Whole of Life Costs

The Do Minimum option was a refurbishment of the existing aeration tank. As this tank is at the end of its life, refurbishment does not mitigate any of these aspects and is not considered a viable option.

The Pump to Mangonui option would meet a number of aspects but was eventually discounted due to (i) whole of life costs far exceeding benefits, and (ii) expected time to obtain a resource consent for a harbour crossing, including objections, exceeding project timeframe of 2 years.

The Moving Bed Bioreactor option was also discounted due to (i) cost, (ii) operational impact of new technology, and (iii) no additional identifiable benefits over the activated sludge process.

The workshop confirmed two replacement options for this final detailed business case. Along with a default, Do Nothing, option these are:

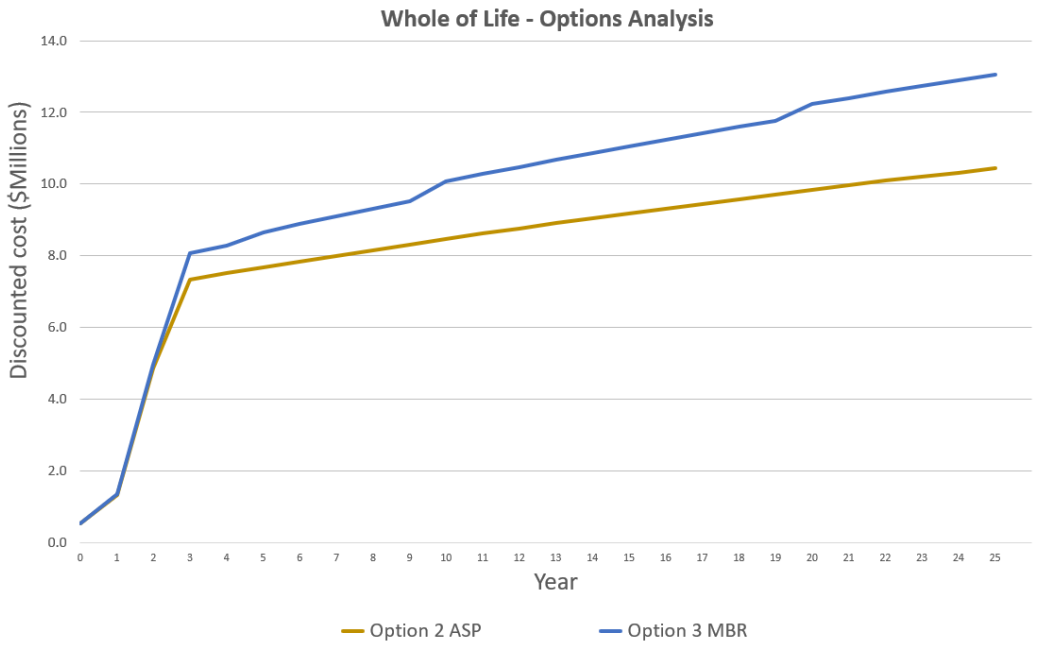
- Option 1 – Do Nothing
- Option 2 – Install new Activated Sludge Treatment System, demolish and remove old system. Scope also includes earthworks within the wetlands and necessary repairs to the network.
- Option 3 – Install new MBR system, demolish and remove old system.

6.2 Options analysis

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
Capital Expense	Total cost would mirror Option 2 or 3, depending on the option chosen, as the plant would have to be replaced in a few years due to the imminent structural failure of the aeration tank. Structural failure of the	Total Capex cost estimated at $6,215,951. This cost includes initial deliverables, temporary repairs to current tank, design and construction	Total cost estimated at $6,370,973. This cost includes initial deliverables, temporary repairs to current tank and design and construction.

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
	aeration tank would have catastrophic effects on the environment, local community and reputation. It would also incur significant extra costs of daily wastewater removal, likely for an extensive time, while emergency measures or a replacement plant was procured, designed and built. Consequences would include infringement notices, fines and likely prosecution. The RMA specifies the maximum fine is $300,000 for a natural person and $600,000 of any other person.	and necessary repairs to the network. In addition, Opex costs for wetland works are estimated to be around $700,000. This will be funded separately to the project from the sludge management fund. Further details of these costs are included in the Project Cost section.	Repairs to the network are also estimated as $600,000. In addition, Opex costs for wetland decommissioning are estimated to be around $700,000. This will be funded separately to the project from the sludge management fund. Further details of these costs are included in the Project Cost section.
Rating Implications	Same as Option 2 or 3 as the plant will need replacing once structural failure occurs.	• $1,458.49 replacing existing capital rate of $435.28	• $1,851.01 replacing existing capital rate of $435.28 This figure includes repair to the network which may not be required. Removal of this aspect reduces the rate by approximately $200.
Advantages	None	Complies with current consent conditions. Can be designed to account for future growth and peak loads and expected consent conditions. Improved quality of effluent compared to current system. Little to no increase in operational expenditure. This is a conventional solution, known to operators. Assets Maintainable.	The MBR will produce a very high quality of effluent. High Biomass adapts rapidly to change in load – provides a consistent level of service. Could remove the need for the wetlands. Can be designed to account for future growth and peak loads and expected consent conditions. Complies with current consent conditions. Is unlikely to have any additional capital changes required from the renewal of the resource consent. Could remove the need for wetlands altogether.

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
			Can be built in limited footprint of designation; inclusion of membranes in the system eliminates the need for secondary clarifiers (which ASP need), results in significantly reduced footprint. Staged construction and decommissioning could minimise plant downtime during construction. Could be largely modular for removal from site to new location if sea level rises. Assets maintainable.
Disadvantages	The existing Resource Consent is due for renewal in Nov-22, which will include new conditions for compliance. This plant will not meet new conditions. This would result in infringement notices, fines and potential prosecution. The existing plant is not performing as it should and is structurally unsound; it must be replaced as soon as possible. Failure to replace the plant exposes the council to the following major risks: • Environmental – Contamination is already occurring; high sludge levels and low dissolved oxygen were identified within the wetland cells indicating poorly disinfected effluent passes through the stream to a popular swimming beach. • Safety for operators, locals and tourists. • Continual breaches of consent conditions. • Reputation - National exposure is likely if there is a catastrophic	The site footprint is still likely to pose challenges for the layout of an Activated Sludge Plant. This site has minimal buffer zone between it and the next property. Sand filter access not addressed. Activated Sludge Plants often have issues with Nocardia which require managing to control it. These plants often produce excess sludge that would require monitoring and management. Activated sludge plants have limitations with removal of recalcitrant (compounds that remain in the treated effluent and then persist in the environment), potentially causing environmental and health problems. The activated sludge plant could require additional capital spend to comply with new resource consent conditions.	It is a more technical plant to manage and will require a full-time employee on site and highly trained personnel. MBR plants are susceptible to membrane fouling, which significantly reduces membrane performance and lifespan, resulting in a significant increase in maintenance and operating costs. Failure to control membrane fouling may lead to failure to treat the required design flows. Fouling control strategies are still being researched. It requires regular chemical cleaning, and chemical storage and disposal. Higher energy costs. Membrane cost, availability and lead time. This has been accounted for in whole of life costs. Potential transport issues for larger vehicles that require a turnaround bay. Emergency power supply required. This has been

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
	failure as the deteriorating condition of the plant is well documented.	Due to the size of the new plant (similar to existing), installation and decommissioning of the old plant may require an extended period of plant downtime. Requires continued use of the wetlands.	allowed for in the project costs.
Whole of Life	 Note: MBR plants have two membranes that each require replacement every 5-10 years, they cost between $180k – $250k each. These have been included in the whole of life calculations at 10 years with a value of $200k, but they may occur more regularly or be a higher value membrane. Whole of life cost will be more accurately determined through the design stage.		
Operational costs	Current operational costs (operations and power) have been as follows: • 16/17 FY $116,977 • 17/18 FY $112,822 • 18/19 FY$163,877 • 19/20 FY $183,419 • Projected 20/21 costs $220,000	Expected yearly operating costs: • Approximately $181,000. Includes operator cost at 10 hrs per week $60/hr. These costs would be more accurately estimated during detailed design.	Expected yearly operating costs: • Approximately $250,000. Includes expected operator cost. These costs vary greatly between MBR technology selected and would be more accurately estimated during detailed design.
Operating Impact	Contamination would continue to occur and worsen; poorly disinfected effluent would continue to pass through the stream to a popular bathing beach in the tourist-oriented town.	Temporary repairs should be undertaken to the existing plant whilst the new plant is designed for construction installation. During the implementation of the treatment plant	Temporary repairs should be undertaken to the existing plant whilst the new plant is designed and constructed. This is a new system for the operational team to

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
	Continual breaches of consent conditions would result in infringement notices, fines and potential prosecution. The current plant presents a number of safety issues for the operators; • Manual handling of screenings • Proximity of pumps to electrics • Limited maintenance access to sand filters • Building housing sand filter and UV has no air conditioning or venting • Insufficient water for washdown Nocardia issues would persist which affects the efficacy of the plant.	upgrade, the existing plant needs to remain operational. Due to the size of the new plant (similar to existing), installation and decommissioning of the old plant will require careful planning and staging. This may be achieved through item-by-item replacement.	learn and manage. Highly skilled training is required, and FNDC would need to allow for operational assistance during the Defects Liability Period. It is likely that an operator is required onsite for the majority of the time and allowance has been made for this in the whole of life and operating cost estimates.
Risks	Failure to replace exposes the council to the following major risks: • Environmental – due to the plant's poor condition and insufficient capacity for both peak flow and peak load. Contamination is already regularly occurring; High sludge levels were identified within the wetland cells indicating poorly disinfected effluent will pass through the stream to a popular bathing beach in the tourist-oriented town. • Safety for operators, locals and tourists. • Continual breaches of consent conditions, infringement notices and fines. • Reputation - National exposure is likely if there is a catastrophic failure as the deteriorating condition	The site footprint is still likely to pose challenges for the layout of an Activated Sludge Plant – design will be required to determine if this system will fit within the designation. The activated sludge plant could require additional capital spend to comply with new resource consent conditions. This is unlikely as the new plant would be designed to meet modern standards. This process will require use of the wetlands. The price will allow for basic earthworks to address the worst issues at the wetlands. However, there is still a risk of landslides at this site. The condition of the rising main is as yet unknown. This should be investigated	MBR is a new system for FNDC, which introduces a level of risk with regards to ongoing operational costs. It is important to note that MBR plants are still relatively new technology. The efficiency of the filtration process in an MBR is governed by the activated sludge filterability, which is still not well understood and is determined by the interactions between the biomass, the wastewater and the applied process conditions. The costs for MBR differ significantly depending upon the adopted technology and the site conditions. MBR plants are susceptible to membrane fouling, which significantly reduces membrane performance

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
Risks, continued	of the plant is well documented.	as upgrading or repair may be required. The current plant poses a significant environmental risk and designing and building a replacement will extend the time the current aeration tank remains in operation. Temporary repairs to the existing plant will be required to minimise risk. There is a large impact on ratepayers; Consultation will be required.	and lifespan. Fouling control strategies are still being researched. Proposed lifespan of the membranes is between 5-10 years. The whole of life cost has been calculated as replacing both membranes every 10 years, but this could be required almost twice as often; membranes cost between $180k – $250k each. Hihi is a relatively isolated community and this will make it more expensive to get resources delivered and additional professional support. The wetlands may not be required but may need to be decommissioned to eliminate environmental risks. The current plant poses a significant environmental risk and designing and building a replacement will extend the time the current aeration tank remains in operation. Temporary repairs to the existing plant will be required to minimise risk. There is a large impact on ratepayers; Consultation will be required.
Interdependencies	N/A	Site survey required to confirm boundary and establish if existing storage tanks are outside designation. All critical success factors to be completed prior to implementation.	All critical success factors to be completed prior to implementation.
Stakeholders	Hihi Community, Iwi Operational team, Public Visitors / Tourists	Hihi Community, Iwi Operational team Public Visitors / Tourists, Far North Waters	Hihi Community, Iwi Operational team Public Visitors / Tourists, Far North Waters

Category	Option 1 Do Nothing	Option 2 New Activated Sludge Plant (ASP)	Option 3 New MBR System
Programme	Continued reactive approach (with escalating costs) until plant fails. Emergency response post failure until plant is replaced.	Programme will require staging e.g.; 1. Temporary repairs (may not be required as other systems could be implemented such as mobile septic system) 2. Design 3. Enabling works for new plant 4. Demolish, remove and install new	Programme will require staging e.g; 1. Temporary repairs (may not be required as other systems could be implemented such as mobile septic system) 2. Design 3. Enabling works for new plant 4. Demolish, remove and install new

Table 1) Options analysis

6.3 Ability of the options to address the major risks

The table below summarises the risks and issues that each option addresses, with emphasis on the most serious risks identified in WSP's Business Risk Assessment.

Risk	Option 1 Do Nothing	Option 2 New ASP	Option 3 New MBR
Site boundary/designation	No	Yes	Yes
Elevated ammonia (NH3), E-coli and high total suspended solids after treatment. Reduced dissolved oxygen (DO) in wetlands discharge.	No	Yes	Yes
Bypass sand filters and secondary treatment during heavy rain events	No	Yes	Yes
Nocardia presence (Note: Conventional ASP plants are always susceptible to Nocardia.)	No	No	Yes
Clarifier and WAS tank capacity insufficient and pump station floods due to insufficient capacity Mixed liquor suspended solids (MLSS) uncontrollable	No	Yes	Yes
Unscreened wastewater	No	Yes	Yes
Insufficient flow buffering	No	Yes	Yes
Inadequate aeration (too little and too much)	No	Yes	Yes
Sludge accumulation in effluent tank	No	Yes	Yes
Sludge build-up in wetlands	No	Yes	Yes
Hill stability with history of slips impacting on wetland	No	No	No but wetlands decommissioned
Single UV reactor	No	Yes *	Yes
Leaking main reactor	No	Yes	Yes
Clarifier scraper unreliable and poor condition and has worn the base of the clarifier	No	Yes	Yes
All tanks at end of life; Clarifier tank structure poor and Secondary reactor structure poor condition	No	Yes	Yes
No redundancy on blowers (single unit) or sand filters and limited critical spares for blower	No	Yes *	Yes
Limited Maintenance access to sand filters	No	Yes *	Yes
SCADA (Red Lion) no longer supported	No	Yes	Yes
Building housing sand filter and UV has no air conditioning or venting	No	Yes *	Yes

Insufficient water for washdown	No	Yes *	Yes *
Manual handling of screenings	No	Yes *	Yes *
Proximity of pumps to electrics	No	Yes *	Yes *

* *Depending on outcomes specified for detailed design.*

7 Recommendation

An analysis of the three options has been completed based on the WSP Options Report and a QS Peer Review Report. The detailed information from both reports has been collated, along with an analysis of the rate impacts and whole of life costings against each option.

As noted in WSP's Hihi Options Review from 2020, the membrane bioreactor (MBR) option is the most robust and adaptable solution for future performance needs and resource consent demands, as well as offering the most operationally consistent performance. It is this option that appears to best satisfy the project objectives, while balancing the cost implications.

8 Project Deliverables

8.1 Items Completed to date

The following have been completed:

- Indicative business case that identified what further investigation and actions were required to enable completion of the business case.
- Structural assessment of aeration tank.
- Options Review by WSP.
- Business Risk Assessment Workshop.
- QS Report

8.2 Next Steps

This Business Case will need to be presented to Council to confirm the preferred option. Regardless of the replacement Option chosen, the deliverables are:

Initial Deliverable	Recommendation
Implement temporary measures on aeration tank	Temporary measures to stabilise aeration tank (interim mitigation) should be undertaken until new plant is implemented. The WSP Structural Condition Assessment in 2019 proposed the following actions on the critical structural elements; • The tank should be cleared of sediment and the base examined • All cracks on the perimeter should be sealed appropriately • Regular maintenance and structural inspections of the existing tank should occur to monitor the deterioration of the reservoir. • Estimated minimum cost is $80,000 and it is expected to take 2 weeks. Additional budget has been allowed for in project costs due to expected continued deterioration of the tank. Alternative options to temporary repairs may exist (such as mobile septic system) and will need to be further explored. NOTE: No temporary measures have yet been implemented.
Site Survey	Recommend engaging a surveyor to complete.

Prepare an Engagement Plan	Proposed solution, programme and rates impact to be presented to community. Consultation required with NRC regarding upcoming resource consent renewal and conditions.
Cultural Impact Assessment	May be best completed with consultation with NRC regarding resource consent.
Conservation and Ecology Report - Wetlands	May be best completed with consultation with NRC regarding resource consent.
Planning Assessment	Engage Planner to advise what items are required as part of the resource consent process.
Physical Works Deliverable	
Procurement	Open tender for Design and Build Contract
Construction	Proposed staged construction methodology: Stage 1: Enabling works Stage 2: Demolition, Construction, Installation, commissioning Stage 3: Wetlands upgrade, (priced in Option 2, but not in Option 3). Requirement to be confirmed during design phase.

9 Critical Success Factors

The following items are critical to the success of the project.

Critical Success Factor	Justification
Decision from Council regarding preferred option	This Business Case covers the benefits, issues and risks of the two replacement options. A recommendation has been made based on the current understanding of the risks and benefits of each option. However, the preferred option may change if the Council perceives that the risks or costs of that option outweigh the benefits.
Timing	The chosen option must be implemented as quickly as possible; the current plant poses a significant environmental risk.
Risk reduction	Whichever option is preferred, a risk management plan will need to be developed for the project. The role of risk management should be sited with one person and be reported on monthly in a documented format to be utilised as a monitoring tool.
Affordability	The following will be critical to the success of the project: • Funding – Ensure sufficient funding is available in the LTP. • Rates - Either the Hihi community accept the impact on their rates, or the impact on ratepayers is reduced.
Community engagement / iwi consultation	Ensure community know the reasons behind Council's decision and the impact of that decision.
Definition of Scope	A formal Scope of Work for the preferred option will be developed to be used for procurement.
Health and Safety	Site specific safety plans, site access plans, health and safety and hazard reporting plans will also require approval as part of the procurement process. These will be approved by Council, or suitably qualified personnel, prior to commencing any works.
Quality Assurance	It is important to plan for and effect an audit process for supplier performance to ensure quality assurance of service delivery, standards of excellence, agreed levels of service are met and asset life cycle competency.

Continued level of service throughout construction	Temporary repairs, or an alternative, need to be considered as the current plant poses a significant environmental risk. In addition, the small footprint of the site will present challenges for maintaining wastewater treatment during construction and commissioning. A detailed methodology will be required as part of the procurement process detailing the contractor's approach to demolition, construction and commissioning.

10 Procurement

10.1 Procurement Approach for Initial Reports and Consultation

The recommended consultant assessments and reports highlighted under scope deliverables and critical success factors should be commissioned and have been allowed for in project costs. These items are required to provide certainty in the proposed solution and alleviate the community's concerns by providing clarification around any environmental and community impacts. All reports can be direct sourced as they will be under the FNDC procurement threshold value.

Deliverables include:

- Certificate of Titles – boundary properties of plant, wetlands and stream.
- Site Survey – confirmation of plant boundary required; existing storage tanks currently sit outside boundary on desktop assessment.
- Concept design
- Cultural Impact Assessment.
- Conservation and Ecology Report.
- Planning Assessment – FNDC or external planner (pending on internal capacity).
- Consultation – undertake community engagement with the ratepayers.

10.2 Procurement Approach for Option 2 or 3

It is recommended that Option 2 or 3 be procured by Open Tender for a Design and Build contract with weighted attributes. It is recommended that the RFT non-price attributes weightings reflect the project deliverable requirements. Therefore, increasing standard weightings for critical attributes such as proposed solution, construction methodology and programme. Tenderers should be encouraged to:

- Collaboratively design alongside the plant supplier to problem-solve out or mitigate high risk items and recognise any 'out of scope' anomalies.
- Be forthcoming with innovative and sustainable solutions.

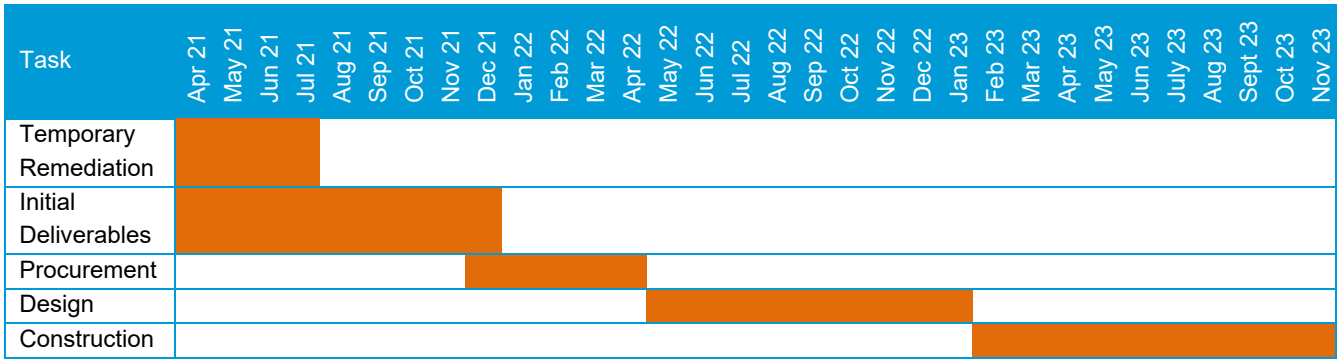
It will be a requirement for tenderers to:

- Design solution
- Manage supply, delivery and installation of package plant directly with supplier.
- Separable portions could include:
    - Enabling works (pending scope but may include; land extension, wetland remediation)
    - Plant Supply and Installation
    - Demolition, Decommissioning
    - Remediation, reserve works (scope depends on option chosen)

11 Project Timeline

The indicative timeline is aligned to the delivery approach of either option. They reflect that the business case is to be delivered to the Council meeting on 25 February 2021.

11.1 Timeline for Options 2 and 3



12 Project Cost

12.1 Funding

The figures below were obtained in December 2020 from the Budget included in 2021/31 LTP.

Funding ($)	2020/21 Forecast	2021/22 LTP	2022/23 LTP	2023/24 LTP	All years
Opex					
Sludge – external services – GL 1.5514.01.2407	*522,750*	*1,070,592*	*1,089,327*		*2,682,669*
Capex					
New (PR 551302.1.1.4917)	*0*	*2,500,000*	*3,400,000*	*0*	*5,900,000*
Renewal (PR 551302.1.1.4922)	*100,000*	*0*	*0*	*0*	*100,000*
Total Capex Available	*100,000*	*2,500,000*	*3,400,000*	*0*	***6,000,000***

12.2 Cost Estimation

Option 2 - ASP

Cost Estimation ($)	2020/21	2021/22	2022/23	2023/24	All years
Opex – incl Professional Services					
Wetlands work (Sludge management)			*700,000*		***700,000***
Capex					
Temporary measures to stabilise current aeration tank	*300,000*				***300,000***
Initial deliverables	*40,000*	*60,000*			***100,000***
Design and Construction Costs, includes repair to the network *		*500,000*	*3,439,706*	*1,876,245*	***5,815,951***
				Total Project Capex Cost	***6,215,951***

** Repair to the network is included in the construction cost as ASP plants are more susceptible to variable flows and removing irregular influx from stormwater is desirable.*

Option 3 – MBR

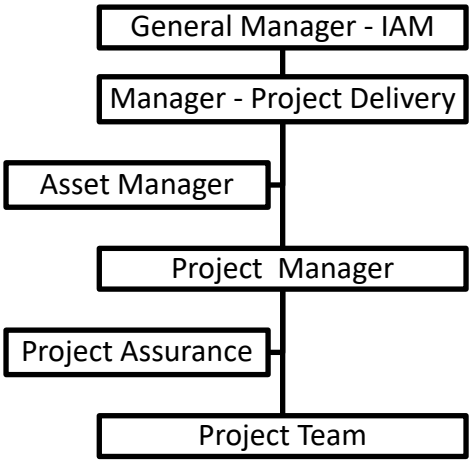
Cost Estimation ($)	2020/21	2021/22	2022/23	2023/24	All years
Opex – incl Professional Services					
Wetlands Decommissioning* (Sludge management)				*700,000*	***700,000***
Capex					
Temporary measures to stabilise current aeration tank	*300,000*				***300,000***
Initial deliverables	*40,000*	*60,000*			***100,000***
Design and Construction Costs		*500,000*	*3,439,706*	*1,876,245*	***5,970,973***
				Total Project Capex Cost	***6,370,973***
Repair to the network**				*600,000*	***600,000***
				Total Cost, including network repairs	***6,970,973***

** The wetlands may need to be decommissioned to avoid non-compliance. This would be an Opex cost from a different budget and potential costs have been included in this table to give a full picture of possible costs.*

*** Repair to the network is included as a separate item as it would be ideal to undertake, but is not assumed to be imperative to the MBR option. This would need to be confirmed during design. These costs have been included in the rate calculation.*

13 Project Approach

13.1 Project Governance



Name & Position	Project Roles *
Andy Finch General Manager – IAM	Executive Sponsor
Tanya Proctor Manager – Project Delivery	Senior Responsible Owner
Mark Keehn Asset Manager	Business Representative
Glenn Rainham Operations Manager	Business Representative
Corey Hutchinson Maintenance Manager	Business Representative

* Responsibilities for project roles are detailed in the Capital Works Project Management Framework.

13.2 Project Management

Management of the project will be undertaken following the requirements and procedures detailed in Far North District Council's Capital Works Project Management Framework, and consistent with expectations for a **Complex** project.

13.3 Project Constraints, Assumptions & Dependencies

The following items can be resolved, refer to Recommendations and Timeline sections for further details.

Type	Description	Action required
Constraint	Budget and rate impact	FNDC
Dependency	Final decision on preferred option from Council	FNDC
Constraint	Site Survey and certificate of titles will confirm the designation that the solution must fit within	FNDC
Dependency	Cultural Impact Assessment	FNDC
Dependency	Planning Assessment	FNDC
Dependency	Consultation Report / Public Meeting	FNDC
Dependency	Design of solution and installation methodology must be confirmed	FNDC

14 Quality considerations

14.1 Quality requirements:

The Hihi WWTP has an existing resource consent due to expire in Nov-2022, the sites listed are also designated and have conditions set under the District Plan.

Resource Consent:

- Northland Regional Council (NRC) have four monitoring sites, three are located at the constructed wetlands and one is at the WWTP site.
- Resource Management Act and the Regional Water and Soil Plan apply to this site/activity.

- Hihi WWTP existing resource consent: RC – CON19940739901
  Endorsed: 14-05-2008
  Expiry: 30/11/2022
  Conditions:
  1) The discharge of treated wastewater into an unnamed tributary of Hihi Beach (Hihi Stream).
  2) To discharge contaminants to ground via seepage from the base of an artificial wetland.
  3) To discharge contaminants (primarily odour) to air from wastewater treatment facilities.
- Resource Consent conditions renew 2022, new conditions are unknown; consultation is required to determine if the preferred solution will meet consent conditions.

Far North District Council Plans:

1. Existing Site (Lot 78 DP 73991)
   - District Plan – Underlying zone Coastal Residential with a Designation (FN164) for the purpose of Hihi Sewage Treatment and Disposal – applying to Lot 78 DP 73991 and SO 69378 Blk IV Mangonui SD.
2. Neighbouring Site (Part Lot 71 DP73991)
   - District Plan – Recreation reserve land zoned recreational activities subject to the Reserves Act.
3. Wetland Site (Part Lot 1 37697 and Part Lot 2 DP 88975)
   - District Plan – Rural Production Zone with designation FN164A. The designation was approved on 1 May 2008 – Consent number RC 2061079. This decision was issued by the Environment Court, it has specific conditions that apply to the site.
4. Far North District Council's Engineering standards and Guidelines 2004 (3rd revision July 2007).

Note: Figure 4 shows the Far North District Zoning (referred to in the previous numbered points) for Hihi WWTP designations.

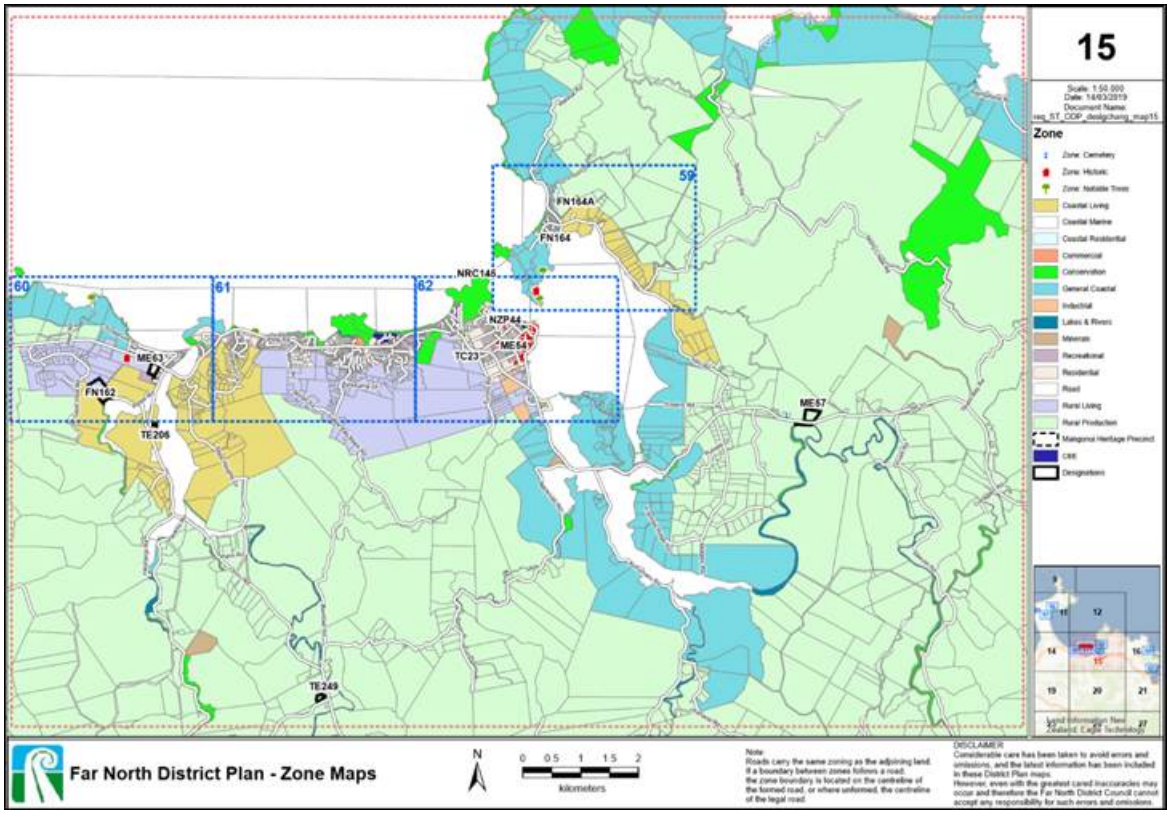


Figure 4) FNDC Zoning and Designations – refer FN164 and FN164A

Noise
All noise associated with the site and access construction shall comply with the permitted activity standard of the Rural Production Zone of the Proposed Far North District Plan. Construction noise shall be within levels required by NZS 6803:1999 'Acoustics – Construction Noise'.

Odour
Odour concerns are minimal; the grit and screenings facility that is proposed is the most likely source of offensive odours. Options would be investigated; however, a biofilter is the preferred option if the odours are to be managed aggressively.

14.2 Quality tolerances:

Lower standards have been adopted over the past few years during feasibility investigations to identify the best outcome for Hihi. Quality has been compromised this has been managed extremely well by the operational team and the community as the circumstances have been less than desirable and continue to decline. The current circumstances are tolerated for now. However, when the resource consent is renewed in 2022, the condition of the treatment plant and the wetlands will no longer be acceptable, therefore the following points should be addressed.

WWTP, Marchant Road:
Most recently, adverse conditions for the activated sludge process have resulted in the accumulation of foaming from the filamented bacteria, Nocardia. Nocardia is difficult to eliminate due to its growth cycle; the bacterium branches out and cells break off and dissipate, the gram-positive genus continues to branch out, break off and spread. While it is difficult to eliminate Nocardia, a better functioning plant should substantially reduce the issues caused by it.

Constructed Wetlands:
The constructed wetlands have also been neglected due to insufficient funding and maintenance. Observations made from a recent site visit confirmed that the wetland basins were performing poorly. Several prior reports indicate the wetlands poor condition is nothing new, stating the basins regularly overflow due to blocked pipes. At the site visit the first cell was clearly struggling to perform and the basin was overflowing into an open drain caused by blocked pipes. The marshes are covered in weeds, there is minimal visibility of scheduled plant life, vegetation or aquatic planting and no sign of animal life – these natural elements are key to a wetlands function and success.

A conservation report should be commissioned, reporting on the ecology and flows in the receiving stream, local species, monitoring and effects of current systems in place, water features and flora and fauna. An assessment of the current design/cell layout requires options for remediation to bring the wetlands back to the distinct ecosystem they should be and serve as home to a wide range of plant and animal life.

15 Risks and Issues

15.1 Risks with Option 1 – Do Nothing

RAG	Risk / Issue description	Risk owner
A	Upgrades have been made which extend the plant outside the existing site boundary/designation.	FNDC Planning/Asset Management
R	Resource consent expiry 2022 – new conditions currently unknown.	FNDC Finance/ Asset Management/Delivery
R	HSQE Issues exist with the current plant; Limited Maintenance access to sand filters; Building housing sand filter and UV has no air conditioning or venting; Insufficient water for washdown; Manual handling of screenings; Proximity of	FNDC Health & Safety/Asset Management

	pumps to electric; Issues with Nocardia; No redundancy on blowers (single unit) or sand filters and limited critical spares for blower; SCADA (Red Lion) no longer supported. These pose health and safety, compliance and environmental risks.	
R	Poorly treated effluent is achieved which will not be acceptable in renewed consent conditions; high total suspended solids, elevated E-coli, elevated ammonia and reduced dissolved oxygen.	FNDC Asset Management
R	Clarifier capacity designed for 2.5 l/s flow but flow has increased with the population increase to be 4 l/s. There is insufficient treatment capacity for peak flow and parts of the system have to be bypassed in heavy rain.	Project Delivery
R	All tanks are at the end of their design life (30 years); Some are structurally unsound and leaking. All tanks are critical to the process, so failure in one is catastrophic as there is no backup.	FNDC Asset Management/Delivery
R	Sludge reaches and builds up in the wetlands. This exceeds the maximum condition in consent and impacts on the local stream which leads to a popular swimming beach.	FNDC Asset Management/Delivery

15.2 Risks with Option 2 - ASP

RAG	Risk / Issue description	Risk owner
R	Site footprint - existing site location is very small and should be extended. Extension further back requires a planning assessment, site survey (boundary confirmation).	FNDC Planning/Asset Management
A	Buffer zones around the current footprint are minimal – there is a house in close proximity.	FNDC Asset Management
A	Community – odour and noise of new plant (there have been previous concerns with existing plant). This should be substantially improved.	FNDC Planning/Asset Management
R	Rate impacts – explore options to decrease impact on residents.	FNDC Finance/ Asset Management/Delivery
R	Resource consent expiry 2022 – new conditions currently unknown. The activated sludge plant could require additional capital spend to comply with new resource consent conditions.	FNDC Finance/ Asset Management/Delivery
R	Aeration tank structural integrity fails, resulting in spillage into the environment and harbour. Temporary measures to stabilise aeration tank or other interim measures should be undertaken to mitigate this risk until new plant is implemented. This is included in the project estimate.	FNDC Health & Safety/Asset Management
A	Construction and Decommissioning: existing plant to remain operational until new plant is commissioned. Ability to do this will need to be confirmed.	Project Delivery / coordination with community
R	The plant and wetlands cannot cope with storm events, which results in overflows and flooding; the potential risk impact is very high, due to risk of an environmental spill into the harbour. This risk will not be mitigated until the new plant is operational which will realistically be the 22/23 financial year.	FNDC Asset Management
R	Climate change: If sea-level-rise predictions and/or a 1-in-50-year storm event occurs, an environmental spill/harbour contamination could occur. An Activated Sludge Plant is not designed to be relocated; however, it should be able to be designed to mitigate the effect of large storm events.	FNDC Asset Management/Delivery
A	Nocardia is often an issue with ASP, even if it is eliminated in the short term, it will likely reappear.	FNDC Asset Management
R	Supply chain stability will need to be explored due to the impacts of the current and ongoing pandemic.	Project Delivery

R	The condition of the rising main between the ASP and the wetlands is as yet unknown. This should be investigated and there is a risk that it may require upgrading or repair. Cost is unknown as yet.	Project Delivery

15.3 Risks with Option 3 - MBR

RAG	Risk / Issue description	Risk owner
R	Post construction/implementation operational management – need contractual assurance that the operational team are skilled to do all maintenance duties required with new plant. The MBR process requires the plant operators to have a high level of skill to ensure optimal operation and early detection of degradation in membrane performance; This means having an office with a staff member onsite (this has been accounted for in whole of life and operational cost calculations). Failure to manage the plant well could result in more frequent membrane replacement, at significant cost.	FNDC Asset Management/Delivery
R	MBR is a new system to FNDC; There is a lack of published operational advice and experiences available on flat sheet and hollow fibre membranes in New Zealand. Current proposals are not based on actual flow and load data.	FNDC Asset Management/Delivery
A	Community – odour and noise of new plant unknown. Biofilters could be required to reduce odour, this cost is not included in estimate.	FNDC Planning/Asset Management
R	Rate impacts – explore options to decrease impact on residents.	FNDC Finance/ Asset Management/Delivery
A	Resource consent expiry 2022 – new conditions currently unknown. The membrane plant will produce a very high quality of effluent and is unlikely to have any additional capital changes required from the renewal of the resource consent.	FNDC Finance/ Asset Management/Delivery
R	Aeration tank structural integrity fails while the old plant remains in operation until the new plant is built, resulting in spillage into the environment and harbour. Temporary measures to stabilise aeration tank or other interim measures should be undertaken to mitigate this risk until new plant is implemented. This cost is included in the estimate.	FNDC Health & Safety/Asset Management
A	Construction and Decommissioning: existing plant to remain operational until new plant is commissioned. Ability to do this will need to be confirmed.	Project Delivery / coordination with community
R	The plant and wetlands cannot cope with storm events, which results in overflows and flooding; the potential risk impact is very high, due to risk of an environmental spill into the harbour. This risk will not be mitigated until the new plant is operational which will realistically be the 22/23 financial year.	FNDC Asset Management
A	The wetlands are not required for this option. Leaving them in place could result in non-compliance but this is yet to be confirmed. Decommissioning has been included in the project cost section.	FNDC Asset Management
A	If the repairs to the network are not undertaken to address stormwater ingress, the plant should be designed to cope with this issue if this is possible.	FNDC Asset Management/Delivery
A	Climate change: If sea-level-rise predictions and/or a 1-in-50-year storm event occurs, an environmental spill/harbour contamination could occur. This can be accounted for in design of the new plant.	FNDC Asset Management/Delivery
R	Supply chain stability will need to be explored due to the impacts of the current and ongoing pandemic.	Project Delivery

16 Key Stakeholders

Stakeholder	Interest level	Influence level	Recommended approach	Dependency
FNDC Asset Management	High	Empower	Detailed BC	N/A
FNDC Project Delivery	Medium	Inform	Detailed BC	N/A
FNDC Planning	High	Collaborate	Detailed BC	N/A
FNDC Finance	High	Involve	Detailed BC	N/A
NRC	High	Involve	Planning assessment	Critical Success Factor
Community	High	Inform	Consultation Report - Public Meeting	Critical Success Factor
Iwi	High	Inform	Consultation Report - Public Meeting	Critical Success Factor
Plant Supplier	High	Involve	Proposal request	Site Survey
Far North Waters	High	Inform	Consultation during design	Critical Success Factor

17 Document sign off

Role	Name, title	Signature	Date
Prepared by:	Jody Kelly Project Manager, Hoskin Civil Ltd		26/01/21
Reviewed by:	Mark Keehn Asset Manager, FNDC		
Reviewed by:			
Approved by:			

18 Appendices

18.1 Appendix A - Hihi WWTP Referenced Material

Date issued	File name	Description of detail	Author/Company
30-Oct-2019	Indicative Business Case	Stage 1 BC – Next Steps	Hoskin Civil Ltd
25-Nov-2019	Hihi WWTP Activated Sludge Reactor	Structural Condition Assessment	WSP
11-Mar-2020	Hihi Options Review and Appendices	Options Workshop Findings. Appendices include the Business Risk Workshop which is an important document to read.	WSP
August 2020	Hoskin Civil QS Report August 2020	Peer Review	Hoskin Civil Ltd