Sludge Minimisation Business Case

Absolutely Positively **Wellington** City Council

Me Heke Ki Pōneke

Contents

Executive summary

This business case presents a preferred solution for the long-term processing and management of sewage sludge in Wellington. The business case seeks formal approval of the preferred option which is a Lysis-Digestion & Thermal Drying Sludge Minimisation Facility (SMF) at Moa Point, adjacent to the existing Wastewater Treatment Plant. Building the SMF will enable Wellington City Council (WCC) to materially decouple the disposal of sewage sludge from the Southern Landfill in advance of the resource consent lapsing.

Sewage sludge is a natural and unavoidable outcome of the current wastewater treatment process. WCC currently disposes of its sewage sludge from the Moa Point Wastewater Treatment Plant at the Southern Landfill. The consent for this disposal expires in 2026, and the ability to continue to use this disposal pathway in its current capacity will cease.

Sewage sludge is currently piped from Moa Point to the Southern Landfill via 9 kilometres of pipeline under residential neighbourhoods and this creates a single point of failure risk for WCC. The only mitigation for the risk of pipe is dumping sewage sludge in the cook strait or transporting untreated sewage sludge by truck through residential neighbourhoods as was the case in 2020 when the pipes failed at a direct cost of around $20 million to the ratepayers of Wellington City.

WCC is committed to a significant reduction in waste to the Southern landfill, aspiring to reduce it from 600kg per person per annum to 400kg per person by 2026. Developing a solution that removes the reliance on the Southern Landfill for the disposal of sewage sludge is the largest single initiative WCC can pursue to be able to achieve these targets and avoid the risks inherent in the current sewage sludge disposal model.

The SMF project has been established to realise four key investment objectives.

Investment Objective One	By 2026, minimise the amount of sludge sent to the Southern Landfill.
Investment Objective Two	Enhance the resilience of sludge management in Wellington.
Investment Objective Three	Reduce the environmental impact of sludge management in Wellington.
Investment Objective Four	Align practice of sludge management in Wellington to mana whenua values and principles.

The SMF Project team has undertaken extensive analysis on a wide range of potential solutions. The following table shows the ranking of the shortlisted options following quantitative and qualitative analysis, resulting in the selection of the preferred solution.

Economic Analysis Summary	1 Base case	10M Lysis-digestion + Thermal drying	12M Digestion Lysis-digestion + Thermal drying	17M Digestion + Thermal drying	19M Thermal drying + Gasification
Discounted Costs and Benefits	$213.5	$256.2	$273.5	$291.8	$281.2
Rank	1st	2nd	3rd	5th	4th
Critical Success Factors	-1.25	1.5	1.5	1.25	1.05
Rank	5th	1st	1st	3rd	4th
Overall Rank	3rd	1st	2nd	4th	4th

While the base case is lowest economic cost option, primarily due there being no upfront capital costs, it fails to deliver on any of the project objectives.

The preferred option requires significant up-front capital for the design and build of a new facility, but has a substantially lower operating cost compared to the base case and delivers against project objectives.

The preferred option is a highly complex structure to design and build. The technology is well established around the world but is new to New Zealand. The core technology is primarily sourced from international vendors, with specific expertise required locally to construct the facility.

To achieve public value through procurement the project team undertook market sounding and based on feedback has recommended a procurement methodology that has four key components:

1. **Designer** - Preliminary design services are already contracted. Competitive tenders will be obtained to select a Designer for the Early Contractor Involvement (ECI) phase with an option for negotiated award of the balance of design services (with independent assurance of cost and time). Options for Contractor provided design (including novation of the Designer from the ECI phase) will also be maintained.
2. **Contractor** - Competitive tenders will be obtained to select a preferred tenderer to participate in ECI phase and to ascertain the suitability of the preferred tenderer accept design novation, process risk, and other delivery risks that may reasonably be allocated during the ECI phase. A negotiated award of a works contract is then expected with independent assurance of cost and time.
3. **Tier 1 Equipment Supplier** - Suppliers of Tier 1 equipment packages will be engaged early to secure manufacturing capacity and appropriate delivery timeframes.

Performance based contracts will be tailored to the supply relationship and reflect WCC risk tolerances.

In 21-31 LTP, Council stated its preferred option to fund this project was to deploy deploy a new funding tool made available to WCC through the Infrastructure Funding & Financing Act 2020 (IFF). The IFF enables private capital to be raised for new infrastructure outside of the WCC's debt constraints, enabling delivery of infrastructure projects than would be otherwise possible under its limited capital budgets. A final decision on funding is expected to be achieved in August 2022.

Infrastructure investment facilitated under the IFF is paid for through a levy charged to beneficiaries of the infrastructure. The levy is included on WCC's rates bill.

WCC and CIP are working towards achieving financial close by 31 March 2023. The purpose of setting financial close at this time is to:

1. Enable early ordering of critical long lead items to mitigate international supply chain challenges
2. Enable settlement of land purchase agreements for land required for the SMF
3. Minimise the amount of early project costs funded by WCC
4. Provide confidence to the construction market that project funding is locked in.

The SMF Project seeks to use the IFF Levy funding model. An amount of $350m is currently anticipated to cover the cost of constructing the SMF, along with providing the initial component of contingency provision.

The final structure of the IFF Levy will be designed to optimise the overall cost of funding to beneficiaries. Key elements to be confirmed subject to finalising the target outturn cost are levy tenure and the start year. Affordability analysis has indicated that a levy model that disburses the cost of levy funding in a manner similar in nature to general rates does not cause the sum total of rates plus the levy to be unaffordable.

The remaining contingency is proposed to be provided by WCC in a form of a guarantee that sufficient debt headroom will be maintained over the latter period of construction to ensure contingency funding is available if it is needed to complete the SMF.

WCC has established a Governance Group with a balance of skill and experience to lead the SMF project. The Governance Group is chaired by WCC's Chief Infrastructure Officer. A core "client side" Project Team comprising a mixture of technical, commercial and project delivery resource. WCC will maintain overall project control and direction through the Governance Group and Project Team but will procure operational elements of the project from suitably qualified organisations.

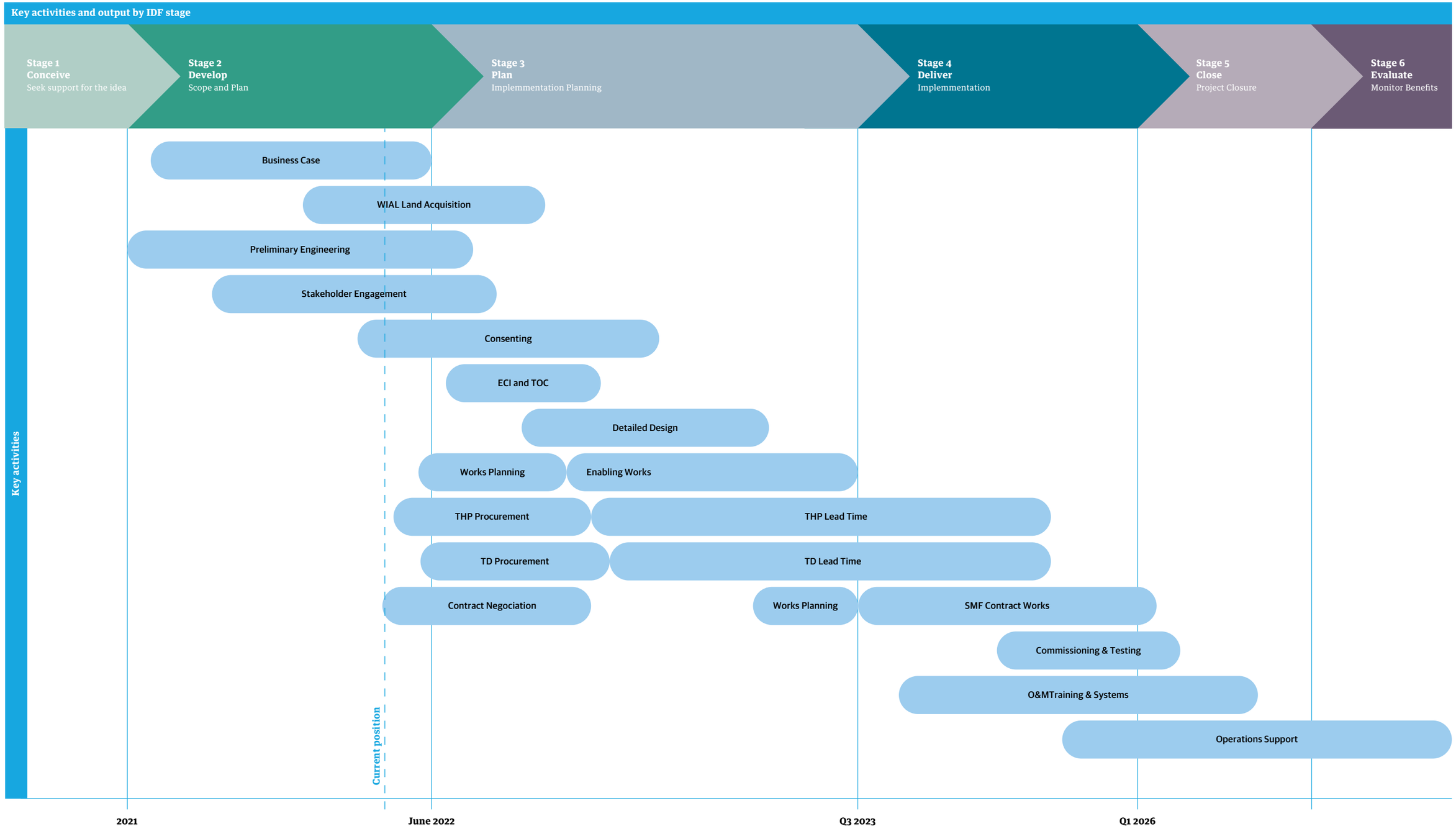
The Project Team has developed a schedule for the delivery of the project by 2026, a summary of which can be found below.

Key project risks include:

- **Ability to secure funding** - the SMF project is working with CIP to secure IFF funding
- **Supply chain disruption** - the SMF projects procurement strategy includes early engagement and ordering of key equipment and resource.
- **Resource availability for project delivery and operations** - the SMF project team is going to the market early to secure relevant resource.
- **Long term reliability and performance of the facility** - the plant commissioning phase will involve suppliers of critical technology
- **Hazard management during project delivery** - the main contractor will be responsible for developing and delivering a hazard management plan, the SMF project team will monitor performance against the plan.

These risks, and other identified risks, are managed under the project risk management framework and associated project associated assurance programme.

The Governance Group has endorsed the option selection, this business case document and the funding model as the preferred option for funding. The delivery of the project is subject to approval of the Final Investment Decision (FID) when target costs and timeframes are assured in quarter 1 2023.


Key activities and output by IDF stage
Stage 1
Conceive
Seek support for the idea
Stage 2
Develop
Scope and Plan
Stage 3
Plan
Implemmentation Planning
Stage 4
Deliver
Implemmentation
Stage 5
Close
Project Closure
Stage 6
Evaluate
Monitor Benefits
Key activities
Business Case
WIAL Land Acquisition
Preliminary Engineering
Stakeholder Engagement
Consenting
ECI and TOC
Detailed Design
Works Planning
Enabling Works
THP Procurement
THP Lead Time
TD Procurement
TD Lead Time
Contract Negociation
Works Planning
SMF Contract Works
Commissioning & Testing
O&MTraining & Systems
Operations Support
Current position
2021
June 2022
Q3 2023
Q1 2026

Strategic case
Making the case for change

The Strategic Case summarises the strategic context for the investment proposal and makes the case for change. It demonstrates alignment of the proposed investment with wider national or sectoral priorities and goals, policy decisions, other multi-agency projects (if relevant) and with the WCC's strategic intentions.

Background and Organisational Overview

Wellington's centralised wastewater processing systems produce a by-product called sewage sludge, which is disposed of at the Southern Landfill by being mixed with other waste. The Southern Landfill consent expires in 2026.

Sewage sludge is a natural and unavoidable by product of the current wastewater treatment process. Wellington City Council's (WCC) ability to dispose of it in the manner it currently does past 2026 is uncertain. WCC's current waste disposal resource consent imposes an obligation to develop options for long term management of sewage sludge having regard to minimising the landfill disposal pathway. This business case addresses that requirement.

Approximately 80% of carbon produced by Council functions comes from the Southern Landfill, and a significant amount of this is directly attributable to the existence of sewage sludge at the landfill. In 2018/19 the GHG emissions for Council were 115,000 tCO2e. Solid waste and wastewater treatment were the highest emitting areas for Council, producing 101,908 tCO2e or 88.6% of the Council's gross emissions.

WCC needs to have a plan in place to address the disposal of sewage sludge in advance of the expiry of the Southern Landfill consent.

WCC initiated the Sludge Minimisation Facility (SMF) project in late 2019, with the aim of removing the current constraints waste minimisation in Wellington. At the direction of WCC, Wellington Water (WWL) assumed responsibility for the feasibility stage of the project, as well as, for optioneering that investigated alternative technologies for the processing of wastewater and by extension new pathways for the disposal of sewage sludge. Following this phase, the project returned to WCC to fulfil the role of principal to the contract for the design and construction stages. The last two and a half years have seen the SMF project evolving in scope.

Stakeholders and Engagement

WCC has to date taken a proactive approach to establish genuine engagement and connection early with key stakeholders and community groups most affected by the proposed Wellington Sludge Minimisation Facility. The engagement has sought to:

- Build awareness and understanding of the project, its drivers, and benefits ahead of the public consultation process.
- Provide an opportunity to ask questions and give feedback that can be factored into the design process.
- Build trust.
- Establish preferred lines of communication ensuring efficient and effective delivery of information throughout the project.
- Ensure appropriate consultation on effects associated with the facility and its construction (as required for regulatory approvals).
- Ensure expected levy costs are publicly notified in advance, with the opportunity for feedback prior to finalising the funding model and levy scheme.

Formal Consultation

During the 21-31 LTP WCC consulted on four options to address sewage sludge and to break the link with the Southern Landfill. The four options consulted on were:

1. No change to the current practice
2. Invest in technology at the Southern Landfill
3. Council funded sludge minimisation facility at Moa Point
4. IFF funded sludge minimisation facility at Moa Point.

Feedback was split between two choices, the Council's preferred option, Option 4: Minimisation at Moa Pt through alternate funding, and Option 3: Minimisation at Moa Pt through Council funding both received 39% support. The Council decided to pursue option 4.

Community Feedback to Date

In April 2022 WCC carried out a further community engagement, primariliy targeted at the commercial sector, seeking feedback on the proposed IFFA funding approach. The engagement was open for just over one week and received 42 submissions.

Around a third of respondents supported the facility location and funding. However, there were some additional concerns raised including wanting the Council to do more to make other 'leaky' water infrastructure more resilient. Many respondents were concerned if not opposed to use of the IFF and levy to fund the facility, as creating an additional burden on ratepayers on top of recent rates increases.

Both the Chamber of Commerce and the Property Council are supportive of the council's aspirations for the city and, in principle for development of the SMF. However, both share concerns about the levy mechanism and additional and disproportionate burden on commercial ratepayers, particularly given the impacts of COVID on the city's commercial sector.

The full sumamry of those submissions can be found here: Sludge minimisation facility rates levy | Kōrero mai | Wellington City Council.

The following is a summary of groups that have been engaged through face-to-face meetings and with ongoing communication established:

- **Moa Point Road Residents Association:** Two meetings were held with the Association given they represent the closest neighbours to the treatment plant and planned sludge facility. These residents have had historical issues with odour from the plant and will also be most impacted by construction of the new facility with noise and traffic. We continue to work closely with them to address their concerns.
- **Strathmore Park Residents Association:** Representing residents in proximity to the treatment plant and have an interest in the new facility. At a meeting with Association representatives and a subsequent presentation on the project at the AGM, concerns were raised around odour from the pump station at the Moa Point wastewater treatment, when the pump station is open. Concerns were also raised about the fact that planned amenity planting around the treatment plant had not been completed to the full extent initially planned.
- **Owhiro Bay Residents Association:** These residents have a strong interest in sludge and waste management not only living near the Southern Landfill but also particularly sensitised to the issue of sludge / trucking sludge having been impacted by the 2020 Moa Point sludge pipe failures.
- **Residents Association of Wellington:** This Association is made up of representatives from all of Wellington City's residential associations and an important conduit to the wider Wellington community. Association representatives have been met with and briefed about the project to build awareness and understanding of the project ahead of wider community consultation.
- **Guardians of the Bay:** The Guardians have a particular interest in Wellington International Airport and development of the airport. The sludge minimisation facility is within the airport precinct and the project will involve purchasing land from the airport.

Participation of stakeholder groups has overall been positive, with stakeholders expressing their clear support for the project. This engagement will be ongoing as the project progresses.

Alignment to strategic intentions

WCC has committed to a significant reduction in waste to the Southern landfill - from 600kg per person per annum to 400kg per person by 2026 - and in carbon emissions - by 57% by 2030 and 100% by 2050.

Developing a reliable and effective new SMF that removes the reliance on the Southern Landfill for the disposal of sewage sludge is the largest single initiative WCC can put in place to realise waste reduction targets and open up opportunities for further waste minimisation initiatives.

The proposed investment is aligned with government's strategic imperatives and would support several government priorities at the local, regional, and national levels.

Wellington City Council Strategies

WCC has established a 2040 Vision for the city of Wellington1 to be 'an inclusive, sustainable and creative capital for people to live, work and play. A cornerstone of this vision is WCC's Environmental commitment, to be a sustainable, climate friendly eco capital city where the natural environment is being preserved, biodiversity improved, natural resources are used sustainably, and the city is mitigating and adapting to climate change - for now and future generations.

The Vision also covers six priority objectives for the next three years, three of which are addressed directly or progressed by the SMF Project:

5. A functioning, resilient and reliable three waters infrastructure with improving harbour and waterway quality and reducing water usage and waste.
6. An accelerating zero-carbon and waste free transition - with communities and the city economy adapting to climate change, development of low carbon infrastructure and buildings, and increased waste minimisation.
7. Strong partnerships with mana whenua upholding Te Tiriti o Waitangi, weaving Te Reo Māori and Te Ao Māori into the social, environmental, and economic development of our city and restore the city's connection with Papatūānuku (nature).

Te Atakura - First to Zero
Te Atakura - First to Zero is WCC's Implementation Plan for the period 2020 - 2030 and directs the first stage of WCC's journey to become a net zero carbon city. In the waste management sector, the plan sets out measurable actions to reduce GHG emissions from the city's waste management by 2030. It notes that potential reductions are heavily reliant on a viable sewage sludge solution being adopted and the 33% reduction in landfilled waste being achieved.

Wellington Resilience Strategy
Provides a blueprint for dealing with future shocks and stresses that impact WCC and its communities. The Wellington Resilience Strategy was published by WCC in March 2017 and includes action plans to address both short-term and tactical challenges, as well as long-term strategic challenges. The strategy identifies four key projects, one of which (Project 25) is to explore options for sewage sludge disposal, to reduce carbon and landfill liability related to sewage management.

Long Term Plan (2021-2031)
The WCC 2021-31 Long Term Plan (LTP) identified waste minimization, including investment in a new sewerage sludge reduction project as a key component of the environmental pillar of the LTP. The LTP proposes an investment of between $147m and $208m in a new Sludge Treatment Plant at Moa Point funded through the use of the Infrastructure Funding and Financing Act mechanism.

The Regional Level

Wellington Regional Policy Statement contains a related objective and policy:

Objective 2 of the Regional Policy Statement seeks to reduce and minimise the quantity of residual wastes for disposal through reuse, recycling and resource recovery. The Hearing Panel considered that, overall, the disposal of sludge to landfill does not fully meet the intent of this objective.

Policy 5 seeks to promote, as a matter of priority, the concepts of clean production and waste minimization and to support all sectors of the community in the implementation of these concepts. Further, Policy 6 seeks to provide opportunities for the reuse of waste materials, recycling and recovery of resources from waste.

Wellington Region Waste Management and Minimisation Plan (2017 - 2023), which sets the priorities and strategic framework for managing waste in the region.

Alignment to National Strategies and Requirements

New Zealand Water Reform Programme
In July 2020, the Water Services Bill was introduced to Parliament in response to the review and contains provisions relating to source water protection and Taumata Arowai's (the water regulator's) wastewater and stormwater functions. Subpart 6A of the Water Services Bill includes provisions for Taumata Arowai, following consultation as specified, to set environmental performance standards that include requirements, limits, conditions or prohibitions in relation to, inter alia:

- Discharges to air, water or land,
- Biosolids and any other by-products from wastewater,
- Energy use, and
- Waste that is introduced by a third party into a wastewater network (such as trade waste).

The establishment of environmental performance standards in any one of the four areas above would have an impact on biosolids management and specifically this project.

The case for change

Discussions with key stakeholders and SMEs have been held to gain a common understanding of the problems, business needs, high-level benefits expected from the investment and agree the investment objectives.

The four main problem statements are presented below:

Problem Statement One
Relatively untreated (unstabilised, high-moisture content) sludge places significant constraints on operations at the Southern Landfill because volume of sludge that needs to be disposed increases and solid waste that is to be mixed with sludge to manage odour, emissions, proneness to collapse, and pathogens, decreases, making it difficult to achieve required 4:1 mixing ratio with sludge.

Problem Statement Two
Due to the nature of the current sludge product produced from the Carey's Gully Sludge Dewatering Facility and the Western WWTP, there is only one pathway for sludge disposal. This exposes WCC to potential legislative and cost pressures including central government policies for waste minimisation, GHG emissions and the Three Waters Reform which will increasingly expose WCC to increased capital and operating costs to manage sludge.

Problem Statement Three
Current sludge management approach has several issues that make it unacceptable to community and iwi, risking future obtainment of consents for extensions to Southern Landfill. Issues are:

- Odour caused by sludge composting operation
- The current treatment method before disposal does not align with traditional Māori values and methods of human waste management or the principles of rahui in disposing of human waste
- The existing sludge treatment methodology does not recover energy or nutrients from the sludge
- High probability of potential impact to the environment in the event of failure of the sludge pipelines.

Problem Statement Four
In the current practice of sludge management, Council cannot achieve carbon reduction commitments it has made by risking causing itself reputational damage.

The solutions of these problems can offer two main opportunities:

1. WCC delivers a project that fulfils the wants and needs of diverse stakeholder groups and representatives of Wellington City.
2. Implementing a sustainable solution for sludge management lowers long-term costs of carbon to WCC.

Investment objectives

The below tables outline investment objectives, existing arrangements, including problem statements), where the organisation wants to be (desired future state) and the business need.

Table 1: The case for change is summarised for each investment objective below.

Investment Objective One	**By 2026, minimise the amount of sludge sent to the Southern Landfill** To minimise operational impact of sludge and support WCC's commitments under the Regional Waste Management and Minimisation Plan.
Existing Arrangements	At present, raw sludge from moa point WWTP is transferred by pipeline across the southern districts of Wellington the Carey's Gully Sludge Dewatering Facility, which is located at Southern Landfill. The Dewatering Facility removes some water from the sludge to produce a moist cake" product, but the sludge receives no further treatment. The sludge from Karori WWTP is dewatered at the WWTP and trucked as a dewatered cake to Southern Landfill. At Southern Landfill, the dewatered sludges are mixed with solid waste at a ratio of 4-parts solid waste to 1-part dewatered sludge. When compared to national and international standards for sludge treatment, sludge from Wellington's wastewater treatment plants that is sent to Southern Landfill is considered relatively untreated, because: • The sludge is unstabilised- it still contains a high organic matter content which is prone to degradation when placed in the landfill. Its unstabilised nature makes the transportation and disposal of the sludge into Southern Landfill prone to odour generation and creates carbon emissions from the breakdown of sludge in the landfill. Unstabilised sludge also attracts vectors (vermin and scavengers). • The sludge is high in moisture content - the dewatered sludge contains approximately 75% water and resembles a moist / jelly like soil product. This makes the sludge susceptible to collapse if piled or placed in large clumps in the landfill. It also substantially increases the volume of sludge that needs to be disposed of, compared to stabilised and/or dried sludges which have undergone treatment first. • The sludge contains pathogens, which present a public health hazard. This places significant constraints on operations at the landfill because sludge must be mixed with solid waste to manage these issues. Under the requirements of the existing resource consent, each tonne of sludge must be mixed with 4 tonnes of solid waste. Solid waste volumes to landfill have been decreasing, while sludge volumes have remained steady or are increasing.
Desired Future State & Business Needs	The desired future state is to produce a sludge product that is no longer a constraint on landfill operations, consenting of Southern landfill, or the ability for WCC to achieve its aspirations for waste and carbon emissions reduction. To achieve this, WCC needs to construct a facility that treats the sludge in a way that: • Stabilises sludge - to reduce odour and vector attraction from sludge disposal. • Substantially reduces sludge volume. • Substantially reduces pathogen content.
Benefit Link	1, 2, 4

Investment Objective Two	**Enhance the resilience of sludge management in Wellington** By 2026, provide an advanced treatment of sludge thus supporting WCC's commitments to achieve a sustainable long-term solution in line with the Regional Waste Management and Minimisation Plan.
Existing Arrangements	There is a singular solution for disposal of sludge from Wellington's WWTPs. This exposes WCC to potential legislative and cost pressures which could otherwise be avoided. This exposure includes, but is not limited to: • Increases in waste levies. The large volume of sludge currently produced and disposed of from Wellington City's WWTPs means that any increases in levies will have a larger impact on operational costs. • Carbon emissions liabilities, which are borne from government policy and legislation to meet global commitments in relation to climate change mitigation. Higher standards for environmental protection and lower environmental impact. The three waters reform programme includes the potential implementation of environmental performance standards for wastewater treatment, including the management of by-products and odour producing operations, and energy use reduction.
Desired Future State & Business Needs	Sludge product is produced that provides flexibility of where and how it is disposed of, i.e., being able to dispose of sludge to multiple pathways. To achieve this, WCC needs to construct a facility that treats the sludge in a way that: • Meets requirements of current guidelines for disposal of organic material to land. • Is reliable, i.e., can process sludge under a range of operating conditions.
Benefit Link	1, 2, 4

Investment Objective Three	Reduce the environmental impact of sludge management in Wellington - includes meeting consenting requirements as well as the requirements in the **Reduce the environmental impact of sludge management in Wellington**.
Existing Arrangements	The current Resource Consent for disposal of sludge to Southern Landfill, which expires in 2026, requires that investigations be undertaken to identify alternative ways to manage sludge. This brings into question the consentability of the current wet sludge disposal solution. Furthermore, consents for disposal of municipal waste at Southern Landfill also expire in 2026. Achieving new consents for extensions to Southern Landfill will be challenging due to a lack of community and iwi acceptance of current wet sludge management practices if an alternative sludge management strategy is not identified.
Desired Future State & Business Needs	The desired future state is that the community does not object to the management of sludge because environmental impacts have been addressed, and this does not have knock-on effects for consenting of sludge disposal or landfill activities. In order to achieve this, WCC needs to construct a facility to treat the sludge so that the sludge product is sufficiently "inert" that it does not create excessive odour or carbon emissions when disposed of.
Benefit Link	1,2,3,4

Investment Objective Four	Align practice of sludge management in Wellington to mana whenua values and principles.
Existing Arrangements	Early consultation with iwi, both Ngati Toa and Taranaki Whanui, identified key mana whenua principles for sludge management from Wellington's WWTPs. The existing sludge treatment and disposal method is not aligned to these principles in the following ways: • The traditional Māori values and methods of human waste management, and the principles of rahui in disposing of human waste, require careful handling and disposal of the sludge. The current treatment method before disposal does not align with these principles. • Ability to harness and use the resources available from the sludge to give them another life (such as energy utilisation from the sludge). The existing sludge treatment methodology does not recover energy or nutrients from the sludge. • Having a positive impact on the environment and our communities through the action we take (kaitiakitanga). Concern has been raised on the potential impact to the environment in the event of failure of the sludge pipelines, and/or the effect of sludge disposal on local waterways. Furthermore, odour release from the current sludge disposal is of significant concern. For these reasons, the current sludge management practice does not create a positive impact on the environment.
Desired Future State & Business Needs	Future sludge treatment and disposal method is aligned to key mana whenua principles for sludge management, including: • Use of sludge treatment processes that align to traditional Māori values and methods of human waste management, and the principles of rahui in disposing of human waste and the issues of transferring human waste from one rohe to another, • Ability to harness and use the resources available from the sludge to give them another life (such as energy utilisation from the sludge), • Having a positive impact on the environment and our communities through the action we take (kaitiakitanga), and • Understanding and mitigating the potential impacts on areas of settlement (marae, papakainga), use (food gathering areas), wāhi tapu, statutory acknowledgements, rohe boundaries and sites of significance. To do this, WCC need to partner with iwi to identify a preferred sludge treatment process that best aligns to these principles.
Benefit Link	1,2,3

Potential scope and services

At a facilitated case for change discussion key SMEs identified the business scope and key service requirements.

Service Requirements #	Scope Assessment		
	Minimum Scope	Maximum Scope	Out of Scope
End-product conforms to requirements of organic material disposal guidelines	Provide a facility that produces a grade A biosolids quality requirement under the Guidelines.	Provide a facility that produces a product, which is in a form that can be immediately applied to land without further treatment.	Identifying and implementing alternative disposal pathways for the treated sludge. Achieving contaminant grades under the guidelines. Addressing stakeholder concerns about a beneficial reuse of sludge.
Plant has sufficient capacity for projected growth in WWPT catchments	Create a solution through which the capacity of the plant exceeds the sludge production capacity of Moa Point and Karori WWTPs.	n/a	The plant does not provide capacity for other WWTPs in the Wellington Region, such the ones in Porirua and Hutt Valley.

The scope of the project being proposed by this business case is to identify a preferred sludge treatment solution for Wellington City within the following defined scope boundaries:

- **Geographical:** The Sludge Minimisation Facility will serve the sewerage catchments of Moa Point and Karori (Western) Wastewater Treatment Plants. While a regional solution for biosolids management encompassing sludge from other wastewater treatment plants has been considered previously, the need for a sludge management solution for Wellington City is more urgent. Furthermore, geographical constraints such as the location of the wastewater treatment plants, and the dense urban environment make a truly integrated regional facility difficult to achieve. However, the design is to consider how the facility could be integrated into sludge management facilities for other wastewater treatment plants in the future.
- **Feedstock:** The feedstock for the new Sludge Minimisation Facility is limited to municipal sludge from Moa Point and Karori (Western) wastewater treatment plants only. WCC are considering options for other organic waste streams, such as green and food waste.
- **Disposal pathway:** This business case does not consider disposal methods for treated sludge. Treated sludge from the new Sludge Minimisation Facility will continue to be disposed of to a landfill (not necessarily Southern Landfill), until alternative disposal pathways for the treated sludge can be developed which would enable it to be beneficially reused. In this regard, the Sludge Minimisation Facility needs to be future proofed to enable the beneficial reuse of biosolids, and this is to be a consideration of technology selection for the new plant. Beneficial reuse is governed by the Guidelines for the Safe Application of Biosolids to Land in New Zealand.
- **Timing:** The sludge treatment solution must be implemented before expiry of the existing sludge disposal consent in 2026.

Main benefits

The identified benefits of the Sludge Minimisation Facility (SMF) are shown in the table below.

ID	High-level Benefit	Description	Strategic Imperative, KPI Linkage, Indicator Framework
1	Contribution to the Wellington Regional Waste Minimisation and Management Plan	WCC aims to protect and enhance Wellington's natural environment through waste reduction and energy conservation. WCC has committed to investing $187m until 2031 to reduce sewerage sludge as a key enabling step in reducing waste.	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) **KPI linkages:** (Waste minimisation activities) Volume of waste diverted from landfill (tonnes) **Investment-level indicators:** Amount of sludge going to Southern Landfill
2	Contribution to Te Atakura (WCC's Zero Carbon Plan)	WCC aims at making Wellington City a zero-carbon capital (net zero emissions) by 2050. The construction and operation of the waste minimisation facility is clearly identified as a risk treatment which will contribute to reducing our "Inadequate Climate Change Response" risk.	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) Te Atakura: GHG Reduction Focus **KPI linkages:** (Waste minimisation activities and energy conservation): • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 • Volume of waste diverted from landfill (tonnes) **Investment-level indicators:** • Average percentage reduction in carbon and GHG emissions from Southern landfill • WCC Group GHG emissions (tCO_2-e) decreasing • Progress on achievement of Te Atakura implementation plan.

3	Reduced exposure to external costs[2] (e.g., landfill levies, carbon, and fuel) that impact wastewater and sludge management[3]	WCC's aims at enabling and accelerating GHG reduction. Council also works on having adequate planning and prioritisation when it comes to financial management policies and procedures. There are also risk registers which recognise gaps and mitigation responses.	Te Atakura, Wellington Resilience Strategy[4] (Programme 3.2 Water and Natural Environment, Explore options for sewage sludge disposal) LTP - Finance and Infrastructure strategy Strategic risk register Procurement strategy **KPI linkages:** • Financial and health impacts on Wellingtonians and on city council (LTP) • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 **Investment-level indicators:** • Lowered costs of sludge disposal to WCC • Less susceptible to increases in landfill levies, carbon, and fuel prices.
4	Reduction in operational risks and costs to dispose of sludge[5] (e.g., asset management/ renewal costs, financial, environmental, service, and reputational risks)	Council adheres to principles of financial affordability and sustainability, which support consistent and effective financial and investment decisions. This may include: • Minimising whole-of-life cost. • Considering investment in large capital cost in order to reduce long-term operational costs. • Focusing on providing resilient infrastructure that is not prone to failure, does not expose its ratepayers to elevated operational costs, and meets the needs of a growing city. • Thorough development of a comprehensive business plan and following robust process for the business case, decision-making, construction, and operation will demonstrate that we are mitigating our "Inadequate Asset Management Planning" risk.	WCC Risk Register (Strategic Risks) **KPI linkages:** • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 **Investment-level indicators:** • Maintenance and operational costs • A reduction in the risk rating expressed as per Council's risk standard.

5	Improved commitment to reflecting Mana Whenua values and principles	Council strengthens partnerships with Mana Whenua. Council values alignment and recognition of Mana Whenua values into design and delivery processes. Council is also committed to ensuring Mana Whenua and Māori meaningfully participate in, contribute to, and inform Council decisions. Improved partnerships and capacity building are the cornerstones of this new strategic direction. Council gives effect to Tākai Here - the Mana Whenua Partnership Agreement and key priorities. Identify opportunities for the codesign and development of public and streetscape projects, physical environment, green belts and waterways projects. Find codesigning opportunities within the Waste minimisation, food waste, climate change space to collaborate and support mutual outcomes that work together for our whenua and taiao.	LTP, Objective 6 Strong partnerships with Mana Whenua Tākai Here - Mana Whenua Partnership Agreement **KPI linkages:** • The level of involvement of our Mana Whenua partners in this whole process. • Strong partnership with Mana Whenua. • Reflecting Mana Whenua values in the project. **Investment-level indicators:** • The selected treatment method reflects Mana Whenua values • Support for our consent process • Involvement of a Mana Whenua representative throughout the project • Asking Mana Whenua to gift a name to the project • Participation of Mana Whenua in appropriate ceremony or ceremonies.

Main risks

At a facilitated workshop, stakeholders identified and evaluated the key risks that might prevent, degrade, or delay the achievement of the investment objectives.

Table 1: Current risk analysis

Main Risks		Likelihood (H/M/L)	Impact (H/M/L)	Comments & Risk Management Strategies (Mitigations)
1	If we do not achieve funding through CIP to meet criteria; it will fall to WCC to fund the project.	Low	High	WCC is working hard to ensure this funding option is achieved. In the event it is not achieved, reallocation of WCC capital programme to afford this.
2	Global economic upheaval may cause delays to the project and increase costs. If global pandemic continues through procurement and construction activities, then there is likely to be extended lead times for all equipment and resource constraints for contractors.	Medium	High	Early procurement of Tier 1 long lead items (by WCC for novation to Contractor). Early specification of Tier 2 packages to enable efficient procurement to be completed by Contractor. Engagement of the Contractor early during design and consenting activities.
3	Scarcity of construction resource.	Medium	High	Early procurement of main works contractor. Active engagement with that contractor on local skills required. Active engagement with the contractor on resourcing and skill set requirements.

A Risk Management Strategy, and Risks and Issues Registers, have been developed and will be regularly and progressively updated throughout the project as more information comes available. There is also detailed operational risk information in the Management Case of this document.

Key constraints, dependencies, and assumptions

The proposal is subject to the following constraints, dependencies, and assumptions.

Management strategies and registers have been developed to record these and they will be regularly monitored and managed during the project.

Table 2: Key constraints, dependencies, and assumptions

Constraints		Notes
C1	Moa Point Wastewater Treatment Plant (WWTP) Capacity Upgrades	Recent process analysis has been undertaken to support the Sludge Minimisation Project which has identified a potential capacity constraint within the existing Moa Point WWTP. A wastewater treatment process specialist has been engaged to undertake an analysis and options assessment in two stages. Under stage 1, detailed process analysis will be undertaken to understand the capacity constraints and performance challenges with each individual part of the plant, and how this affects overall wastewater treatment plant performance. An assessment of current asset condition will also be undertaken. Combining these assessments, a whole picture of current plant constraints will be developed. Under Stage 2, plant upgrade options will be identified. This will consider how plant upgrades can be staged in a prioritised manner to improve plant performance but enable smoothing or deference of investment if possible.
C2	Wellington International Airport Limited's (WIAL's) Development Plans	The proposed location for the new Sludge Minimisation Facility is adjacent to the Moa Point WWTP, alongside or on land owned and operated by WIAL. Specialist airport operations will place constraints on the design (such as height, heat emissions etc), construction and operation of the plant. Existing designations will need to be adjusted to suit the proposed use of the land. Conversely, this project may present opportunities for WIAL. For example, some sludge management processes produce surplus heat and/or can produce electricity that could be used by the nearby airport operations.

Dependencies		Notes & Management strategies
D1	Moa Point and Western WWTP Capacity	Moa Point and Western WWTPs are the two wastewater treatment facilities for Wellington City that produce sludge by-product. These facilities have been designed to account for future population growth by providing he potential to expand the WWTPs. It is critical that the capacity of the new SMF is aligned to the WWTPs, so that there is not an under or over investment in the SMF for the population it serves. This requires us to understand the current and proposed future capacity of the WWTPs within the design horizon of the SMF.
D2	Consenting and Design of the Southern Landfill Extension.	An extension to the Southern Landfill is currently being considered and the conditions of any new consent, with respect to acceptance of or management of sludge at the landfill, may have a significant impact on this project. Conversely, the end-product from the proposed Sludge Minimisation Facility may impact the design of the landfill, by the way that sludge is managed within it (for example, a monofil for treated sludge could be established). The expansion of the Southern Landfill will be scoped/developed based on the assumption that untreated sludge has been removed from being disposed at the landfill.

Assumptions		Notes & Management strategies
A1	Treated sludge from the new SMF can be received at Southern Landfill in the short to medium term	The SMF project assumes that the output from the new SMF will continue to be disposed of at the Southern Landfill while beneficial reuse opportunities are established. It may take a long time to build an alternative re-use "market" for treated sludge, therefore, it is important that the treated sludge product can continue to be disposed of at Southern Landfill as an economic option for sludge management for the next 10 -15 years. Otherwise, a commercial landfill outside of region which will need to receive the sludge, but it will also cost more money. Council would need to accelerate identifying a sludge reuse option.
A2	Land can be purchased from Wellington International Airport Limited for the SMF	The SMF project assumes that the requisite land at Moat Point can be purchased from WIAL. In the unlikely event that is not possible, especially given the compulsory acquisition powers available to WCC, then WCC will need to look for alternative land to build a plant, as well as redesign the plant, which would essentially mean planning for the project again.
A3	Achieving funding from infrastructure funding and financing.	The SMF project is moving forward based on the assumption it will achieve funding through the IFF. In the event that funding cannot be achieved through the IFF mechanism, WCC will have to determine whether how it goes about reprioritising its capital projects and making a funding decision if the SMF project is a priority.

Economic case

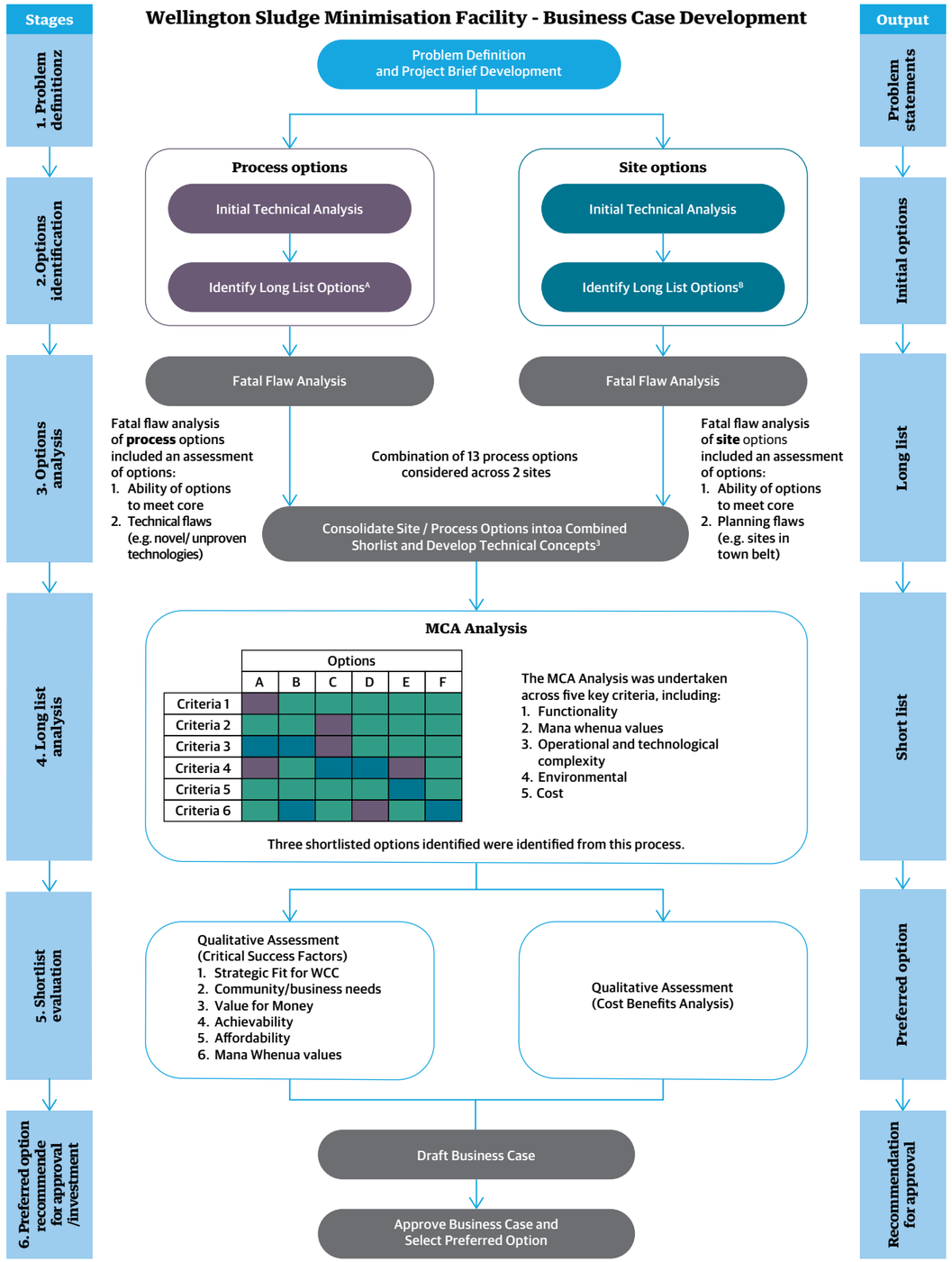
Finding our preferred way forward

The purpose of the Economic Case is to step through the structured quantitative and qualitative processes that have been applied to assess potential investment options against specified criteria, culminating in the selection of a preferred option.

The structure in this section draws heavily from Treasury's Better Business Case framework with the specific purpose of ensuring that the appropriate analytical tools have been utilised for a project of this scale and importance. The following diagram outlines the process followed for this economic case.

This section sets out the analysis that was undertaken to identify and assess potential sludge treatment options and site locations for the proposed Sludge Minimisation Facility (SMF), leading to selection of a preferred sludge treatment and site location option.

The preferred option selected from this economic case is taken forward for impact and operational analysis in the Financial, Commercial and Management case sections of this business case.



Options Identification and Appraisal

Step 1. Potential Sludge Treatment Methods

As described in the Strategic Case, the current nature and volume of sludge creates a significant challenge in current disposal and is inhibiting waste management initiatives for Wellington City. To address these issues, treatment of the sludge is required which targets the following:

- **Removal of water** - The existing sludge dewatering process used at Carey's Gully only generally targets free water within the sludge, which is the water between and not bound tightly within the organic matter in the sludge. Additional processing is needed to target additional free water and embedded water within the sludge. This will significantly reduce the volume of sludge.
- **Stabilisation of organic matter** - The volume of sludge can be further reduced by processes that break down organic matter in the sludge. This reduces the potential for further degradation of sludge in the landfill, reducing the generation of odour and greenhouse gas emissions, minimises landfill stability issues, reduces the side effect of attracting rodents. It is this degradation that creates the current requirement to mix general waste with the sludge.
- **Removal of pathogens** - This is generally achieved by thermal treatment. This makes the sludge safer to handle during disposal or in beneficial re-use, such as application as a fertiliser on land.

A range of technologies are available to address one or more of these constituents of the sludge. When combined into process systems, they provide a holistic solution to sludge treatment that changes the nature and volume of the sludge. The technologies are broadly categorised as follows:

- **Concentration technologies** - reducing sludge volume, generally by removing water from the sludge
- **Stabilisation technologies** - stopping or stabilising biological activity, which can reduce odour emissions from further handling/disposal, in addition to reducing microbiological contaminants
- **Hydrolysis technologies** - treatment to support the enhanced recovery of energy or nutrients, or aid sludge reduction and microbiological stabilisation
- **Conversion technologies** - conversion of the sludge into other forms for beneficial re-use.

To identify potential process systems that might be applicable for sludge from Wellington's WWTPs, independent engineers and technical specialists initially identified combinations of the technologies in these categories. These formed 25 potential sludge treatment methods, as follows:

1. Status Quo (Sludge Dewatering Only)
2. Electrostatic Belt Filter Press
3. Heated Filter Press
4. Solar Drying
5. Aerobic digestion + solar drying
6. Mesophilic anaerobic digestion + solar drying
7. Autothermal anaerobic digestion + thermal drying
8. Mesophilic anaerobic digestion + composting
9. Mesophilic anaerobic digestion + vermicomposting
10. Thermal hydrolysis + mesophilic anaerobic digestion + thermal drying
11. Mesophilic anaerobic digestion + thermal hydrolysis + thermal drying
12. Digestion-lysis-digestion + thermal drying
13. Mechanical Hydrolysis + MAD + thermal drying
14. Ultrasonic Hydrolysis + MAD + thermal drying
15. Biological Hydrolysis + MAD + thermal drying
16. Mesophilic anaerobic digestion + struvite recovery
17. Mesophilic anaerobic digestion + thermal drying
18. Thermal drying
19. Thermal drying + Gasification
20. Thermal drying + Pyrolysis
21. Mesophilic anaerobic digestion + thermal drying + Pyrolysis
22. Hydrothermal liquefaction + oil upgrading
23. Wet Air Oxidation
24. Thermal hydrolysis + mesophilic anaerobic digestion + wet air oxidation
25. Incineration (thermal drying optional)

Step 2. Potential Site Locations

Potential sites were identified by independent technical and planning specialists by way of a desktop study of viable locations in the southern districts of Wellington based on key criteria defined in the table below. Locating the plant in another part of Wellington would add significant operational risk, cost, and complexity of having to transfer sludge from the sources (the WWTPs) located in southern Wellington through dense urban environments to another location.

The criteria used to identify an initial list of potential site locations is shown in the table below.

Table 2: Criteria for Initial Identification of Potential Sites.

Criteria	Criteria Description
Size	Providing sufficient space and an appropriate site configuration for sludge processing operations
Vehicle access	Being able to accommodate heavy vehicle access for loading / unloading operations
Noise and odour	Sufficient distance from sensitive residential areas
Utilities access	Ability to access to power and utility connections
Topography	Favourable sites have flat, open land for vehicle movements and large building and process plant areas
Land use and Designation	Ability to acquire land based on district plan rules and zoning, designations, existing land use, community amenity value, land ownership, Selected Land Use Register (SLUR) status

The desktop assessment found that there are very limited appropriate site locations across southern Wellington. Using the above criteria, feasible sites were identified which generally fell into two groups:

- Group A sites are all located close to Moa Point Wastewater Treatment Plant (WWTP)
- Group B are all located close to the Southern Landfill (Carey's Gully).

Other potential site locations were discounted from consideration because much of the area of Southern Wellington is already developed as residential suburbs which is unsuitable placement of a sludge facility, is designated Town belt and therefore cannot be considered, or has other uses not aligned to this activity such as sports fields and shopping centres.

Step 3. Fatal flaw analysis on treatment methods and site locations - establishing the long list

Assessment of Sludge Treatment Methods

A fatal flaw assessment of potential sludge treatment methods was undertaken by a technical working group made up of WWL representatives and independent specialists who considered three criteria in their assessment, as follows

1. Maturity of the treatment method: If a new or emerging technology was to be implemented in Wellington that was untested or unsupported, this could impact the resilience of the sludge management system. This would include technologies that are only available from a single global supplier that is not established in New Zealand.
2. Whether the treatment method provides a significant reduction in volume as indicated by the dry solids content of end product. Dry solid content of end sludge product is an important consideration, as a high dry solids content represents a significant reduction in volume of sludge.
3. Land area required for the treatment process: only processes that can fit within available site footprints should be considered. The estimated maximum land available is 15,000m^2.

The table below summarises the scoring that was applied to sludge treatment methods.

Table 3: Scoring of Fatal Flaw Criteria

Criteria	Scoring Parameters		
	Meets Criteria	Partially meets Criteria	Does Not Meet Criteria
Maturity of treatment method	Current application in NZ	Applied in more than 2 sites globally	Applied in 1 site / Novel
Dry solid content of end product	> 60% dry solids	~60% dry solids	< 60% dry solids
Total plant footprint	<15,000m^2	~15,000m^2	>15,000m^2

A summary of the fatal flaw analysis is shown in the table below. Any treatment methods with at least one does not meet score across the three criteria was not taken forward for further consideration.

Table 4: Summary Evaluation of Potential Sludge Treatment Methods based on Fatal Flaw Analysis

Treatment Method		Evaluation Criteria		
		Maturity of Technology	Dry Solids content of End Product	Total plant footprint
1	Base Case			
2	Electrostatic Belt Filter Press			
3	Heated Filter Press			
4	Solar Drying			
5	Aerobic Digestion + Solar Drying			
6	Mesophilic Anaerobic Digestion + Solar Drying			
7	Autothermal Anaerobic Digestion + Thermal Drying			
8	Mesophilic Anaerobic Digestion + Composting			
9	Mesophilic Anaerobic Digestion + Vermicomposting			
10	Lysis-Digestion + Thermal Drying			
11	Digestion-Lysis + Thermal Drying			
12	Digestion-Lysis-Digestion + Thermal Drying			
13	Mechanical Hydrolysis + Mesophilic Anaerobic Digestion + Thermal Drying			
14	Ultrasonic Hydrolysis + Mesophilic Anaerobic Digestion + Thermal Drying			
15	Biological Hydrolysis + Mesophilic Anaerobic Digestion + Thermal Drying			
16	Mesophilic Anaerobic Digestion + Struvite Recovery			
17	Mesophilic Anaerobic Digestion + Thermal Drying			
18	Thermal Drying			
19	Thermal Drying + Gasification			
20	Thermal Drying + Pyrolysis			
21	Mesophilic Anaerobic Digestion + Thermal Drying + Pyrolysis			
22	Hydrothermal Liquefaction + Oil Upgrading			
23	Wet Air Oxidation			
24	Thermal Hydrolysis + Mesophilic Anaerobic Digestion + Wet Air Oxidation			
25	Incineration (Thermal Drying optional)			

The fatal flaw analysis identified five treatment methods that met the criteria. There were five options considered to meet the criteria and a further four treatment methods that were considered to almost meet the criteria.

Methods that met the criteria well:

8 Mesophilic Anaerobic Digestion + Composting

10 Lysis-Digestion + Thermal Drying

17 Mesophilic Anaerobic Digestion + Thermal Drying

18 Thermal Drying

25 Incineration (Thermal Dryer optional).

Methods that largely met the criteria:

7 (Autothermal) Aerobic digestion + Thermal Dryer

12 Digestion - Lysis - Digestion + Thermal Dryer

19 Thermal Drying + Gasification

24 Wet Air Oxidation

Assessment of Potential Site

Further analysis on potential site locations was also as follows:

- **Group A Sites:** Investigations were undertaken first to identify technical constraints with the options. This was done to inform discussions with Wellington International Airport Limited in May and June 2020. WIAL were consulted because they either own the land on which the sites are located, or their operation could be affected by locating a facility on the proposed sites.
- **Group B Sites:** Consultation with Southern Landfill identified some key constraints with most of the site options selected, requiring that most of the Group B sites be negated from further consideration. Additional technical investigations were then undertaken on the remaining Group B sites.

Step 4. Initial MCA - establishing the shortlist

The next step in the process was to overlay the longlist of viable sludge treatment methods and site locations to create a definitive long list, which could be evaluated in an initial MCA. Note that it is not possible to locate all sludge treatment methods at both site locations due to technical limitations.

The resulting long list of treatment methods at each site location is shown in the table below. For consistency, the options numbers for the process options above have been retained and an “M” or “C” added to denote whether the plant would be located at Moa Point or Carey’s Gully respectively.

Table 5: Combined Longlist of Process and Site Options

Moa Point Site		Carey’s Gully Site	
6M	Autothermal Aerobic Digestion + Thermal Drying	**6C**	Autothermal Aerobic Digestion + Thermal Drying
2M	Lysis-Digestion + Thermal Drying	**1C**	Mesophilic Anaerobic Digestion + Composting
7M	Digestion-Lysis-Digestion + Thermal Drying	**7C**	Digestion-Lysis-Digestion + Thermal Drying
3M	Mesophilic Anaerobic Digestion + Thermal Drying	**3C**	Mesophilic Anaerobic Digestion + Thermal Drying (option 17)
4M	Thermal Dryer Only	**4C**	Thermal Dryer Only (option 18)
8M	Thermal Drying + Gasification	**8C**	Thermal Drying + Gasification
9M	Wet Air Oxidation	**9C**	Wet Air Oxidation
5M	Incineration	**5C**	Incineration

To assess these long list of options, MCA criteria were initially developed collaboratively by a group of technical specialists, WWL staff and iwi stakeholders. These criteria are outlined in the table below, together with how each criterion ties back to the project investment objectives. The associated weightings of each criterion were determined by MCA workshop participants.

Table 6: Summary of MCA Criteria Used to Evaluate Site and Process Options, and Relationship of Criteria to Project Objectives.

Criteria (and initial weighting)	Sub-criteria	Relationship to Investment Objectives		
		Objective 1: Minimise Sludge Volume	Objective 2: Enhance Resilience	Objective 3: Reduce Environ. Impact
Function (21%)	Level of sludge volume minimisation	✓	–	✓
	Potential to re-use the biosolids product	✓	✓	✓
Mana whenua values (20%)	Mana whenua values / principles	–	–	✓
Complexity (21%)	Operational and Technical Complexity	–	✓	–
Environmental (17%)	Ecological Impacts	–	–	✓
	Carbon Emissions Reduction Potential	–	–	✓
	Community impacts	–	✓	✓
	Consenting and planning considerations	–	✓	✓
Cost (21%)	Whole of life cost	–	✓	–
	Ability to stage to meet budget constraints	–	✓	–

To test the MCA process, alternative weightings were then applied and incorporated into the final rankings of the short-listed options, to provide a sensitivity analysis of how outcomes of the assessment might change if criteria weightings are changed. The alternative weightings are shown in the following table.

Table 7: Sensitivity Analysis for initial MCA.

Weighting Scenarios	Criteria Weightings				
	Function	Mana Whenua Values	Complexity	Environment	Cost
Baseline Criteria Scoring	21%	20%	21%	17%	21%
Alternative Weighting 1 Weighted towards further feedback from MCA participants	35%	20%	5%	20%	20%
Alternative Weighting 2 100% towards core project objectives	33%	–	33%	–	33%
Alternative Weighting 3 Environmental and Mana Whenua Values at 100%	–	50%	–	50%	–
Alternative Weighting 4 Environmental and Mana Whenua Values at 60%	20%	25%	10%	35%	10%

The table below provides the scoring based on the baseline and alternative weightings, and the ranking of the long list of options based on this assessment which is shown in parenthesis.

Table 8: Scoring of Long List Sludge Treatment and Site Locations for Wellington Sludge Minimisation Facility, Based on Baseline and Alternative Weighted Criteria.

Weighted Score Ranking of options is indicated in the parenthesis.

	Options	Baseline	Alternatives				Total Score	Median Ranking	Ranking Based on Total Score
			1	2	3	4			
Moa Point Site	**7M Autothermal Anaerobic Digestion + Thermal Drying**	6.71 (5)	5.77 (12)	6.03 (13)	6.83 (4)	6.50 (6)	31.84 (8)	6	8
	10M Lysis-Digestion + Thermal Drying	7.14 (2)	7.05 (4)	6.88 (7)	7.19 (4)	7.02 (2)	35.28 (3)	4	3
	12M Digestion-Lysis-Digestion + Thermal Drying	7.39 (1)	7.48 (2)	6.76 (8)	7.89 (1)	7.57 (1)	37.10 (1)	1	1
	17M Mesophilic Anaerobic Digestion + Thermal Drying	6.94 (3)	6.56 (7)	6.42 (11)	7.08 (3)	6.78 (3)	33.78 (6)	3	4
	18M Thermal Drying	6.60 (9)	5.73 (13)	7.26 (4)	5.08 (12)	5.71 (14)	30.39 (11)	12	10
	19M Thermal Drying + Gasification	7.09 (4)	7.74 (1)	7.75 (2)	6.19 (9)	7.08 (4)	35.86 (2)	4	2
	23M Wet Air Oxidation	4.88 (15)	6.10 (10)	4.91 (15)	5.47 (10)	5.99 (10)	27.35 (14)	10	14
	25M Incineration	5.81 (13)	6.77 (5)	7.17 (5)	4.72 (14)	6.18 (11)	30.66 (10)	11	11
Carey's Gully Site	**7C Autothermal Anaerobic Digestion + Thermal Drying**	6.65 (10)	5.56 (14)	6.14 (12)	6.44 (8)	6.39 (9)	31.19 (9)	10	9
	8C Mesophilic Anaerobic Digestion + Composting	5.59 (12)	4.40 (16)	4.34 (16)	6.92 (2)	5.62 (12)	26.87 (15)	12	13
	12C Digestion-Lysis-Digestion + Thermal Drying	6.70 (7)	6.51 (6)	6.67 (9)	6.19 (7)	6.52 (7)	32.60 (7)	7	7
	17C Mesophilic Anaerobic Digestion + Thermal Drying	6.93 (6)	6.51 (9)	6.53 (10)	6.94 (6)	6.87 (5)	33.79 (5)	6	6
	18C Thermal Drying	6.20 (11)	5.29 (15)	7.16 (6)	4.19 (15)	5.25 (16)	28.10 (13)	15	15
	19C Thermal Drying + Gasification	6.84 (8)	7.47 (3)	7.90 (1)	5.36 (11)	6.72 (8)	34.29 (4)	8	5
	23C Wet Air Oxidation	4.83 (16)	5.90 (11)	5.02 (14)	5.11 (13)	5.89 (13)	26.75 (16)	13	16
	25C Incineration	5.64 (14)	6.57 (8)	7.38 (3)	4.00 (16)	5.89 (15)	29.48 (12)	14	12

The key finding of the MCA analysis was that, for the purposes of shortlisting options for further analysis, the same options were consistently ranked within the top four options.

These options are:

10M Lysis-Digestion + Thermal Drying, located at Moa Point.

12M Digestion-Lysis-Digestion + Thermal Drying, located at Moa Point.

17M Mesophilic Anaerobic Digestion + Thermal Drying, located at Moa Point.

19M Thermal Drying + Gasification, located at Moa Point.

These options are further assessed against the project investment objectives, as described below.

Short List Evaluation

Determining the Base Case

A Base Case is a fundamental requirement of any economic analysis and should provide a realistic interpretation of what costs, benefits and impacts would accrue if no investment was made. The determination of a Base Case is as important as the options to be tested.

The defining feature of this Base Case is that the current sludge management system cannot continue as the Southern Landfill consent expires in 2026 and space for ongoing disposal of sludge at Southern Landfill is very limited. Determining how sludge would be managed post 2026 is a critical activity in the context of this analysis.

A range of Base Case options were initially identified. During a technical workshop, in which experts from WCC and Wellington Water were present, these Base Case options were discussed to identify the most viable potential Base Case. Three options considered were:

- **Outfall** - sludge is discharged with treated effluent from Moa Point WWTP via the long sea outfall into Cook Straight. This would mean that the sludge would not require any further treatment. Note that this is an activity not currently permitted for which specific resource consents would need to be sought.
- **Transport** - undertake sludge dewatering of Moa Point WWTP sludge at the Carey's Gully Sludge Dewatering Facility, as at present. Additionally, continue to dewater sludge from Karori (Western) WWTP at its dedicated facility. The dewatered sludge from these two facilities would then be transported to a landfill facility other than Southern Landfill. It is understood that there are capacity and operational constraints on the other landfills in the Wellington Region, Spicers and Silverstream, which would prevent them from accepting Wellington's sludge in its current form and volume. Therefore, it is assumed that the dewatered sludge would be trucked to Bonny Glen landfill, a regional landfill facility located near Marton. Bonny Glen is the closest landfill that has sufficient capacity to be able to accommodate Wellington's sludge over the modelling period.
- **Landfill + Transport** - continue with current sludge dewatering operations at Carey's Gully and Karori (Western) WWTP and dispose of dewatered sludge to Southern Landfill for as long as feasible. At that point, transport dewatered sludge to the Bonny Glen landfill as described above.

An assessment framework was developed and applied to determine the preferred Base Case. The criteria in this framework were based on the investment objectives and two additional critical success factors, as follows:

Investment objectives

- By 2026, minimise the amount of sludge sent to the Southern Landfill
- Enhance the resilience of sludge management in Wellington
- Reduce the environmental impact of sludge management in Wellington
- Align practice of sludge management in Wellington to mana whenua values and principles.

Additional Success Factors:

- Reduce the likely long run financial costs of the Base Case. (Financial).
- Enhance the ability to support waste reduction policy objectives. (Waste).

For each option, each criterion was assessed to determine the degree to which it supports the objective according to a scale from not acceptable to excellent. In any event where one or more criteria is scored not acceptable for an option, the option was determined to be rejected from further consideration.

Table 9 provides a summary of the evaluation of the Base Case options against these criteria.

It is worth stressing that this Base Case option is not an agreed WCC or WWL position - rather it represents an alternative viable pathway once the Southern Landfill consent expires and is suitable for use in this economic assessment.

Table 9: Summary Evaluation of Base Case Options.

	Investment Objective Criteria				Additional Criteria	
	Reduce Operational Impact	**Long-term Sustainable Sludge Management**	**Environmental Impact and Consentability**	**Mana Whenua Values & Principles**	**Reduce Long Run Financial Costs**	**Waste Reduction Policy Objectives**
Option 1 Outfall	Excellent	Poor	Not acceptable	Not acceptable	Excellent	Excellent
Comment: the likelihood of getting consent for this activity, or iwi acceptance of it, is considered very low to impossible.						
Option 2 Truck to Bonny Glenn	Poor	Average	Average	Poor	Average	Poor
Option 3 Southern Landfill then Bonny Glenn	Poor	Average	Average	Poor	Excellent	Poor

Based on this evaluation, the Landfill + trucking Base Case option was determined as the most viable Base Case. It is assumed that under this Base Case, sludge will be managed under current operating practices until 2026 when the current consent expires.

A trucking solution (service contract) for the transport of dewatered sludge from Carey's Gully and Karori (Western) WWTP to a regional landfill facility (Bonny Glen) will then be pursued.

Step 5. Final MCA based on CSFs to identify the preferred treatment and location option

Critical success factors (CSFs) were identified for this project **to determine** which of the shortlisted options best delivers essential elements for project **success**.

A description of each of the CSFs is provided below. As described below, all criteria have been assigned a weighting based on an assessment of criteria importance undertaken by the project team. A score has then been applied for each option on a range of -2 (does not meet) to +2 (exceeds).

Achieving Strategic Fit

Weighting 20%

This criterion assesses each option against its fit with WCCs key strategies which relate to the project and were described in the Strategic Case section of this project. These include:

- The Wellington Region Waste Management and Minimisation Plan (WRMMP). The key consideration here is the degree to which each option supports the diversion of sludge from Southern Landfill, as this is identified as a key project in the WRWMMP, to enable the key goal of reducing waste to landfill from 600 to 400kg per person per year.
- The Te Atakura - First to Zero (carbon reduction) Strategy. Again, the key consideration here is the degree to which each option supports the diversion of sludge from Southern Landfill, recognising that meaningful carbon reduction from solid waste disposal cannot be achieved until sludge management is addressed.
- The Wellington Resilience Strategy. The key consideration here is the degree to which each option supports the following key requirements of the strategy, including:
  - Directly address the stress on existing infrastructure.
  - Reduce the city's financial exposure to carbon markets.
- Align Wellington's environmental aspirations with the way it operates "on the ground".

To arrive at a score for each option, the options were assessed on a traffic light scale as to whether they support each of these strategies:

- Does not support the strategy.
- Supports the strategy to some extent.
- Supports the strategy to some extent.

Refer to Appendix One to be added for an assessment of each option against these strategies according to the above criteria. Upon assessment as described, an overall score for this CSF was applied for each option, as follows:

Score	Assessment
-2 Does not Meet	Does not meet any of the requirements of the strategies as described.
-1 Somewhat Meets	Meets the requirements of one of the strategies as described, or partially supports two of the tstrategies.
0 Partially Meets	Meets the requirements of two of the strategies as described, or partially supports three of the strategies.
+1 Meets	Fully supports the three strategies as described.
+2 Exceeds	Fully supports the three strategies as described, with additional benefits.

Meeting Community and Business Needs

Weighting 20%

This CSF recognises the importance of sludge management to the community as described in supporting documentation for the current resource consent for sludge disposal to Southern Landfill. The Hearing Report for the consent points to two key considerations which have been assessed for this CSF:

- The ability of each option to reduce and minimise the quantity of residual wastes for disposal through reuse, recycling, and resource recovery, and to support the community to implement waste minimisation and "clean production" principles.
- The ability of each option to reduce odour impacts on Southern Landfill.

To arrive at a score for each option, the options were assessed on a traffic light scale as to whether they support each of these requirements:

- Does not support the requirement.
- Supports the requirement to some extent.
- Fully supports the requirement.

Refer to Appendix One for an assessment of each option against these requirements according to the above criteria. Upon assessment as described, an overall score for this CSF was applied for each option, as follows:

Score	Assessment
-2 Does not Meet	Does not meet any of the requirements of the requirements as described.
-1 Somewhat Meets	Partially meets one of the requirements as described.
0 Partially Meets	Meets one of the requirements as described, or partially supports both requirements.
+1 Meets	Fully supports both requirements as described.
+2 Exceeds	Fully supports both requirements as described, with additional benefits.

Value for Money

Weighting 15%

While a cost benefit analysis has been undertaken, many of the benefits of this project can only be defined qualitatively. Therefore, this CSF assesses qualitatively the degree to which each option meets each of the key benefits against the level of investment required, including:

- Material reduction in sludge volume achieved.
- Improving landfill management.
- Reducing exposure to external cost factors associated with sludge disposal.
- Opportunity to take leadership to create a circular economy.
- Removing constraints that sludge management might place on the wastewater system for Wellington.
- Creating an environmentally friendly sludge management system.

Note that this is not an exhaustive list of all benefits presented in the Strategic Case, because some of the benefits are addressed in other CSFs, so the list of benefits for this CSF has been truncated to avoid "double counting" of benefits when assessing each option.

Refer to Appendix One for an assessment of each option against the benefits noted above. Each option has been assigned a score according to the following:

Score	Assessment
-2 Does not Meet	Does not satisfy any of the benefits.
-1 Somewhat Meets	Satisfies at least two of the benefits, or partially satisfies at least three of the benefits.
0 Partially Meets	Fully satisfies three of the benefits, or partially satisfies at least four of the benefits.
+1 Meets	Fully satisfies at least four of the benefits and partially satisfies the others.
+2 Exceeds	Fully satisfies all of the benefits.

Achievability

Weighting 10%

This critical success factor assesses the ability of Wellington City Council and the supply chain to deliver a successful project. It considers supplier / workforce availability, the maturity of technology and ability to access technical support, and operational and technical complexity (as scored in the earlier MCA for the long list options).

The following table shows how each option has been scored against this CSF. Refer to Appendix One for the full assessment of each option against this criterion.

Score	Assessment
-2 Does not Meet	No available supplier / workforce for installation and O&M New technology with no material overseas technical support available Score of <3 for operational and technical complexity criteria from the previous MCA
-1 Somewhat Meets	Available overseas supplier workforce for installation support and O&M respectively Technology is established globally with limited installations (<20 known) and limited technical support available Score of ≥4 for operational and technical complexity criteria from the previous MCA
0 Partially Meets	Available overseas supplier workforce for installation support and O&M respectively Technology is established globally with enough installations to understand operational risk (more than 100 sites operating) and technical support available Score of ≥5 for operational and technical complexity criteria from the previous MCA
+1 Meets	Available Asia-Pacific supplier and workforce for installation support and O&M respectively Technology is established globally with enough installations to well understand operational risk (more than 200 sites operating) and technical support freely available Score of ≥7 for operational and technical complexity criteria from the previous MCA
+2 Exceeds	Available local supplier / workforce for installation and O&M Technology is well-established in NZ with local technical support available Score of ≥8 for operational and technical complexity criteria

Affordability

Weighting 15%

Funding the project must take into consideration both the immediate cash requirements to pay for the project, and the downstream cost imposed on WCC ratepayers. This qualitative assessment of affordability seeks to assess whether an option will fit neatly into the financial status quo, rather than to act as a veto at this stage.

The assessment of affordability therefore simply considers whether the initial assessments of the undiscounted cash cost of the project are broadly affordable within known financial structures. The smaller weighting allocated to affordability is to ensure absolute cost of an option has a bearing on the selection of a preferred option but is not the dominant selection criteria at this stage.

The following table shows how each option has been scored against this CSF. Refer to Appendix One for the full assessment of each option against this criterion.

Score		Assessment
-2	Does not Meet	Undiscounted net costs of the project are well beyond WCC's financial capacity
-1	Somewhat Meets	Undiscounted net costs of the project are within WCC's financial capacity but would impose a significant increase in rates for ratepayers
0	Partially Meets	Undiscounted net costs of the project are within WCC's financial capacity and the rates impact on ratepayers is acceptable
+1	Meets	Undiscounted net costs of the project are within WCC's financial capacity and does not impose a significant increase in rates on ratepayers
+2	Exceeds	Undiscounted net costs of the project are within WCC's financial capacity and results in a minimal increase in rates on ratepayers

As part of the 21-31 LTP the public was consulted on their preference for funding a sewage sludge project. The options provided during consultation were for WCC to debt fund the project or for WCC to pursue an alternative funding model call IFFA (covered in more detail in the Financial Case). The consultation estimated the IFFA model would result in a levy of $70-$100. This estimate was intended to represent the cost to the average household, however this was not explicit in the consultation. The funding model is not considered as part of this assessment of affordability, rather is covered in depth when considering how to best fund the eventual preferred option.

Mana whenua values

Weighting 15%

This CSF assesses the alignment of each option to the mana whenua values / principles established for this project. It is based on the assessment of mana whenua values undertaken at the earlier MCA for each option. The CSF assesses the degree to which each option aligns to:

- Traditional Māori values and methods of human waste management, and the principles of rahui in disposing of human waste and the issues of transferring human waste from one rohe to another,
- Ability to harness and use the resources available from the sludge to give them another life (such as energy utilisation from the sludge),
- Having a positive impact on the environment and our communities through the action we take (kaitiakitanga), and
- Understanding and mitigating the potential impacts on areas of settlement (marae, papakainga), use (food gathering areas), wāhi tapu, statutory acknowledgements, rohe boundaries and sites of significance.

The following table shows how each option has been scored against this CSF. Refer to Appendix One for the full assessment of each option against this criterion.

Score		Assessment
-2	Does not Meet	Does not align to any of the mana whenua values / principles relevant to this project
-1	Somewhat Meets	Aligns to one of the mana whenua values / principles, or partially supports two
0	Partially Meets	Aligns to two of the mana whenua values / principles relevant to this project, or partially supports all of them, and may be supported with some reservations from iwi
+1	Meets	Aligns to all of the mana whenua values / principles relevant to this project with only minor reservations from iwi that can be readily addressed
+2	Exceeds	Aligns to all of the mana whenua values / principles relevant to this project with only minor reservations from iwi that can be readily addressed

Assessment of Options Against the CSFs

Each of the options have been assessed qualitatively against the Critical Success Factor with supporting commentary to provide the basis of the scoring.

A summary of this evaluation is provided in the table below, and further information is provided in Appendix One.

Table 15: Qualitative Assessment of Shortlist Options Against the Critical Success Factors (CSFs).

Critical Success Factor	Weighting	Options				
		1	10M	12M	17M	19M
Strategic fit	20%	-2	2	2	2	2
Comment: The base case does not support any off WCC's related strategies or plans because it does not fundamentally contribute to a reduction in waste for Wellington and does not enhance resilience. This is because the option does not materially reduce the volume of, or nature of, the sludge, and still relies on the sludge transfer pipelines and provides only a singular pathway for sludge disposal. The Base Case would also increase carbon emissions associated with sludge management.						
Community / business needs	20%	-1	2	2	1	2
Comment: While it would remove sludge from Southern Landfill (thereby alleviating community concerns around odour), the Base Case would still result in the management of untreated sludge which is unlikely to be the community. It fundamentally does not lead to more responsible, environmentally friendly sludge management.						
Value for Money	15%	-2	2	2	1	1
Comment: Other than improving sludge management at Southern Landfill, the Base Case does not contribute to any of the key non-monetary benefits. Due to the process configuration and less potential for biogas utilisation, Options 4 and 5 do not reduce to the same extent (as options 2 and 3) WCC's exposure to cost factors outside of its control. Options 2 and 3 have an advantage as they maximised energy reuse potential.						
Achievability	10%	2	0	0	1	-1
Comment: All the options, other than the base case, require the use of internationally sourced technology in a complex process system. The difference in scores reflects the accessibility to expertise within NZ and internationally. Option 4 presents the most achievable delivery of the four investment options because all technology is utilised already in NZ.						
Affordability	15%	-1	0	0	0	0
Comment: All options result in a obvious increase in costs for the ratepayer. The base case does this through a higher operating cost imposition, whereas the investment options result in an immediate draw on the debt capacity of WCC but have a lower operating cost profile. The investment options provide WCC with the ability to spread the cost over a longer period of time, allowing for intergenerational cost allocation.						
Mana whenua values	20%	-2	2	2	2	1
Comment: Previous consultation with iwi identified that processes involving anaerobic digestion best mimic the natural process of human waste degradation in ground and therefore are most aligned to traditional values of waste management. They also represent significant opportunity for resource recovery. The Base Case presents significant issues in terms of mana whenua principles, most notably because untreated sludge would cross rohe boundaries.						
Total score	100%	-1.25	1.5	1.5	1.25	1.05
Rank		5th	1st	1st	3rd	4th

Step 6. Cost Benefit Analysis (CBA) of short list of options

This section describes the specific impacts that underpinned the CBA, and the quantification of all costs and benefits in monetary terms.

Information input

The inputs for the CBA include:

- An opex model which used engineering analyses to determine sludge flows, energy use and production, chemical use and the like. These form the basis on which cost rates for consumables are applied. The inputs and calculations from this model have been replicated in the CBA model with minor inflation adjustments to rebase prices to 2022.
- Estimated trucking costs to Bonny Glen, asset renewal costs and revised sludge disposal costs.
- Quantified biogas and resilience benefits.

Outputs of an ancillary carbon model were not included in the CBA - because all carbon costs are assumed to be internalised in the price of sludge management activities, for example, the price of petrol and diesel already includes carbon externalities (as determined by ETS guidelines). However, carbon volumes associated with each option were noted in the CBA.

CBA Assumptions

The following core assumptions formed the basis of CBA.

Table 10: CBA Assumptions

Item	Description
Sludge growth	Sludge will grow at a constant rate that is derived from population growth in the Wellington region. Specific sludge volumes used in the analysis are provided in Appendix One.
Timeframes	The modelling period is 50 years. FY 2023 –FY 2073.
Cost escalation	Cost escalation is not included in the CBA as per Treasury guidance. All prices are real, NZD (2022).
Discount rate	Default government infrastructure discount rate of 5% applies.

Option Descriptions

The options assessed in CBA included the shortlisted options from the initial MCA and the Base Case, as follows:

Option 1 - Base Case

Under the Base Case, sludge will be treated at Moa Point then piped to the Southern Landfill where it is dewatered (≈20-25% solid) and disposed, as is the current approach. This will take place until 2026, when the current Southern Landfill consent expires. After this point, a trucking solution (service contract) will be sought to transport dewatered sludge from the Southern Landfill to a regional facility, Bonny Glen. Bonny Glen has sufficient capacity to be able to accommodate Wellington's sludge over the modelling period.

Option 10M - Lysis-Digestion and Thermal Drying

In this option Moa Point sludge is thickened and mixed with Karori sludge. The blend is fed to a Thermal Hydrolysis followed by anaerobic digestion. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. During the process Biogas can be used to satisfy the heat requirements of the hydrolysis process and/or the dryer.

Option 12M - Digestion-Lysis-Digestion and Thermal Drying

In this option Moa Point sludge is thickened and Karori sludge is mixed in. The Moa Point sludge and the blend is fed to a process consisting of two anaerobic digestion steps with thermal hydrolysis in-between. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. Biogas can be used to satisfy the heat requirements of the hydrolysis process and/or the dryer.

Option 17M - Mesophilic Anaerobic Digestion and Thermal Drying

In this option Moa Point sludge is thickened and Karori sludge is mixed in. The blend is fed to an anaerobic digestion step. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. Biogas can be used to satisfy the heat requirements of the dryer.

Option 19M - Thermal Drying and Gasification

Thermal Drying + Gasification, located at Moa Point.

For the purposes of communication, Options 10M, 12M, 17M and 19M herewith will be collectively referred to as the investment options.

Cost and Benefits Assumptions
Thirteen cost categories were identified, all of which have been included in the CBA. In many instances there were a wide range of sub-categories under these costs impacts, but, for communication purposes, presentation has been retained at a cost category level.

All options (the Base Case and all investment options) share a common pathway until 2026. That is, the current way in which sludge is managed will continue until 2026. Post 2026, cost and benefit pathways then differ for each option.

A description of all economic costs, for the Base Case and investment options, are presented in the table below. For the purposes of communication, Table xx below only refers to costs incurred for each option post 2026. A detailed description of assumptions used in this analysis refer to Appendix XX to be added.

Table 11: Economic cost categories (Post 2026)

Cost Category	High-level description	Options				
		1	10M	12M	17M	19M
Operating costs						
Chemical costs	The cost of chemicals used in the sludge treatment process. The chemicals used in each option vary due to the different sludge treatment processes implemented.	✓	✓	✓	✓	✓
Power Costs - Plant	The cost of power consumption at the dewatering plant, digestion plant, and thermal drying unit(s).	✓	✓	✓	✓	✓
Power Costs - Pipeline	The cost of power consumption used for operating the Moa Point - Careys Gully pipeline. For all investment options the pipeline is decommissioned in 2026 as treated sludge volumes cannot be pumped through the pipeline.	✓	✗	✗	✗	✗
Labour Cost	The cost of labour assumed to manage the plant, equipment and transfer pump stations.	✓	✓	✓	✓	✓
Maintenance Cost - Moa Point	Maintenance costs of capital assets at Moa Point. • For the Base Case this is for existing assets at Moa Point. • For the investment options this covers maintenance costs associated with new plant and facilities at Moa Point.	✓	✓	✓	✓	✓
Maintenance Cost - Pipeline	Maintenance costs of the Moa Point to Careys Gully pipeline. For all investment options the pipeline is decommissioned in 2026 as noted above.	✓	✗	✗	✗	✗
Fuel Cost	A modest amount of fuel consumption is used in the gasification option.	✗	✗	✗	✗	✓

Sludge Transport Costs (within region)	The cost of transporting: • 'Wet' sludge from the Western Treatment Plant (Karori) to Moa Point. • The transport of dry sludge to the Southern Landfill. • Treated sludge is also directly transported from Karori to the Southern Landfill.	✓	✓	✓	✓	✓
Sludge Disposal Cost	The cost of disposing of sludge at the Southern Landfill.	✓	✓	✓	✓	✓
Asset Renewal Costs	In the Base Case, the following assets are subject to asset renewals: • Moa Point • Moa Point to Careys Gully pipeline • The dewatering plant at Southern Landfill No asset renewals are considered in the investment options as the design life is the same as the modelling period.	✓	✗	✗	✗	✗
Additional Trucking Cost	In the Base Case, post 2026, treated sludge is assumed to be transported from the Southern Landfill to Bonny Glen via a trucking solution (services contract).	✓	✗	✗	✗	✗
Alternative Disposal Fees	In the Base Case, post 2026, treated sludge is assumed to be disposed of at Bonny Glen.	✓	✗	✗	✗	✗
Decommissioning Costs	The costs of decommissioning the pipeline and dewatering plant.	✗	✓	✓	✓	✓
Capital Costs						
Capex	The capital cost of each options is included for all investment options. This is inclusive of land acquisition costs and WWL management fee (5%).	✗	✓	✓	✓	✓

Benefit Impacts and Assumptions
Different 'service levels' associated with sludge management was not tested as part of this analysis. Therefore, the benefits of efficient and effective sludge management were not identified for the Base Case or any of the investment options, for example, the reduced health risks from having an effective wastewater/sludge management system (as part of BAU) was not monetized. However, two major benefit categories for the investment options were identified and included in the CBA model.

The economic benefits for the Base Case and investment options are presented in the table below.

Table 12: Economic benefit categories (Post 2026)

Benefit Category	High-level description of impacts and assumptions	Options				
		1	10M	12M	17M	19M
Biogas	Biogas is produced as a biproduct of the sludge treatment process for all investment options. Biogas can be used for industrial processes onsite, can be used to generate electricity that can be used onsite, or can be used to generate electricity that can be fed back into the grid (or to neighbouring users).	✗	✓	✓	✓	✓
Resilience	The discontinuation of the pipeline from Moa Point to the Southern Landfill provides resilience benefits. These benefits arise from the elimination of the risk of pipeline outage and the resulting costs of repairing the pipe, environmental remediation, and trucking of wet sludge to landfill for disposal.	✗	✓	✓	✓	✓

CBA Findings
A summary of the quantified CBA findings has been provided in Table 13 and Table 14.

An analysis of the undiscounted costs and benefits provide an indication of the magnitude of actual costs over the life of the asset.

Table 13: Undiscounted costs and benefits

Undiscounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	19.0	18.3	19.0	21.9	4.1
Power Costs - Dewatering / Digestion plant	11.1	10.9	5.8	39.5	15.5
Power Costs - Pipeline	4.7	0.3	0.3	0.3	0.3
Labour Costs	5.4	15.2	15.2	10.3	15.2
Maintenance Cost - Moa Point	2.9	160.8	168.8	181.3	173.6
Maintenance Cost - Pipeline	15.5	1.2	1.2	1.2	1.2
Fuel Costs	-	-	-	-	0.1
Sludge Transport Costs	78.9	33.1	31.9	33.4	33.4
Sludge Disposal Fees (southern landfill)	18.8	46.6	40.8	48.4	48.4
Asset Renewal Costs	82.0	-	-	-	-
Additional Trucking Cost (Bony Glen)	182.6	-	-	-	-
Alternative Disposal Fees (Bony Glen)	194.4	-	-	-	-
Decommissioning costs	-	1.0	1.0	1.0	1.0
Total Operating Costs	615.3	287.5	284.1	337.3	292.8
Capital costs	0	186.5	208.1	210.6	201.8
Total Costs - Undiscounted	615.3	474.0	492.2	547.8	494.6
Benefits	0	72.4	78.9	76.9	36.8
Net Costs - Undiscounted	615.3	401.8	413.3	471.0	457.8
Ranking	5th	1st	2nd	4th	3rd

An analysis of the discounted costs and benefits provide the ability to compare options in todays dollars on a like for like basis. The discounted CBA provides the net present cost of the option.

Table 14: Discounted costs and benefits

Discounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	6.6	6.5	6.6	7.5	2.1
Power Costs - Dewatering / Digestion plant	3.9	3.8	2.2	12.6	5.2
Power Costs - Pipeline	1.6	0.3	0.3	0.3	0.3
Labour Costs	2.0	5.1	5.1	3.5	5.1
Maintenance Cost - Moa Point	1.1	51.6	54.1	58.1	55.7
Maintenance Cost - Pipeline	5.7	1.1	1.1	1.1	1.1
Fuel Costs	-	-	-	-	0.0
Sludge Transport Costs	27.5	13.4	13.0	13.5	13.5
Sludge Disposal Fees (southern landfill)	16.6	25.2	23.4	25.7	25.7
Asset Renewal Costs	39.3	-	-	-	-
Additional Trucking Cost (Bony Glen)	56.1	-	-	-	-
Alternative Disposal Fees (Bony Glen)	59.7	-	-	-	-
Decommissioning costs	-	0.8	0.8	0.8	0.8
Total Operating Costs	220.1	107.7	106.7	123.2	109.5
Capital costs	0	162.1	180.8	183.0	175.4
Total Costs - Discounted	220.1	269.8	287.5	306.2	284.9
Benefits	0	22.7	24.7	24.1	11.8
Net Costs - Discounted	220.1	247.1	262.8	282.1	273.1
Ranking	1st	2nd	3rd	5th	4th

Analysis Summary

Economic Analysis Summary	Options				
	1	10M	12M	17M	19M
Discounted Costs and Benefits	1st	2nd	3rd	5th	4th
Critical Success Factor	5th	1st	1st	3rd	4th
Rank	3rd	1st	2nd	4th	4th

Preferred option selection

The economic analysis, indicates that the base case will provide the best economic outcome, followed by options 10M and 12M. The relative difference in the economic outcomes between the base case and option 10M is only $43m, and between 10M and 12M is only $15.7m.

The Critical Success Factor analysis indicates that options 10M and 12M best meet the investment objectives as well as a range of other factors with the base case performing very poorly - it is the only option to deliver a negative weighted average outcome. The reason for this is that the base case will not deliver against the required strategic and community outcomes, and is the only option that fails to meet Mana Whenua values.

The analysis concludes that there isn't much difference between options 10M and 12M. Option 12M has been adopted in larger municipalities, but there are far fewer examples of it in the world compared to plant that are similar to option 10M. Additionally, option 12M increases the engineering complexity due to the required configuration on what is already a tight site and given it is not commonly used globally, it would be harder for WCC to access the technical expertise to design and operate the plant.

On balance, given these key differences between the two leading options, the preferred option is option 10M, Lysis-Digestion and Thermal Drying Sludge Minimisation FacilityOn balance, given these key differences between the two leading options, the preferred option is option 10M, Lysis-Digestion and Thermal Drying Sludge Minimisation Facility.

Commercial case

Preparing for the potential deal

The SMF project is progressing through the preliminary design phase which has contributed significantly to the identification of the preferred option. This commercial case summarises the procurements strategy and processes the SMF project is following and how it will build towards an appropriate construction and delivery contract.

Project Characteristics

This project will see the implementation of a significant piece of critical infrastructure in Wellington, involving the integration of complex, internationally sourced technology into a responsive process system. The proposed site is neighboured by critical operations including but not limited to Wellington International Airport, the Moa Point Wastewater Treatment Plant and medical supply facilities. It requires unique construction techniques to sequence and manage the works within these constraints and the relatively small site. These and other constraints have a significant bearing on the procurement strategy.

To support the development of a delivery model for this project, an assessment of project characteristics has been undertaken against Appendix B of the NZ Transport Agency's (NZTA's) Procurement Manual for Activities Funded Through the National Land Transport Package (Version 5, October 2019). This is a generally accepted model which sets out specific criteria for selection of delivery models in large infrastructure projects.

A summary of these characteristics is provided in Table 16.

Table 16: Summary of Key Characteristics / Criteria for Development of a Delivery Model for the Wellington Sludge Minimisation Project.

Characteristic	Description	Implication for Procurement
Complexity and uncertainty	The project has very high structural complexity, measured by the number of varied components and the interdependence of these components. There is a strong relationship between the particular vendor plant used and the size and configuration of the buildings and tanks. This creates a high degree of potential variability in size and configuration of the plant and structures depending on which specific technology is selected. Furthermore, there are a significant number of interfaces between different vendor packages, and poor interface management may have a bearing on performance of the plant, and/or voidance of any performance guarantees offered. The project has very high technical complexity, measured as the extent to which untested or new technical issues need to be addressed in delivering that activity.	A high degree of interaction between the designer(s), plant vendor(s) and construction contractor(s), is needed to manage the high degree of potential change and new technical issues to resolve as the project progresses and understand the knock-on impacts through high levels of collaboration.
Scale	In terms of the type of suppliers or group of suppliers needed to deliver the project, the scale of this project is deemed large.	The scale and technical risk of the project lends itself to large, reputable international vendors who have the capability to manage multiple plant items under a single vendor supply package. The scale of the project lends itself to "Tier 1" construction contractors.
Timing and urgency	Target completion is Quarter 1 2026, in order to stop the discharge of unstabilised dewatered sludge in June 2026. Missing this target would have significant knock-on impacts in terms of cost and reputation for WCC.	Meeting this target date will require efficient decision making, which requires a high level of collaboration between all parties delivering the project. An innovative delivery approach requiring parallel streams of work will be required to de-risk adherence to programme.
Innovation potential	The original Project brief called for: • The application of international expertise in sludge processing technology. • Minimisation of whole of life cost. • Furthermore, the proposed site has very tight space constraints and complex interfaces between construction works and with neighbouring activities. • On that basis, there is strong scope for innovation to enhance value.	Given that these innovations may have a strong influence on the design, innovation input from vendors and construction contractors would be required early (in the design process).

Part 1. Key Procurement-Related Project Risks

A Project Risk Register has been developed for the project during the Concept stage and is being updated at major project milestones, including most recently at the commencement of the preliminary design, and consenting process. The project risks are actively monitored and managed through the project Risk Register (part of the project Control Book), where greater detail on the risks, impacts, and mitigations is documented.

This section describes the key risks identified from the Project Risk Register that relate directly to or are managed through the way that goods and services for the project are procured. These key risks have been grouped into broad categories, as described below, together with commentary on how these risks could be managed through the procurement process, as context for subsequent sections of this procurement strategy.

Resource and Supply Chain Risks

Summary of Resource and Supply Chain Risks

The following table summarises the key resource risks that have been identified in the Project Risk Register and how they impact the procurement strategy.

Table 1: Summary of Key Resource and Supply Chain Risks.

Key Risk	Allocated Risk Score	How Procurement may Impact / Address this Risk
Description: global supply chain disruption (due to COVID, war, geopolitical issues) continues through the project construction phase. Consequence: delays to the construction programme with knock on increases in cost, and or significant disruption leading to force majeure event.	Medium	Market sounding has identified that the greatest challenge in securing resourcing comes from uncertainty in project timeframes and committal of clients / principals to construction projects. This lends itself to delivery approaches that allow key suppliers, especially the head contractor, to be engaged early.
Description: Design, constrcution and operational resource constraints caused by very buoyant infrastructure sector. Consequence: Increase in costs and/or programme delays.	Medium	Early definition of resourcing requirements for project delivery, early procurement of same, and, recruitment of a dedicated “operational readiness lead” person to adequately plan for transition to operations and long term requirements thereafter.

Regional Construction Market Buoyancy

At a regional level, the Wellington and Lower North Island construction market remains relatively buoyant with a number of large projects currently being constructed or to be constructed, some of which may overlap with the construction timeframes for the Sludge Minimisation Facility.

Overall, the market is expected to remain buoyant over the construction timeframe proposed for this project. It is important this is recognised in the selection of the delivery model, noting different levels of appetite for taking risk and committing to expensive procurement processes as a result.

there is a strong presence in the Wellington market from a range of Tier 1 contractors noting these are mainly civil projects. The larger projects are typically led by personnel outside of the region, with support from their local resources, indicating that if the interest is there, suppliers will be agile with their resourcing pool.

Estimated Exposure for WCC

Estimates of cost escalation relating to the current extraordinary market conditions were provided by independent cost estimators (BondCM and Alta Consultants) in June 2021. These indicate that, in the year since the last project cost estimate was prepared, escalation of between 10% and 13% could be expected. If these escalation levels were to continue through the duration of the project, escalation costs in the order of $60 million to $80 million above the current project estimate could be expected.

Potential Mitigation Strategies

Market sounding was undertaken by WCC in November / December 2021 to seek the views of potential head contractors, including in relation to current resource constraints. The feedback suggests that supply chain and resource risks are best managed when the following approaches are applied:

Securing a construction contractor early (such as, through an Early Contractor Involvement process) so that they are more readily able to understand and adequately plan for the types of resources required.

Provide certainty of construction start date and timing. The construction sector has experienced significant challenges where a lack of certainty exists in the actual construction start date, which has knock-on impacts for resource profiling. Certainty is created by:

Indicating early commitment to suppliers. This means that, where early contractor involvement / engagement models are used, limiting the number of “off-ramps” upon which the contractor would not be taken forward to deliver the construction; and

Having the contractor contribute to the staging and planning of the works at an early stage.

Creating market attractiveness. The buoyant market means that client / principal organisations must ensure that projects do not present extraordinary or unfamiliar risks, which would otherwise cause suppliers to not pursue the project when considering the array of opportunity available in the marketplace. This is exacerbated by the amount of sole source work available to contractors and the way they allocate resource to pursue and deliver competitively tendered projects. Furthermore, collaborative delivery models are favoured.

Condensing the procurement timeframe. This will provide greater certainty to the construction contractor market and in doing so will commit the resources to bid and then support delivery of the project.

In summary, this procurement strategy considers how key suppliers can be attracted to and then engaged early in the project. The use of collaborative delivery models supports this.

Process Performance Risks

Summary of Process Performance Risks

The following table summarises the key resource risks and how they impact the procurement strategy.

Table 2: Summary of Key Process Performance Risks.

Key Risk	Allocated Risk Score	How Procurement may Impact / Address this Risk
DIscription: The preferred option involves a complex process facility that, while is common internationally, will be the first of its kind in New Zealand. There is a risk that the operator does not have sufficient skill or experneice to maintain long term process performance or reliability. Consequence: long term cost expectations are exceeded.	High	Engage an operational resources in the proejct team that has expereince in commissioning and operating THP and TD facilities. Maintain clear line of sight to the operator through water reform and ensure they have input into the project (both design and construction). Ensure process engineering and facility commissioning knowledge is transfered to operations and relevant experts maintain are accessible by the operator as far a possible.
Description: Lack of coordination between supplier design and balance of plant. Consequence: Re-work, additional cost to rectify, delays.	Medium	This may impact the role that the designer plays in managing design inputs. Furthermore, some collaborative delivery models (such as ECI or alliancing) allow for much stronger design co-ordination.
Description: Plant and equipment procurement - poor specification of principal's requirements and/or lack of robust track record evaluation of overseas plant equipment suppliers' lead. Consequence: Higher operational costs.	Medium	Consideration needs to be given to the experience of the design team, in particular the process engineering and specification capability of the team. This will require the experience of international process designers.
Description: This project presents risks that are unfamiliar or complex (such as risk of holding process guarantees / warranties of third-party plant suppliers) Consequence: Lack of interest in tendering for the project, which leads to lower competitiveness and/or higher prices	High	Market sounding to has identified that there is no appetite to assume some process risks, even in EPC type models. The findings of the market sounding should be considered in setting the procurement strategy, especially in relation to this issue.
Description: There is a potential that the sludge may not be able to processed as expected due to its unique characteristics. Consequence: Plant is unable to achieve the benefits, and/or expensive plant modifications are required.	High	Careful consideration needs to be given to who owns this risk and how due diligence is undertaken to confirm the risk.

market sounding undertaken by WCC has indicated that process risk, through design or technology supply, can only be assumed by the head contractor on a limited basis, would reduce attractiveness to tender and will add significant cost. The implications of this are considered in the following sub-section.

Potential Mitigation Strategies

Based on market feedback to date, it is very unlikely that a contractor can be procured to assume all the risk associated with technology and whole system process performance in the current buoyant market conditions. However, as described above, this can be tested during the RFP process so we can be fully informed of this assumed risk.

A considered approach will be needed to address the risks. The following table summarises a range of potential options to manage each of the process risks noted above.

Table 3: Proposed Mitigation Strategies for Key Process Performance Risks.

Key Process Risk	Potential Consequences	Mitigation Strategies
A unit process (plant package) does not perform as required because of faulty plant or poor supplier specification (supplier fault).	Extended commissioning and operations training period (low to moderate) Unit process requires replacement (moderate to high)	Identify specific plant packages that can be procured by the head contractor. Process guarantees to be provided by suppliers for all proprietary plant packages based on an envelope of operating conditions. Use of staged commissioning process to test unit processes and limit knock-on impacts of any under-performance, with appropriate liquidated damages to cover knock-on delays.
A unit process (plant package) does not perform because of poor specification, or because operating conditions are not met.	Extended commissioning and operations training period (low to moderate). Unit process requires replacement (moderate to high).	Use of suitably experienced international process experts who have knowledge of supplier capability to undertake specification. Specification based on wide operating envelope and minimum tolerances to allow for a range of operating conditions. Peer review of unit process specifications.
Process does not perform due to out-of-specification feedstock.	Extended commissioning / tuning and operations training period (low to moderate). Plant upgrades (moderate to extreme).	Use of actual plant data and cross-checks to confirm sludge characteristics and flows. Use of suitably experienced international process experts to undertake analysis and define a wide envelope of operating conditions. Peer review of process basis of design.
Process does not respond to changes in operating conditions.	Extended commissioning / tuning and operations training period (low to moderate).	Design of control systems by head contractor.

The potential to transfer at least some process risk to the head contractor will to some degree depend on their understanding of the risks through familiarisation with the project. This is best achieved through early contractor engagement / involvement models where risks can be openly discussed. Furthermore, early contractor involvement will facilitate WCC's understanding of the cost implications of novation of design and process risk where possible, and/or appropriate contingency allowances where these risks are owned by WCC.

Other Technical and Constructability Risks
The following table summarises the key technical and constructability risks (other than process risks, which have been described separately) and how they impact the procurement strategy.

Table 4: Summary of Other Technical and Constructability Risks.

Key Risk	Allocated Risk Score	How Procurement may Impact / Address this Risk
Description: The Cyclotek facility, which is a nationally significant medical manufacturing and supplier operation, cannot be disrupted. Consequence: Need to protect and prevent disruption to Cyclotek operations requires additional construction controls with increased / unexpected cost implications.	Medium	This risk is best managed by incorporating constructability methodology / considerations into the design process by the use of early contractor involvement / engagement.
Description: There are a significant number of interfaces between technology providers, the design and the construction activities. Consequence: This creates a risk of gaps or overlaps in scope that impact programme and cost if not identified early.	Medium	Consider the early selection of key / complex technology suppliers so that the scope limits of their supply are well understood. Consider assigning management of supplier technology providers to a single party. Consider how design interfaces can be limited through scope for designer.
Description: The construction site is adjacent to an operating airport and WWTP, requiring careful interface management. Consequence: this may increase cost of construction and has potential to cause delays.	Medium	This risk is best managed by incorporating constructability methodology / considerations into the design process by the use of early contractor involvement / engagement.
Description: Very limited land available and tight site constraints. Consequence: Material laydown areas located remotely from the site leading to increased costs.	High	This risk is best managed by incorporating constructability methodology / considerations into the design process by the use of early contractor involvement / engagement.

The following table summarises the key operational risks and how they impact the procurement strategy.

Table 5: Summary of Operational Risks.

Key Risk	Allocated Risk Score	How Procurement may Impact / Address this Risk
Description: Inadequate operations handover and instruction, due to lack of investment in training and handover process; programme pressures, and/or the wrong party undertakes this. Consequence: Poor quality outcomes in early days of SMF operation (additional odour, out of spec biosolids, etc).	Medium	Need to consider contract structure and how operations team will be involved through the design, construction and commissioning phases.
Description: There is a threat of disruptions to operations due to poor commissioning and changeover from old to new sludge systems. Consequence: loss of sludge treatment service.	Medium	Need to consider how the operations team will be selected and will support the design and construction process. There is a need to undertake detailed commissioning planning, with appropriate contingency plans. Understanding the ownership of this risk, and the resources required, is critical.

The following table summarises the key procurement process risks and how they impact the procurement strategy.

Table 6: Summary of Procurement Process Risks.

Key Risk	Allocated Risk Score	How Procurement may Impact / Address this Risk
Description: Market and public perception of directly appointing suppliers. Cause: The THP supplier and a lead designer may be appointed without contestability. Consequence: Reputational risk.	Medium	The procurement strategy and plan for these suppliers must set out a compelling, robust case for not requiring competitive processes.
Description: Failure to understand the market will result in an inability to run a competitive procurement process. Cause: Lack of market understanding or market input into development of procurement strategy / plans. Consequence: Increases the risk of sub optimal pricing, low quality resource, and extended project timelines.	High	Market sounding needs to be undertaken and the findings of this need to be incorporated into the procurement strategy.

Summary
The following table summarises the key risks identified in this section and the proposed response to these risks through the way that suppliers are procured and managed. These have influenced the selection of the delivery model and procurement methodology in Parts 2 and 3 of this Procurement Strategy respectively.

Table 7: Summary of the Proposed Response to Key Risks Identified for the Project

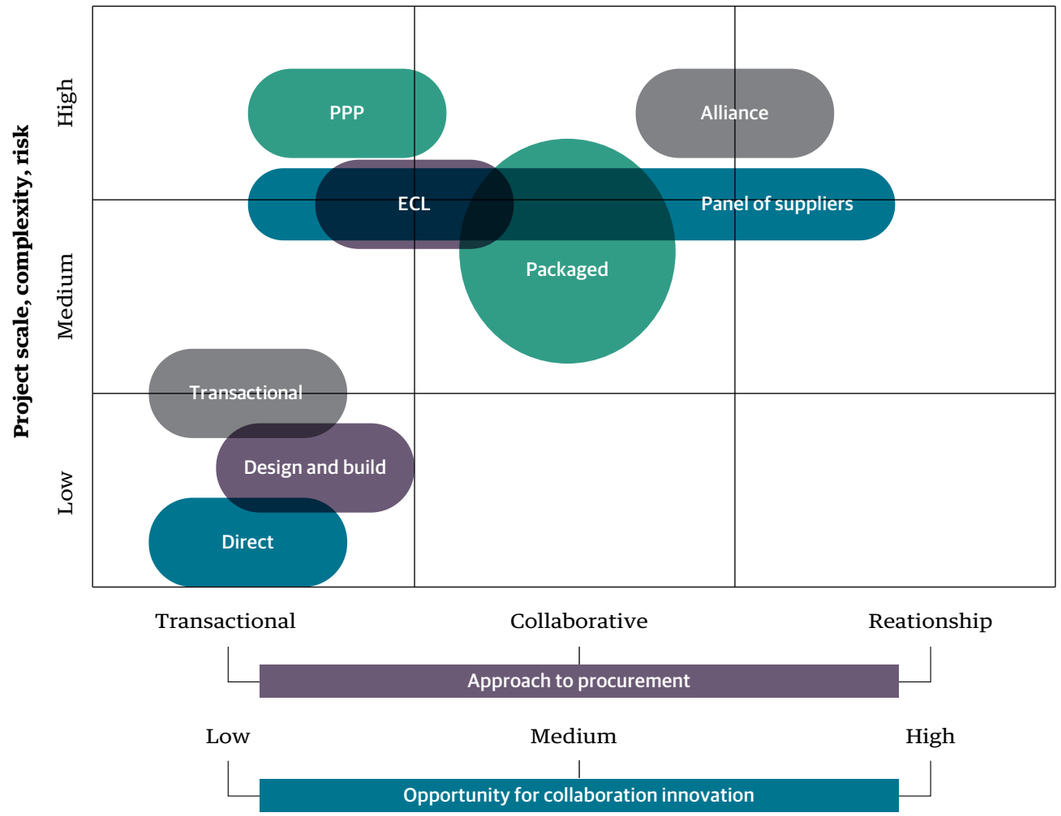
Key risk area	Our proposed response
Resource and supply chain constraints	• Secure a head contractor early through Early Contractor Involvement to adequately plan for the resources required. • Provide certainty of construction start date and timing. • Create market attractiveness by using a collaborative delivery model. • Condense the procurement timeframe to provide greater certainty and more time to mobilise.
Process performance risks	• Market test the ability for the head contractor to assume process performance risk through the RFP. • Identify specific plant packages that can be procured by the head contractor. • Use of suitably experienced international process experts who have knowledge of supplier capability to undertake specification. • Carefully specify performance guarantees based on a wide envelope of operating conditions. • Use of staged commissioning process to test unit processes and limit knock-on impacts of any under-performance, with appropriate liquidated damages to cover knock-on delays. • Peer review of process basis of design. • Design of control systems by head contractor.
Other technical and construability risks	• Procurement options which enable early collaboration between the head contractor and designer will support the appropriate management and allocation of technical risks.
Operational risks	• Clear delineation of responsibilities for commissioning. • Use of a heavily planned, structured, and staged commissioning process. • Onboarding of operational specialists early to support the design / construction proces.
Procurement process risks	• Use of a collaborative delivery model which enables early engagement of key suppliers. This will enable key suppliers to properly comprehend and respond to the risk profile of the project.

Part 2. Selecting a Delivery Model

An assessment of delivery models has been undertaken in reference to the Ministry of Business, Innovation & Employment's (MBIE's) construction procurement strategy guidelines.[1]

The following diagram summarises the selection of an appropriate delivery model based on consideration of scale, complexity, and risk, against the opportunity for collaboration and innovation through project delivery. The feedback provided by suppliers through market sounding, and the earlier identified risks, suggests that:

- The project is of a medium-to large-scale, complexity, and risk profile. The project involves the implementation of a range of internationally sourced technologies within a tightly constrained site, and around critical operations that cannot be interrupted.
- The management of risk as previously noted necessitates a collaborative procurement approach. However, there is limited potential for significant innovation because the process and site have already been selected and deviating from these fundamentals would significantly impact the consenting and design programme.



1 Ministry of Business, Innovation & Employment, 2019: Developing your Construction Procurement Strategy

As shown above, the delivery models that might be appropriate are:

Public Private Partnerships, this is not considered at all appropriate for this project so has been removed from further consideration. The performance of significant high-profile projects delivered by a PPP, such as Transmission Gully, are currently under intense scrutiny and are not well favoured by central government or funders as a preferred model in the current environment.

Four possible project delivery models were identified for this project based on scale, complexity, risk and level of collaboration required. These were:

- Alliancing.
- Panel of suppliers.
- Packaged based delivery model.
- Early Contractor Involvement.

Of these, the packaged delivery model and alliancing model are not considered appropriate as they do not align to the requirements of the funding mechanism sought for this project. Furthermore, a panel of suppliers is not appropriate for a single project delivery.

On this basis, the recommended model is Early Contractor Involvement, which brings significant benefits to manage the risk profile and achieve the level of cost certainty required to secure funding.

Part 3. Procurement Methodology

- For each Procurement package a Procurement Plan will be prepared and submitted for approval before any RFx documents are released or direct negotiations undertaken. Each procurement plan will outline the procurement process applicable to each procurement activity and will be aligned to this procurement strategy.
- The Procurement Plans will provide specific details associated with each Procurement package which will include the relevant timelines, evaluation methodology, criteria and panel in the format prescribed by WCC.
- Procurement Plans will also detail the consideration of Broader Outcomes as they relate to each procurement activity and how this will be evaluated in responses.
- Evaluation of tenders received for any RFxwill typically be using weighted attributes of pricing information, relevant experience, track record and skills aligning to the specific requirements of this project and its complexity, and broader (social procurement) outcomes.

Procurement Approaches for Design Services
A contract is currently in place with Beca who have delivered the conceptual design and are currently progressing the Preliminary design.

Moving forward from this competitive tenders will be obtained to select a Designer for the Early Contractor Involvment (ECI) phase with an option for negotiated award of the balance of design services (with independent assurance of cost and time). Options for Contractor provided design (including novation of the Designer from the ECI phase) will also be maintained. A decision on these options will be reccommended to the SRO for approval before the end of the ECI Phase.

Table 8: Summary of Advantages and Disadvantages for Designer Procurement Options

Approach	Advantages	Disadvantages
1. Novation	Retention of project Intellectual Property is ensured, and secures earlier the project design resource required. More readily enables continued progress on consenting and other aspects of the project development. Simplified probity arrangements for the ECI procurement process.	Requires exemption to normal procurement restrictions for a contract extension given the scale. Arranged marriage type process could create some cultural or positioning issues. Process could be challenged by the wider market. Not attractive to head contractors - as confirmed through market sounding, corporate limits of liability Prevent or make novation very difficult and costly. Even under EPC models, contractors have indicated that they would carve out novation risk to remain with WCC.
2. Contractor selection of designer	Potential for fresh thinking / new ideas from competitive process. Earlier team formation and better organisational cultural alignment likely. Provides open market opportunity for designers to compete for a large project.	Unknown range of suitable designers available in the market could distort the competition. Potential loss of time associated with learning curve associated with a new designer. Requires careful levelling of the playing field for incumbent advantage in procurement.
3. Partial design by incumbent	Wider range of suitable designers available in the market for this scope. Potential for fresh thinking / new ideas from competitive process on C&S scope. Earlier team formation and better organisational cultural alignment likely. Provides open market opportunity for designers to compete for a large project.	Risk allocation and considerable design interfaces present risk and will need to be well defined and managed. Can create conflicts and duplication of effort. Although less than the full design scope option, there remains a potential loss of time associated with learning curve associated with a new designer. Requires careful levelling of the playing field for incumbent advantage in procurement.
4. Direct engagement of incumbent for all design	WCC retain control / oversight of design and decisions that might otherwise significantly impact future operational cost. WCC maintain direct communication with design team. Designer is directly accountable to WCC for delay, defects and potential operating shortfalls etc.	Creates factual questions of whether designer or constructor is liable for delays, defects etc. WCC required to resolve disputes between designer and constructor. Requires WCC to procure “in house” design / technical expertise to support design decision making and risk management.

Procurement of a Contractor
Competitive tenders will be obtained to select a preferred tenderer to participate in ECI phase and to ascertain the suitability of the preferred tenderer accept design novation, process risk, and other delivery risks that may reasonably be allocated during the ECI phase. A negotiated award of a works contract is then expected with independent assurance of cost and time.

The preferred tenderer will participate in an ECI process alongside the Principal's designer and a third party (independent) cost manager for the ECI phase.

Procurement of Equipment Packages
The new Sludge Minimisation Facility includes over 75 identifiable plant and equipment "packages". In terms of procurement needs, these can be divided into three key classifications or tiers, as follows:

Table 9: Classification of Plant and Equipment for the Wellington Sludge Minimisation Facility.

Type	Examples	Degree of Influence Over Process Design	Degree of Influence Over Functional (Physical) Design	Level of specification	Supply Chain Complexity	Level of Testing and Commissioning Support Required	Performance Requirements Sought	After-market Support
Tier 1	Thermal Hydrolysis Plant (THP) Thermal Dryer	High to very high - the process design cannot be frozen until preferred supplier selections are made. High level of interaction required between designer and supplier.	High to very high - the functional design cannot be frozen until preferred supplier selections are made. High level of interaction required between designer and supplier.	Very high - requires detailed performance specifications and high degree of response from suppliers to arrive at selection.	High - plant is dependent on a long supply chain with generally specialist parts. Creates a higher degree of potential disruption to project through disruption to fabrication supply chain.	High - supplier representatives usually present to manage / lead the testing and commissioning process.	High to very high - multiple performance parameters usually specified and negotiated with supplier. Requires extensive testing to prove performance.	High - typically some form of after-market supply contract for spares and operational support may be sought.
Tier 2	Centrifuges Thickeners Pre-fabricated Tanks Polymer Systems Heat Exchangers Specialist Pumps	Moderate to high - process design benefits from knowing preferred suppliers.	High - piping design usually dependent. Spaces and configuration can be more optimised if specific plant selections are made.	High - requires performance specifications and datasheets.	Moderate - made to order but with highly standardised production.	Moderate - supplier representative would usually be present to observe critical testing and commissioning stages.	Moderate to high - multiple performance parameters usually specified and negotiated with supplier. Requires some testing to prove performance.	Moderate - after-market contracts not usually required, but specialist technical / spares support may be sought.
Tier 3	General Pumps Valves General Instruments	Low - process design will dictate selection (rather than other way around).	Low to moderate - spaces and configuration can be more optimised if specific plant selections are made, but to a less degree than Tier 2.	Low to moderate - typically specified on take-off schedules combined with general specifications.	Low - typically "off the shelf" with highly standardised production.	Low - contractor would usually self-perform commissioning and testing.	Low - usually limited to supplier warranties.	Low - off the shelf spares available or run to fail strategy used.

To simplify the project risk allocation and minimise interface risk for WCC, it is the clear preference for procurement of all equipment packages to be in the Contractors scope.

However, given the long lead time involved with Teir 1 packages it is necessary to have the associated supply contracts in place (to secure manufacturing capacity and appropriate delivery timeframes) before the Contractor.

The options to procure Teir 1 packages are therefore:

1. Use of an individual performance-based WCC contract for the supply of a distinct item of plant.
2. Use of an individual performance-based WCC contract for multiple plant items grouped into a bundle, or.
3. Use of an WCC Engineering and Procurement (EP) Contractor to supply the whole process.

Table 11: Key advantages and disadvantages of single supply of plant

Advantages	Disadvantages
• It provides the Principal with the most control / degree of influence over the selection of plant and equipment. This can be particularly important for major process plant, where selection can have an impact on long term operational cost. • Enables open, competitive process (greatest degree of competition). • It enables the greatest level of input and co-ordination into the design process. • It prevents the application of margin by head contractor. This can be significant if otherwise transferring process guarantees to head contractor. • It provides for a direct contractual relationship between the supplier and the principal, which has benefits when addressing process performance issues and for ongoing support services. • Generally, aligns best to the commercial interests / model of the supplier.	• Individual packages require more management overall than for a single supply model. • Requires management to co-ordinate with contractor programme. Typically, equipment supply is to Incoterms 2000 DDP which requires the head contractor to receive and offload the plant. Where significant delays occur, this can present challenges to construction programme. • Splits process guarantees and warranties between multiple parties In this case, the Principal takes more risk on the process performance. As noted above, this is managed through the use of experienced designers and peer reviewers and drawing on operational data or trial results.

Table 12: Key advantages and disadvantages of system supply contract

Advantages	Disadvantages
• It provides the Principal with a higher degree of control / influence over the selection of plant and equipment. This can be particularly important for major process plant, where selection can have a major impact on long term operational cost. It is however less advantageous than Option 1, because it may require us to “live with” some less favourable process selections within the overall process package. • Enables end-to-end performance guarantees for a system. This can be important where one piece of plant feeds into another (such as sludge thickening and dewatering). • Enables open, competitive process (but less than Option 1, because some suppliers can’t supply all plant). • It enables a high level of input and co-ordination into the design process • It prevents the application of margin by head contractor. This can be significant if otherwise transferring process guarantees to head contractor • It provides for a direct contractual relationship between the supplier and the principal, which has benefits when addressing process performance issues and for ongoing support services. • Requires less overall management than for Option 1. • Generally aligns well to the commercial interests / model of the supplier.	• Requires more management overall than for a single supply model. • Requires management to co-ordinate with the head contractor programme. Typically equipment supply is to Incoterms 2000 DDP which requires the head contractor to receive and offload the plant. Where significant delays occur, this can present challenges to the construction programme. • Splits process guarantees and warranties between multiple parties (but less than Option 1). • Principal has less choice over minor items. This can create challenges for long term asset management if there is inconsistency between plant.

Table 13: Key advantages and disadvantages of EP procurement Contractor

Advantages	Disadvantages
• One party co-ordinates and manages procurement of plant items. • One party assumes process risk (although this can be very costly). • Provides access to technical expertise of specialist contractor.	• Limited competition in the NZ market. • Creates significant risk in case of relationship breakdown between process and head contractor. Provides significant interface that can be difficult to manage. • Low degree of control / influence over the selection of plant and equipment • Contractual negotiations and design process can become prolonged. • Process contractor will apply margin. This can be significant. • Contractual relationship lies between the supplier and the process contractor. This can create challenges when addressing plant performance issues after construction and principal must develop own relationship (often at higher cost) for ongoing support services, unless incorporated into process contract. • Can lead to higher operational cost outcomes if process contractor does not have interest in the long term operation. • The prolonged timeframe that will be required to engage a contractor through this model does not fit with the accelerated programme for design and procurement for this project. This tight timeframe requires the design to be developed to support cost certainty, consenting and land acquisition to secure funding, and to deliver the full project before expiry of the current Southern Landfill consents (which influence sludge disposal) in 2026.

Comparison of Options

Drawing on the key factors outlined in the advantages and disadvantages of each option above, a summary comparison of the options has been undertaken and is presented in Table 105 further below. For each option, a colour score has been applied for the attribute as follows:

- Almost certain or highly likely to achieve the outcome sought.
- With appropriate management, the outcome should be achieved
- Difficult (if not very difficult) to achieve the outcome sought.

Table 105: Summary Comparison of Options to Procurement Approaches for Plant and Equipment for the Wellington Sludge Minimisation Project.

Attribute / consideration	Procurement Approach Options			
	1. Separate Plant Supply Contracts	2. System Supply Contracts	3. Main Contractor	4. EP Process Contractor
Degree of influence that the Principal (or their nominated technical specialists) has over plant selection				
Likely competition within the New Zealand market				
Ease of design co-ordination / management between the Principal's designer and the suppliers				
Construction co-ordination / management between the suppliers and the main contractor				
Overall cost outcome for plant and equipment				
Complexity of procurement and timeframe to procure for this project				
Ability for Principal to directly manage plant non-performance with the supplier				
Ability to transfer process risk through plant performance guarantees / warranties				
Achieving cost certainty and consenting outcomes to support the funding process for this project				

Teir 1 Packages are procured under either options 1 or 2 above. The final selection of which to be dependant on the opportunity and logic to bundle multiple items of equipment into a system contract.

Recommendation Summary
The following table provides a summary of the key recommendations from the selection of the delivery model and procurement methodologies for each key supplier package for the Wellington Sludge Minimisation Project. These are based on the risk and market analysis that was described in Part 1 of this Procurement Strategy.

Table 11:

Activity	Recommendation
Proposed Delivery Model	Based on scale, complexity, risk and level of collaboration required, the recommended model is Early Contractor Involvement (ECI). ECI brings significant benefits to manage the risk profile and achieve the level of cost certainty required to secure funding.
Engagement of Contractor	Competitive tenders will be obtained to select a preferred tenderer to participate in ECI phase and to ascertain the suitability of the preferred tenderer accept design novation, process risk, and other delivery risks that may reasonably be allocated during the ECI phase. A negotiated award of a works contract is then expected with independent assurance of cost and time.
Engagement of Designer	Competitive tenders will be obtained to select a Designer for the Early Contractor Involvement (ECI) phase with an option for negotiated award of the balance of design services (with independent assurance of cost and time). Options for Contractor provided design (including novation of the Designer from the ECI phase) will also be maintained. A decision on these options will be recommended to the SRO for approval before the end of the ECI Phase.
Engagement of Other (minor) Professional Services	To deliver the procurement and contracting process, several support contracts are required. These include a probity advisor, procurement and ECI support services, financial auditing, independent cost management, peer review services and legal advice / reviews. These suppliers will work closely with the WCC Commercial Partnerships team to support the necessary procurement elements, and/or the ECI delivery. It is recommended that these are procured by contestable procurement processes where appropriate.
Engagement of Other (minor) Professional Services	To deliver the procurement and contracting process, several support contracts are required. These include a probity advisor, procurement and ECI support services, financial auditing, independent cost management, peer review services and legal advice / reviews. These suppliers will work closely with the WCC Commercial Partnerships team to support the necessary procurement elements, and/or the ECI delivery. It is recommended that these are procured by contestable procurement processes where appropriate.
Engagement of Equipment Packages	• Procurement of plant and equipment packages to be included in the Contractor Scope where possible. • For Tier 1 plant, WCC will engage these suppliers directly via longer form Single Supply Contracts or, if appropriate, bundling into supply contracts.
Forms of Contract	• The NEC4 contract suite be used for Contractor and Tier 1 Supply contracts. • The ACENZ CCCS (with WCC ammendments) to be used for Designer and other professional services contracts.

Financial Case
Affordability and Funding

The strategic case demonstrates the pressing need to develop a long-term solution for Wellington's wastewater sludge that minimises reliance on landfill disposal routes. The preferred solution identified in the economic case has been advanced for assessment against potential funding models.

The purpose of this financial case is to outline the known costs of the SMF project, determine the funding requirements for the SMF project, and to demonstrate the affordability of the preferred option.

Whole of Life Cost Analysis

This financial case covers only the funding and affordability of the capital cost of the SMF project. The cost of operating the plant has not been included in the financial case as it will be funded from rates if operated by WCC, or an equivalent mechanism if operated by another entity, for example the new Water Service Entity created by 3 Waters Reform. This mean all future costs will be fully offset by future revenue, and therefore there are no long-term funding challenges.

For completeness, a preliminary estimate of the operating cost of the SMF was undertaken, which resulted in an estimated operating cost of between $5-$7m annually. In the context of WCC's rates equation, this would amount to an approximate 1-2% increase in rates.

Whole of life cost analysis was included in the Economic Case above as part of identifying the overall economic impact of the options analysed.

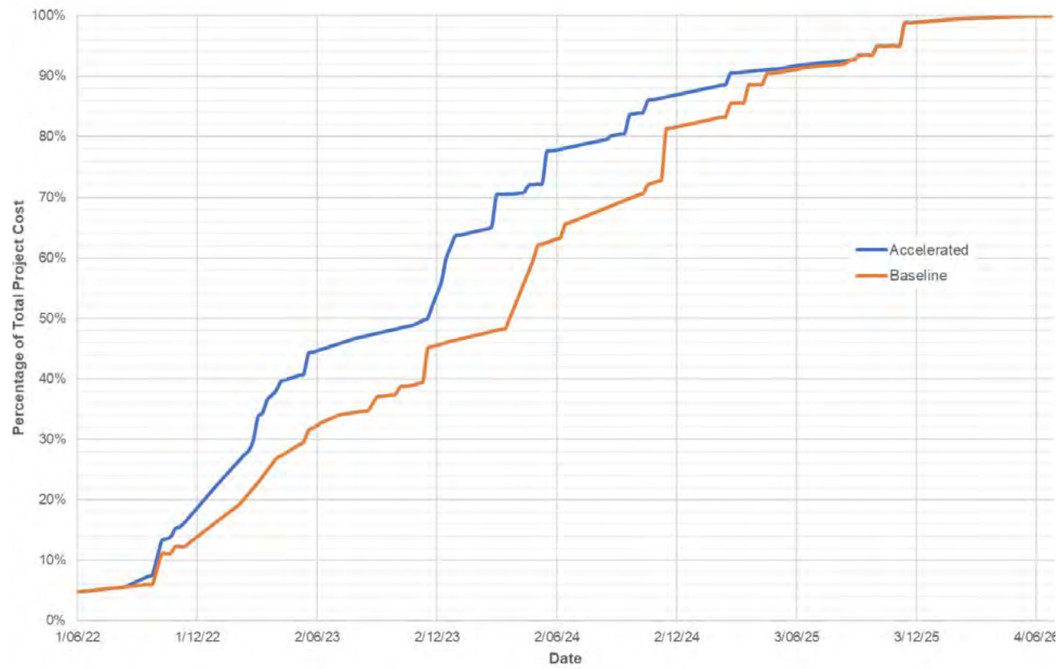
SMF Project Capital Cost

The cost of any project evolves as the scope and design of the project matures. WCC consulted in the 21-31 LTP on an early indicative cost range of $147m to $209m that was provided by Wellington Water. A revised cost range was included in the case for change, estimating project cost between $158m and $222m based on a revised project scope and early design activities.

Since these early estimates there has been an ongoing evolution in the design of the SMF reflecting site complexity and constraint. More importantly, international supply chain challenges and demand driven resource scarcity has resulted in significant inflationary cost pressure in the infrastructure and constructions sectors, both resulting in higher price expectations.

Based on programme and construction sequencing envisaged during the Preliminary Design phase, and identification of options to accelerated project activities, the following chart shows an indicative envelope of spend profile for the project through to completion. Given the formal estimating and determination of Target Out-turn Cost has not been completed this chart is presented as percentage of total costs only.

Indicative Cashflow



The SMF Project has appointed Bond CM as independent cost estimator for the Early Contractor Involvement (ECI) phase. They will be working within an agreed industry recognised cost estimate classification system[2] appropriate for projects of this nature and size.

Contingency

Contingency provisions are sums allocated within a cost plan to cover project risks that result in unplanned project activities, and therefore unplanned project costs, that are necessary to deliver project outcomes. The scale of contingency provisions reduces the more mature a project design becomes. For large complex projects such as the SMF project in the early stages of design, the project contingency can be expected to be set in the vicinity of 30% - 50% of project cost. The contingency provision included in the project funding model will be held and managed at the programme governance level.

The SMF project expects to achieve a greater degree of certainty regarding the target outturn cost and the actual capital spend profile at the completion of the ECI phase, scheduled to be complete in December 2022. Despite the significant inflationary pressures being experienced by the construction industry, the SMF Project is expecting to refine the design and undertake value engineering throughout the ECI and Detailed Design stages to optimise the project cost relative to desired project outcomes.

To account for the known inflationary pressures and to provide confidence in the affordability assessment, the financial analysis that follows is based on a conservative total cost range up to $350m.

2 Association for the Advancement of Cost Engineering (AACE) Recommended Practice 18R-97

WCC Funding Options

WCC funds many capital-intensive projects each year from its capital budget. Like most large organisations there are many different claims on the capital budget, and prioritisation is an ongoing challenge.

In prioritising the application of its available capital, WCC balances:

- service delivery needs
- city shaping initiatives
- compliance with legal changes
- changing policy preferences
- political commitments
- affordability constraints

Additionally, prudent and responsible financial management requires that sufficient debt headroom is always available to provide the capacity to respond to unforeseen events.

When assessing funding options WCC considers investment priorities in the context of intergenerational impact of an investment. Simply put, it is important that the burden of the cost of a long-life asset such as the SMF does not fall solely or disproportionately on the current generation of ratepayers.

WCC typically employs debt funding for assets with an intergenerational profile allowing for the debt to be repaid over the expected life of the asset through only rates funding debt finance costs, asset operational costs, and the depreciation of the asset.

For all capital projects WCC will assess alternative funding models. The absolute cost of alternative finance is typically compared to the cost of debt finance to WCC. This provides a pure cost comparison, but consideration also needs to be given to the wider benefits that can accompany alternative funding models. For example, funding partners often provide ready access to relevant expertise, resources, supply chains, and varying skills and experience not typically resident in local councils.

Establishing a model of funding for a project is related to but is not the same as project cost. When developing funding models WCC needs to consider whether partial or complete funding should come from the same source, including consideration of how different project cost elements are funded. Project funding needs to consider both the known costs, and the estimated contingency provisions.

SMF Project Funding Requirements

WCC assessed a range of funding options for the SMF Project. In addition to the two funding options put forward for public consultation, WCC considered options including reprioritisation of existing capital (delaying or cancelling existing projects), and realising capital through the sale of other assets. Neither of these approaches is a viable option. Accordingly, the two funding options put forward for public consultation were the only reasonably practicable options for funding the SMF Project.

Two viable funding models were presented in the draft Long-Term Plan (2021 - 2031) for public consultation. The two funding options presented were:

1. Funding by WCC as part of its capital programme (ie. directly financing the project from existing debt capacity, with that debt funded through rates)
2. Funding and financing the project externally through use of funding raised pursuant to the Infrastructure Funding and Financing Act 2020 (IFF) (see section 0 below).

Debt

WCC's access to debt funding is primarily through the Local Government Funding Agency (LGFA). The LGFA provides WCC with access to market leading finance rates, making debt financing projects generally the most financially attractive option under most circumstances.

The quantum of WCC's capital programme is primarily governed by its available borrowing capacity. WCC debt levels are capped at a net debt to revenue percentage of 285%[3]. To provide some capacity to weather unforeseen shocks WCC sets a self-imposed debt to revenue ratio of 225%. This self-imposed limit is for guidance purposes rather than an absolute cap.

3 Amongst other conditions, all councils that borrower from the LGFA must comply with financial covenants as set out on their website: Risk management | New Zealand Local Government Funding Agency (lgfa.co.nz)

Preliminary analysis undertaken during the LTP indicated that delivery of the project through Council debt funding would result in a debt impact to Council in the range of $147 - $208m. Table 1 illustrates the impact debt funding the SMF facility would have on WCCs financial capacity over the term of the LTP, assuming no change to other existing capital commitments. Based on the assumed capital expenditure profile, any debt funding raised for the SMF project will materially encroach on debt capacity WCC had set aside to weather unforeseeable events.

Table 1 - WCC Net Debt to revenue forecast

Over recent times, WCC has had to weather significant financial shocks such as the Kaikoura earthquake and the Covid pandemic, resulting in unanticipated spending and reductions in revenue. The ongoing impact of these shocks, coupled with the councils positive and forward-looking investment philosophy, has resulted in a tightening of WCCs available debt headroom.

The use of debt funding to fund the SMF project will have a material impact on WCCs ability to operate a prudent and responsible financial management strategy as it results in substantial encroachment into WCCs critical financial buffer zone.

LTP Consultation

Feedback from the public on the two funding options was split evenly between direct funding and utilisation of the Infrastructure Funding and Financing Act (IFFA). After appropriate consideration WCC decided to adopt its preferred option to pursue funding through the IFFA.

Infrastructure Funding and Financing Act 2020

Overview

IFFA provides a new funding and financing mechanism that enables private capital to be to be raised for new infrastructure outside of the debt constraints of a Local Authority at a highly efficient rate (compared with traditional borrowing tools). The model allows for a Crown Infrastructure Partners (CIP) owned Special Purpose Vehicle (SPV) to levy infrastructure beneficiaries for up to 50 years. CIP uses this levy revenue stream to raise debt finance from the private market. This finance is then provided through progress payments to the delivery agent (in this case, WCC) for eligible project costs associated with eligible project infrastructure.

The model is enabled by the Infrastructure Funding & Financing Act 2020 (IFFA). The IFFA was introduced by the government to provide an alternative funding option for infrastructure that supports urban development and housing supply.

To utilise IFF, WCC (as 'Proposer' under the IFFA) will be required to submit a 'Levy Proposal', a Levy Endorsement (WCC endorsement of the IFFA Levy), and a Infrastructure Endorsement (WCC endorsement of the asset) to the Ministry of Housing and Urban Development (MHUD) for consideration. The ultimate decision of whether to approve an IFFA Levy and transaction will sit with Government. If the IFF funding option is selected, WCC will work closely with CIP to develop the content of the Levy Proposal and Endorsements.

By using IFFA, WCC will be able to progress critical infrastructure investment without compromising the existing composition of its balance sheet. It provides WCC the opportunity to deliver a greater number of projects than would be otherwise possible under its limited capital budgets.

Other benefits of IFF for WCC include:

- **Access to longer term finance** - IFF gives WCC access to longer term finance than is currently able to be sourced via LGFA borrowings.
- **Certainty for rate payers** - IFF provides absolute certainty of cost to ratepayers over the levy period and ringfences ratepayers from interest rate/ refinancing risk.
- **Borrowing Capacity** - IFF finance is excluded from a council's debt burden assessment. This alleviates borrowing constraints to pursue other projects requiring capital investment.

Ministers have appointed CIP as facilitator of the model. CIP's role includes responsibility for sourcing financing and administering the SPVs that are central to the mechanics of the IFFA.

Key features of IFF

Key features of IFF include (but are not limited to):

- **Special Purpose Vehicle (SPV)**
  CIP will establish a wholly owned SPV responsible for structuring and procurement of all finance (debt and equity) required to design and construct the Project. This ensures all financing is ringfenced from construction risk. The SPV will be entitled to receive the levy proceeds and will enter into the debt financing agreements (facility and security documentation) with third party financiers. CIP will manage the ongoing operations of the SPV once established and Ministry of Housing and Urban Development (MHUD) will provide oversight and monitoring. The SPV will not be responsible for cost overruns outside of the amounts assumed to establish the Order in Council.
- **Order in Council (OIC)**
  The OIC is a regulatory instrument that gives effect to the ability of the SPV to levy beneficiaries. This is empowered under the IFFA and approved by Cabinet based on a recommendation by the MHUD. WCC is required to provide a Levy Proposal to MHUD for consideration.
- **Finance GSP**
  The Finance GSP is a guarantee from the Crown (via the Treasury) that will cover certain tail risks to the SPV that cannot be mitigated, managed or borne by other parties. It will cover specific pre-defined risks that would prevent levy revenue being obtained by the SPV and applied to debt service (most notably, specific change in law affecting ability to collect the levy, or judicial review). Lenders will have a security interest in the Finance GSP and would exercise their rights in the event that they suffered a loss that was covered.
  WCC is working closely with CIP and Treasury to determine the details of the Finance GSP, with final terms being subject to negotiation with Treasury and the approval of the Minister of Finance.
- **Cost overruns**
  WCC will be responsible for cost overruns (outside of those amounts assumed to establish the OIC).
- **Operating expenditure**
  IFF funding covers design and construction (along with associated costs) and does not cover operating expenditure.

The IFF levy

The IFF levy is a core component of IFF funding. The SPV is authorised by the Crown, via the OIC, to charge a levy to beneficiaries of infrastructure funding using the IFF model. The levy will be collected by WCC and passed through to the SPV. This arrangement will be governed by an IFF funding and Administration Agreement that will be entered into by the SPV and WCC. The levy itself will be collected by WCC at the same time as other rates (general / targeted etc) and uses the same collection and enforcement mechanisms as general rates.

Calculating the levy

The IFFA does not explicitly state how a levy is calculated which provides WCC with flexibility to tailor a solution specific to the project and the needs of proposed levy payers. The levy remains under development by CIP and WCC. The following are core factors (not exhaustive) that WCC and CIP will consider when developing the levy:

- What portion of the cost of the project should be borne by beneficiaries, noting there may be beneficiary sub groups.
  WCC is working on the assumption that 100% of the capital costs will be funded via IFF.
- The timeframe the levy will be spread across, noting the IFFA allows for a maximum levy tenor of 50 years.
  WCC is working on the assumption the levy will have a tenor of approx. 30 years.
- The number of beneficiaries subject to the final levy. The number of beneficiaries will only impact the amount paid by each beneficiary, not the total levy. WCC is working on the assumption that the levy will be charged to almost all ratepayers in the Wellington catchment area.
- The model used to apportion the total levy amount across the beneficiary group.

Choice of levy calculation methodology
The IFFA allows flexibility as to how the costs of a project are allocated across beneficiaries. The basic principles guiding the choice of methodology are that the distribution should:

- reflect the actual distribution of the benefit,
- seek to reflect a level of fairness, and
- consider the affordability in the hands of the beneficiary.

The strategic case clearly illustrates that benefits flow from finding a solution to sewage sludge management and in particular decoupling sewage sludge disposal from the Southern Landfill (see appendix 1 for benefits analysis). Delivering this outcome creates a domino effect of benefits for WCC and Wellingtonians that were previously otherwise unreachable. This means that a Wellington ratepayer does not need to be directly plumbed into the proposed Sludge Minimisation Facility to enjoy the benefits created by its construction.

Various methodologies are currently under consideration by WCC. These include:

1. Allocating a levy based on Capital Value with no distinction between Residential and Commercial properties
2. Splitting the levy between residential and Commercial (e.g. x% Residential and y% commercial) then allocating by capital value in each category (this approach is sourced from WCC finance policy and represents a historical split for water related costs that seeks to reflect usage differentials between the commercial and residential sectors)
3. Splitting the cost between residential and Commercial and allocating a fixed component and a capital value linked component
4. Splitting the levy between residential and Commercial then allocating by fixed rate by ratepayer
5. Fixed by ratepayer account with no distinction between Residential and Commercial properties.

For completeness, WCC is has considered the following additional approaches but due to a lack reliable data for measurement purposes or the approaching being inconsistent with the strategic case they have been discounted:

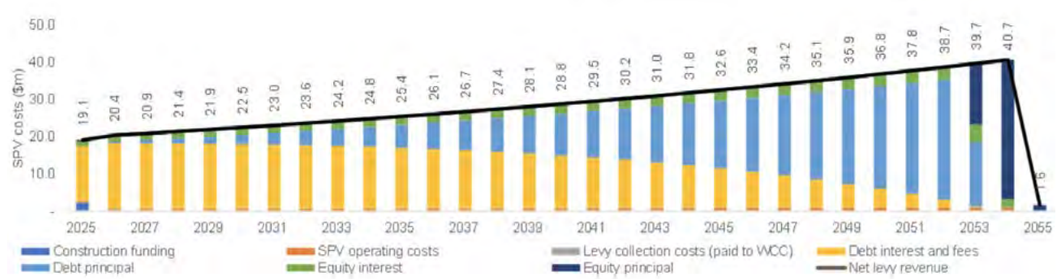
6. allocating based number of toilets installed in a property,
7. allocating based on the number of residents or users in a property,
8. allocating the levy based on volumetric throughput/output,
9. Allocating the levy equally across all beneficiaries,

The final decision on levy calculation approach will be determined by WCC with input from MHUD. At this stage WCC favours allocating levy on the basis set out in b) above that it provides a balance between residential and commercial ratepayers and respects the progressive philosophy that underpins WCC's general rating approach.

Levy revenue over time
It is important to note that once the levy has been decided and the OIC passed, the amount of levy funding cannot increase (other than to account for inflation), however, it can decrease if the actual costs of the project come in less than the available levy funding. Preliminary modelling has assumed the IFF levy is calculated for a 30-year period across all identified beneficiaries.

The following graph illustrates how the levy could unfold over this 30-year timeframe. This graph outlines the cost structure for the $350m (High) scenario where the start of the levy is delayed until the 2025/26 rates year. It is important to note that the start date, final levy structure and the duration will be finalised once total outturn cost is known.

Net Levy Revenue and SPV costs



Preliminary Levy Proposal

WCC has been working with CIP to develop a levy model which would result in achieving financial close in March 2023. The purpose of setting financial close at this time is to:

- Enable early ordering of critical long lead items to mitigate international supply chain challenges
- Minimise the amount of early project costs funded by WCC
- Provide confidence to the construction market that project funding is locked in
- Provide clarity to rating agencies

To fund the SMF Project a preliminary indicative funding amount of $350m using the IFFA Levy funding model has been proposed. This is anticipated to cover the cost of constructing the SMF, along with providing the initial component of contingency provision. The final funding amount will be determine when the target outturn cost estimate is available in March 2023. The parameters of the funding agreement are expected to be in place in August 2022 and will be provided to Council for approval at this time.

The remaining contingency is proposed to be provided by WCC in a form of a guarantee that sufficient debt headroom will be maintained over the period of construction to ensure contingency funding is available if it is needed to complete the SMF.

The following table outlines the suggested requirements that WCC commit to meet in order to achieve financial close by March 2023.

Key item status at FC	Details		Requirement to proceed to Financial Close	Status FC in Mar 2023 (no construction GPS)	Required to commence debt process
Business Case	**Business case has been approved by Council**		WCC has approved the business case	Compete	Yes
Land	**S&P executed**		S&P Agreement executed	Complete	No
Resource Consent	**Recourse consents obtained**		Resource Consents submitted and obtained or clear progress towards obtaining consents with a transparent pathway forward	Obtained	No
Engineering	**Preliminary Design**		Yes	Complete	No
	Early Contractor involvement		Yes	Complete	No
Consultation / approval process	**WCC Consultation requirements satisfied**		Yes	Complete	Yes
Contracts entered into by WCC	**WCC has entered into the following Enabling works packages:**				
	Grassy Knoll - subject to consents		Yes - must have commenced	Yes - works commenced	No
	SMF Site Enabling Works package		Yes - must have commenced	Yes - works commenced	No
	Inlet Pump Station Modifications		Yes - work scheduled	Yes - work scheduled	No
	WWTP modifications		Yes - planning commenced	Yes - planning underway	No
	Procurement of Tier 1 long lead items:				
	Thermal Hydrolysis Plant		Yes - contract for procurement is signed and deposit paid	Ordered and Deposit paid	No
	TD - subject to design requirements				
	WCC has entered into key contracts for:				
	Detailed Design		Yes - Contract for Detailed Design is signed	Contract signed	No
	Main works contract		Yes - Contract for Main Works is signed	Contract signed	
Cost estimate	**AACE Cost class**		Yes - Minimum of Cost Class 3 required	Cost Class 3	No
	Expected Accuracy Range			+30/-20%	
TOC confirmed	**Total outturn cost estimate as reviewed by independent cost estimator**		Yes (within Business Case parameters)	Yes	No
RES	**Updated Res testing No GPS structure**		Yes	Completed	Yes

Optimising the levy for WCC

WCC & CIP are working on sensitivity analysis to optimise the use of the IFF levy to fund the SMF project. The components of the levy calculation that are still being tested include:

Levy structure
WCC & CIP are testing levy scenarios that provide a gradual levy ramp up over the construction period, seeking to initiate the levy earlier to reduce the overall transaction cost and minimise initial levy costs to beneficiaries.

Levy tenure
Combined with the levy structure, testing on the levy tenure to optimise the levy whole of life cost for ratepayers

Population growth
Modelling is underway to align population growth projections in the levy model with WCC LTP population growth projections to ensure the growth in residential ratepayers subject to the levy aligns with WCC forecast population growth.

Capital Value Growth
The growth of the Capital value base both in new residential and commercial ratepayers and absolute capital value growth ensures the levy is appropriately apportioned across the capital value base.

Household income
Relevant for the affordability assessment, testing of the growth rates applied to household income relative to the levy structure and tenure

Levy escalation
Testing the levy escalation rate over the life of the transaction and relative to levy structure.

Ratepayer Affordability Analysis

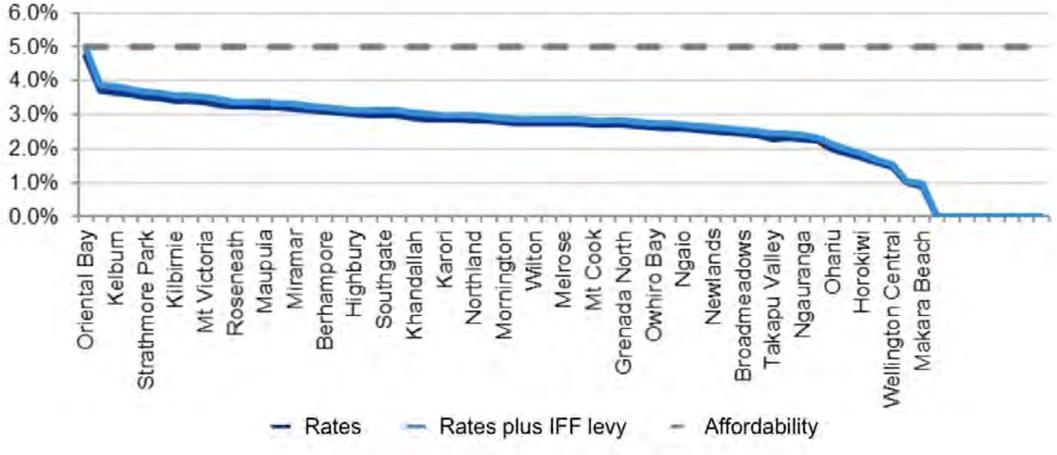
The IFFA levy, while not technically a rate, has many of the same characteristics of a rate, and will appear on WCC's rates invoice alongside actual rates costs. The IFFA specifies that affordability must be considered when setting an IFFA levy and as such the affordability analysis has been undertaken on the cumulative impact of the levy and actual rates.

There is no bright line test to assess affordability, however, the affordability rule of thumb for residential ratepayers is that if rates stay below 5% of average household gross income, they are considered affordable for the ratepayer base.

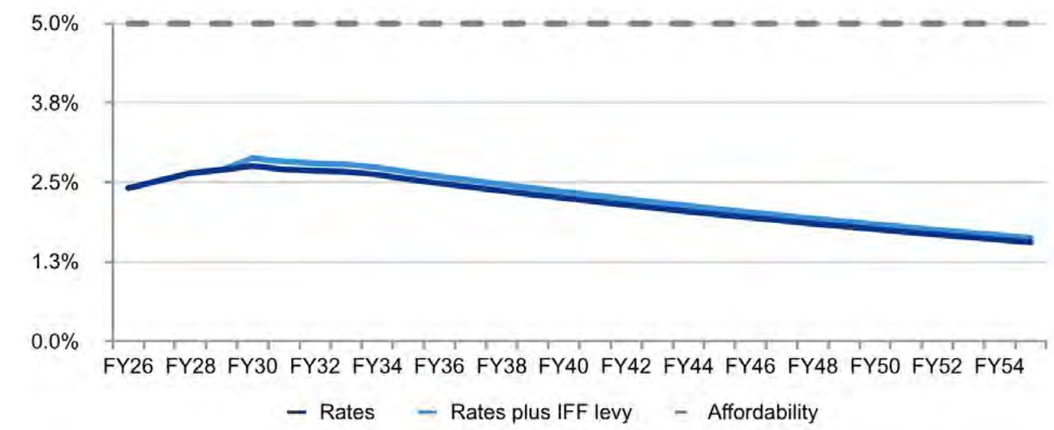
Key assumptions of growth in household incomes and rates costs have been extrapolated forward from the 2018 census data to provide a preliminary view on affordability at the time of the levy inception.

This assessment can be rolled up into a suburb and average ratepayer level, outlined in the following charts. These charts illustrate that based on assumptions of growth of household income and the quantum of ratepayers, the sum of rates plus the levy is expected to stay below the accepted affordability threshold.

Suburb affordability FY26

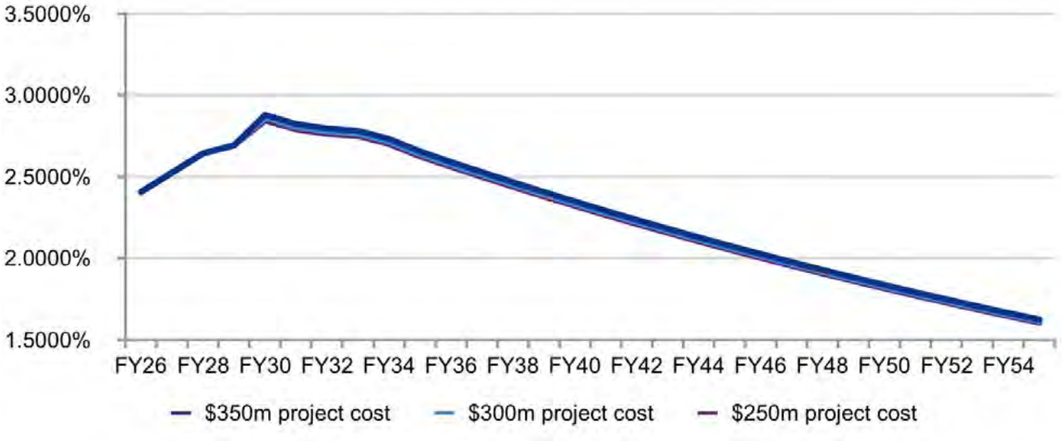


Forecast affordability for average ratepayer



The impact of varying project cost envelopes has a very limited impact on the affordability for the average ratepayer. The following chart illustrates the very minor percentage increase a substantial increase in the SMF project cost would have on an individual beneficiary.

Affordability at different project costs



The imposition of an IFF levy on residential ratepayers is not significant enough to cause the sum of WCC rates plus the IFF levy to be unaffordable.

There is no bright line test for commercial affordability as such, WCC will need to balance multiple factors. As part of its affordability assessment for commercial ratepayers, WCC will consider the levy in the context of regional commercial property yields and proportional increase on total rates increases.

Operational implications for WCC

The use of IFF funding negates the need for WCC to reprioritise other capital investments, to be able to afford the SMF project. This benefits the community by bringing forward capital works not otherwise able to be delivered by WCC in the current LTP.

There are key attributes of the IFF structure that WCC needs to plan for:

- WCC needs to commit to contingent funding if the cost of the SMF project exceeds levy based funding. This commitment exists for both normal project overruns and force majeure events. This contingency will need to be allowed for in debt headroom, with criteria established for access to this contingency if the need arises.
- WCC will need to ensure it maintains the appropriate resource to collect and remit levy payments to the SPV, provide required reporting, and calculate the levy application to ratepayers annually. WCC will be paid an arm's length annual payment for providing this service to the SPV.
- WCC will need to account for the cost associated with operating the SMF post-construction phase.

Impacts on WCC's financial statements

WCC will be providing cashflow funding for the early components of the SMF project on a no regrets basis. The approved budget for this phase is $36m.

All eligible construction expenditure, which is all of WCC's expenditure to date, will be refunded upon financial close including funding costs. Therefore, there is no substantial impact to WCC's financial statements from entering into an IFF model to fund the SMF project.

WCC is the developer and owner of the Sludge Minimisation Facility. The costs of the SMF project will be capitalised up until the point the facility is commissioned. Up until commissioning the asset costs will remain on the balance sheet as Work in progress.

WCC will pay the cost of construction as the principal to the construction contracts. WCC will claim for reimbursement of eligible preliminary costs and construction costs from the SPV under an IFF funding model. The SPV payment to WCC will be in the form of grants. There will be no net cash impact on WCC.

WCC will need to consider recognising a contingent liability for the WCC contingency.

Management Case
Planning for Successful Delivery

As with the commercial and financial components of this business case, the management case lays out the proposed structure and delivery arrangements within each of the project phases.

Governance and Management Arrangements

The SMF project delivery will be managed by WCC, with key work streams contracted by appropriately qualified parties.

Project Governance

WCC has established a Governance Group with a balance of skill and experience to lead the SMF project.

The purpose of the Project Governance Group is to support the Chair/Senior Responsible Owner by:

- Providing strategic advice, governance, and guidance regarding project delivery
- Providing confidence to WCC Infrastructure Committee regarding project delivery
- Recommending escalation of decisions to the CE or the WCC Infrastructure Committee as appropriate.

The Governance Group is chaired by the WCC Chief Infrastructure Officer and includes relevant WCC executives, CIP executive representation, and independent experts.

The independent experts cover specialist waste water technology expertise, project assurance expertise, and large scale construction delivery expertise.

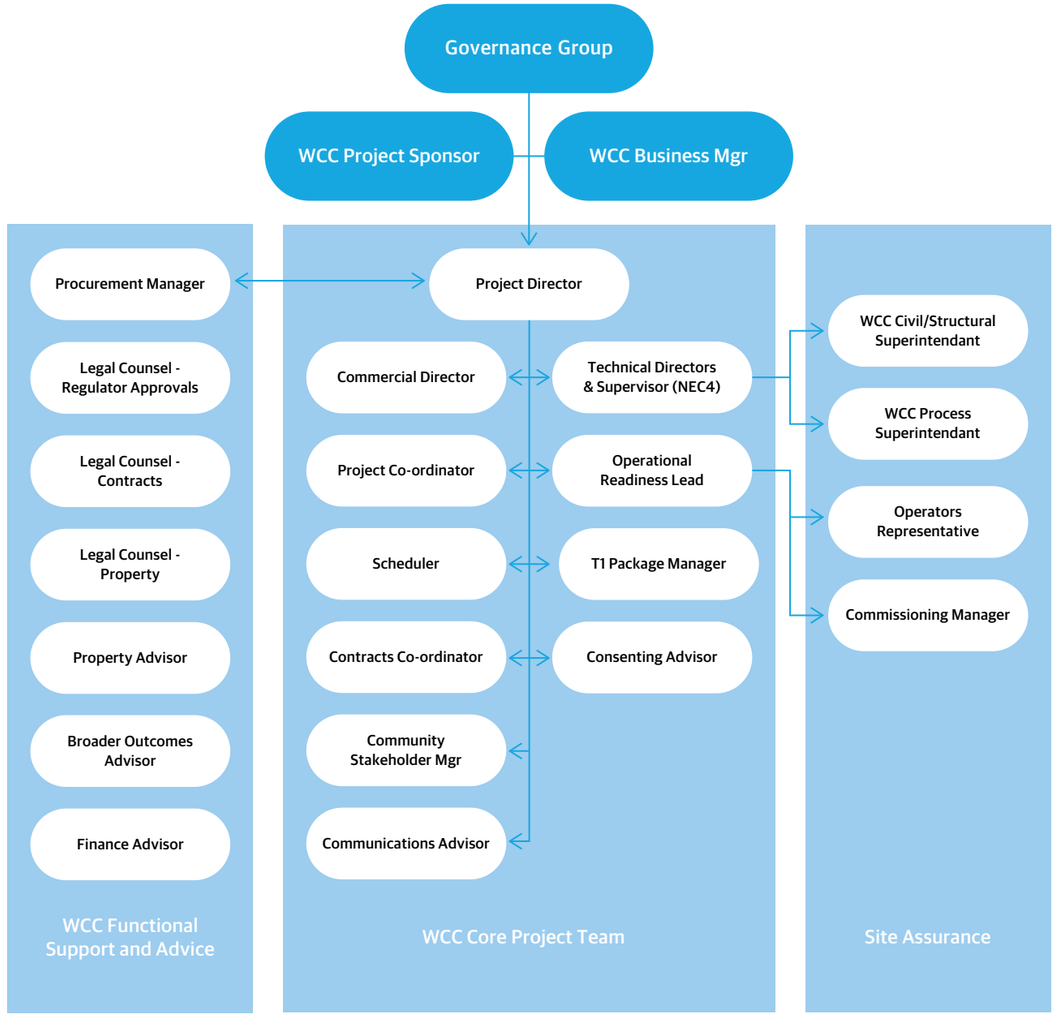
WCC Project Team

In the current planning phase of operations, the WCC team is leading the development of the project's foundational strategies for design, funding & finance, procurement, contract structure and management. These workstreams are to ensure the project is prepared for the Early Contractor Involvement phase.

WCC has established a project team comprising a mixture of external and internal resource. The senior members of the project team are:

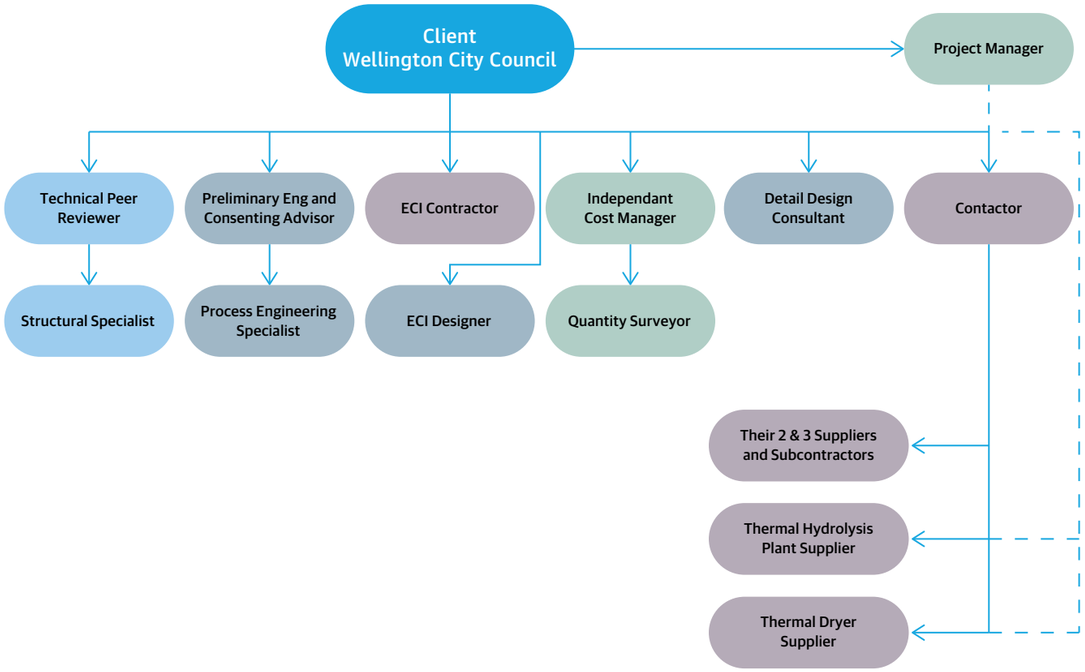
Role	Primary Responsibilities
Project Director	Provides leadership and direction of the Project and the Project team. Owns the relationship with the project contractors and consultants.
Commercial Director	Provides overall commercial assurance to the Project for WCC. Manages the contracts and financial requirements of the Project Team. Owns the relationship with Project funders, and the associated reporting mechanisms.
Technical Director	Provides technical direction to the Project. Oversees technical workstreams and provides assurance that technical risks are being appropriately managed. Transitions to the "Supervisor" role as defined in the NEC4 contract form (similar to the Engineers Representative in NZS391x contracts).

The following sets out the wider organisation chart for the WCC team that has been endorsed by the governance group.



Project Organisational Structure

The following sets out the project organisation that has been endorsed by the governance group.



The following points are highlighted to support this:

1. The Project Management Contract includes the "Project Manager" role as defined in the NEC4 contract form. This role is similar to the Engineer to Contract role provided for in NZS 391x contract forms and fulfils a contract administration role independent to the Client.
2. As noted in the Commercial Case, WCC will procure Tier 1 Packages direct with the intent that these are novated to the Contractor when that contract is established. This procurement prior to novation is indicated by the dashed links between the WCC and the Thermal Hydrolysis Plant Supplier and the Thermal Dryer Supplier.

Project Management

Given the scale and complexity of the project and the requirements to manage the project, engagement of a specialist industrial project management company will considered. This Project Management Contract would be procured via a competitive tender process and may evolve further into an "Integrated Project Management Team" that includes senior members of the WCC team.

The scope of this team will generally include:

- The "Project Manager" role as defined in the NEC4 Contract form (similar to the Engineer to Contract role in NZS391x contracts).
- Management and assurance of construction HSEQ performance.
- Project controls, monitoring and reporting to schedule and budget.
- Planning for effective handover of the Facility to the future operating entity.
- Ensure a culture transparency, trust and collaboration within the project which targets:
  1. zero harm for all aspects of the project,
  2. on time and on budget completion of the project,
  3. reliable startup and ongoing operation of the Facility
- Review and endorsement of Contractors baseline plans for the project.
- Review and endorsement of Contractors site mobilisation, management and demobilisation plans (including safe work method statements and permit to work systems).
- Leading the Construction Control Group Meeting (incl. actions management).
- Monthly reporting on the following aspects of the Project:
  - Cost and schedule performance.
  - HSEQ performance.
  - Risks and hazards
  - Highlights
  - Issues
- Document and information management
- Change management and assurance of value for money on changes
- Management and direction of detailed design activities as required.
- Technical assurance and support as needed
- Construction Readiness Reviews
- Development of commissioning plans
- Pre-commissioning reviews (with package suppliers and process advisors)
- Commissioning management (with package suppliers and process advisors)
- Operational Readiness Reviews
- Close out reporting
- Defects management

Project Control Groups

Two project control groups will be established for phases during project delivery. These are:

1. **ECI Control Group**

   This group is primarily to drive efficient delivery and decision making during the collaborative ECI Phase.

   This group will meet as follows:
   - weekly during the ECI phase to resolve any issues or outstanding decisions,
   - and fortnightly to present to the Senior Responsible Officer for the project.

   This group existing only during the ECI phase.

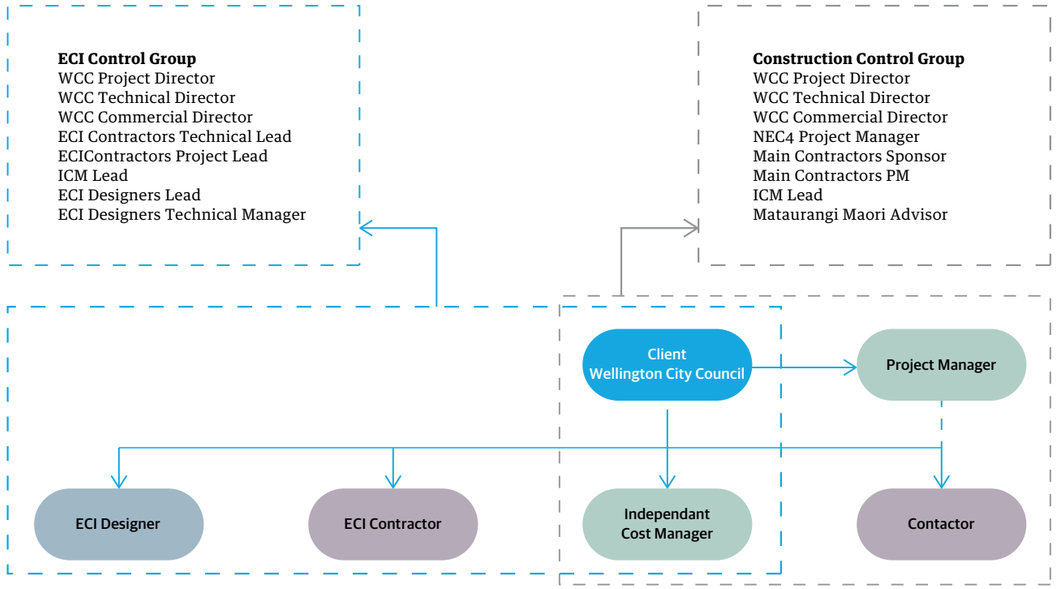
2. **Construction Control Group**

   This group is primarily to oversee construction activities including, forward planning, and, management and performance of:
   - HSEQ
   - Schedule
   - Cost
   - Project interfaces

   This group will meet monthly, typically 2 weeks prior to project governance group meetings.

   This group exists from commencement of construction activities though to taking over of the facility by Operations.

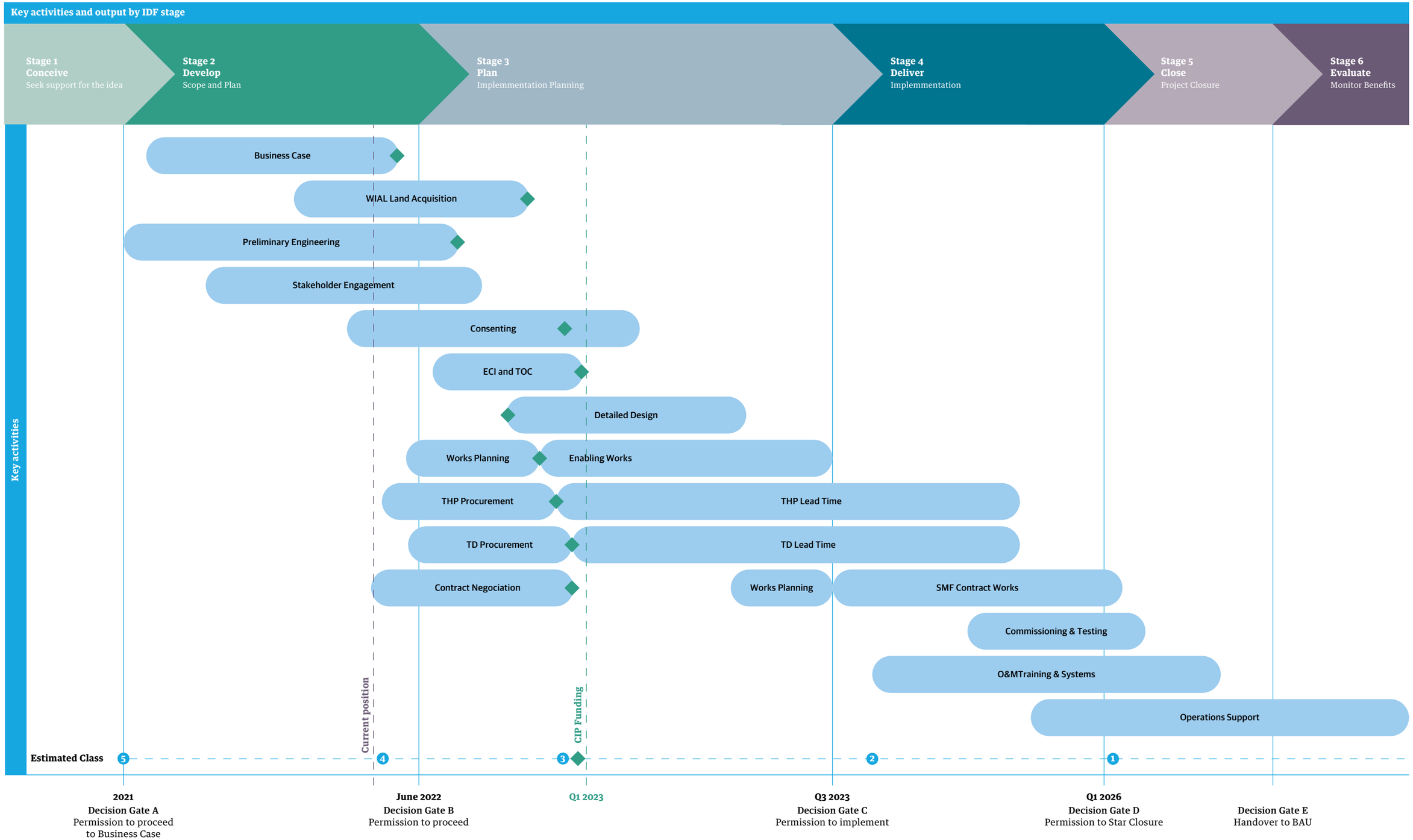
The following diagram indicates the specific representation at the project control groups, both at organisation and specific resource level Project



Timeframes

The SMF project is planning and tracking critical activities in line with WCC's project delivery framework. The following chart is a summary at the front end of a suite of reporting and operational tools designed by WCC's PMO that underpin the best practice approach to project management.

A baselined master schedule will be maintained by the SMF project team, with key contractors feeding into the master schedule with information on relevant work packages.


Key activities and output by IDF stage
Stage 1
Conceive
Seek support for the idea
Stage 2
Develop
Scope and Plan
Stage 3
Plan
Implemmentation Planning
Stage 4
Deliver
Implemmentation
Stage 5
Close
Project Closure
Stage 6
Evaluate
Monitor Benefits
Key activities
Business Case
WIAL Land Acquisition
Preliminary Engineering
Stakeholder Engagement
Consenting
ECI and TOC
Detailed Design
Works Planning
Enabling Works
THP Procurement
THP Lead Time
TD Procurement
TD Lead Time
Contract Negociation
Works Planning
SMF Contract Works
Commissioning & Testing
O&MTraining & Systems
Operations Support
Current position
CIP Funding
Estimated Class
5
4
3
2
1
2021
Decision Gate A
Permission to proceed to Business Case
June 2022
Decision Gate B
Permission to proceed
Q1 2023
Q3 2023
Decision Gate C
Permission to implement
Q1 2026
Decision Gate D
Permission to Star Closure
Decision Gate E
Handover to BAU

The key milestones for this programme of works are as follows:

Table 1: Key Milestones

Date	Milestone
June 2022	Business Case Submission for Approval
	Lodge consent application for Enabling Works
	Lodge consent application for Grassy Knoll Works
July 2022	Expected consent decision for Enabling Works
	Lodge consent application for the SMF
August 2022	Commencement of ECI Phase
	Expected consent decision for Grassy Knoll
September 2022	Commencement of Detailed Design
	Commencement of TOC Reconciliation
October 2022	Contracts signed for Teir 1 Packages
January - March 2023	Commencement of Enabling Works
	Commencement of Grassy Knoll Works
March 2023	Agreement of TOC and Programme for Main Works Contract.
	Achieve Financial Close with Project funder
April-June 2023	Expected consent decision for SMF
July 2023	Commencement of SMF Construction
December 2025	Completion of SMF Construction
February 2026	Completion of SMF Commissioning
March 2026	Handover of the SMF to Operator

Cost Estimating and Cost Control

As detailed in the Financial Case, rough order cost estimates have been developed to inform project initiation, option selection and cost benefit analysis for business case development.

Formal capital cost estimates will be developed during the ECI and TOC reconciliation phase. These estimates will align to the estimate classification system and following Recommended Practice published by the Association for the Advancement of Cost Engineering (AACE):

- 18R-97: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries

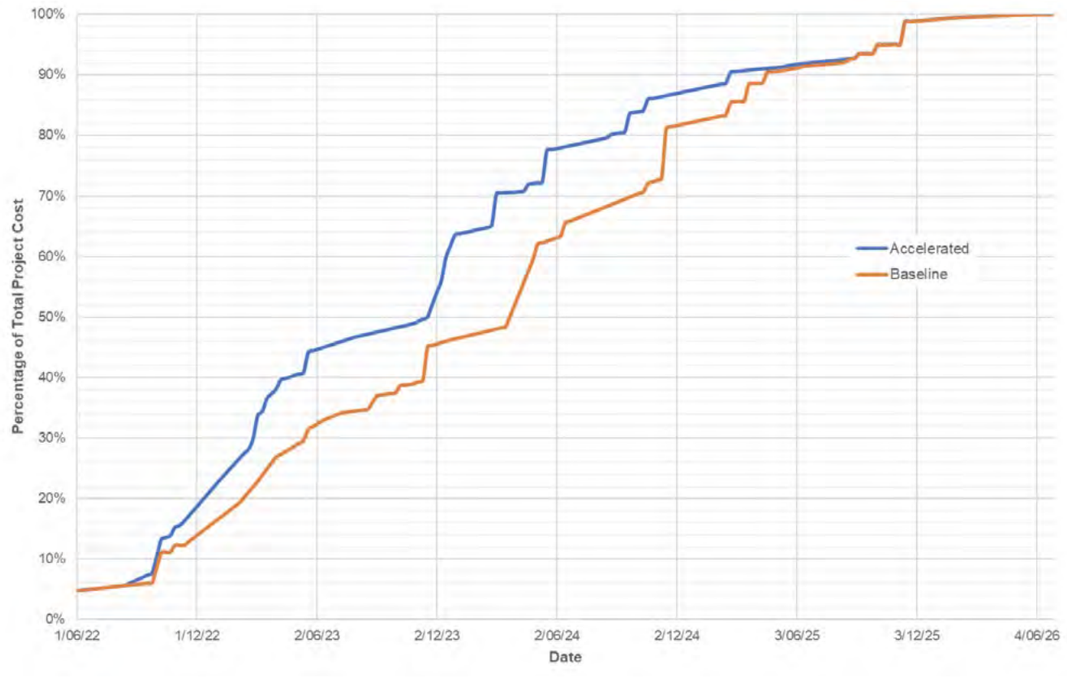
The following formal cost estimates will be developed:

Estimate Class	Use	Forecast Completion
Class 4	Budget planning pre ECI phase commencement.	July 2022
Class 4 (updated)	Budget planning post completion of value engineering in ECI phase.	September 2022
Class 3	To inform the TOC for the Construction Contract	February 2023

The formal cost estimates (used in conjunction with the master schedule) will be used to develop a project spend profile.

The following chart indicates the spend profile (on a percentage of total spend basis) that is currently envisaged. This chart provides an envelope between the baseline (just in time) spend and current views on an accelerated spend.

Indicative Cashflow



The spend profile will be baselined at Financial Close and cost control reporting provided against that. Cost management systems are being developed in conjunction with WCC finance to also ensure adherence to WCC finance reporting requirements and to deliver to SMF project requirements.

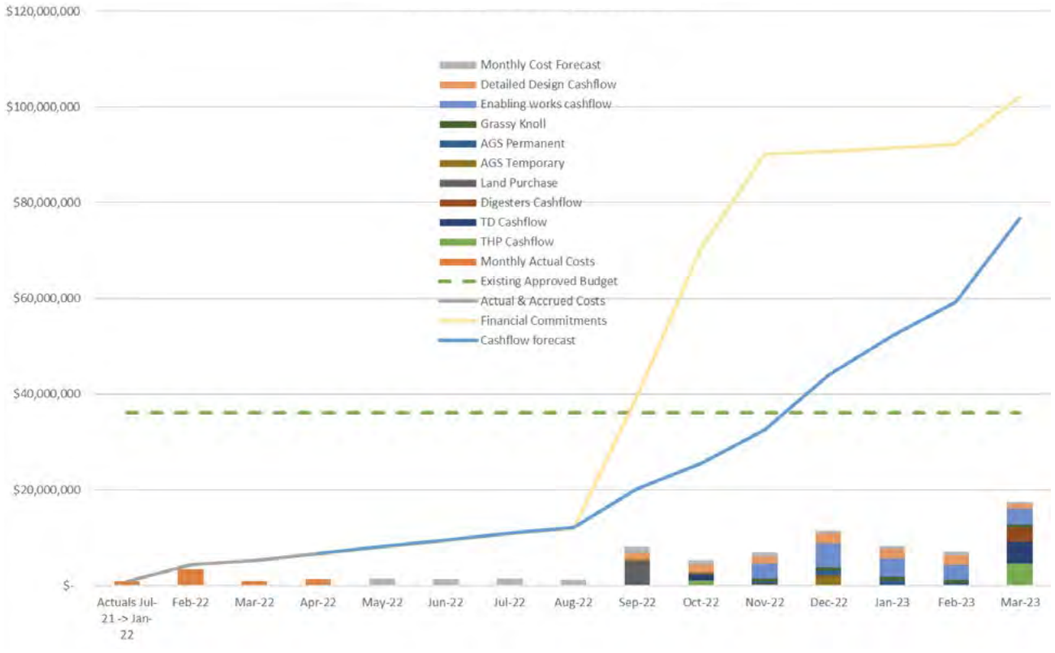
Cost control reporting will include:

- Original Budget
- Approved Variations
- Approved Budget
- Pending Variations
- Cost to Date
- Cost to Complete
- Forecast at Completion
- Earned Value
- Schedule Performance Indicator
- Cost Performance Indicator

Current Financial Status

The following chart represents the current (end of May 2022) forecast to the start of the commencement of the Main Works contract.

Financial Close Budget Forecast



Benefits Management

The high-level benefits for this project are identified in the strategic case. These benefits form the initial benefits register. The management, including the measurement of benefits will be responsibility of the project team, or the Manager, Waste, Water & Resilience, after completion of the project and demobilisation of the project team.

Additional external resources for benefits management (e.g., evaluation and reporting, emissions studies, etc.) may be required. Costs of external contractors need to be factored into the current planned budget.

Specific arrangements for regular benefit reporting and review are as follows:

- A benefits realisation management plan will be prepared to outline the benefits and measures, including the link to the relevant strategic imperative and KPI, including the logic as to how the investment will contribute strategically to the KPI.
- Ongoing status of benefits will be an agenda item for governance group meetings following business case approval.

Main Benefits

The identified benefits of the Sludge Minimisation Facility (SMF) are shown in the table below.

ID	High-level Benefit	Description	Strategic Imperative, KPI Linkage, Indicator Framework
1	Contribution to the Wellington Regional Waste Minimisation and Management Plan	WCC aims to protect and enhance Wellington's natural environment through waste reduction and energy conservation. WCC has committed to investing $187m until 2031 to reduce sewerage sludge as a key enabling step in reducing waste.	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) **KPI linkages:** (Waste minimisation activities) Volume of waste diverted from landfill (tonnes) **Investment-level indicators:** Amount of sludge going to Southern Landfill
2	Contribution to Te Atakura (WCC's Zero Carbon Plan)	WCC aims at making Wellington City a zero-carbon capital (net zero emissions) by 2050. The construction and operation of the waste minimisation facility is clearly identified as a risk treatment which will contribute to reducing our "Inadequate Climate Change Response" risk.	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) Te Atakura: GHG Reduction Focus **KPI linkages:** (Waste minimisation activities and energy conservation) • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 • Volume of waste diverted from landfill (tonnes) **Investment-level indicators:** • Average percentage reduction in carbon and GHG emissions from Southern landfill • WCC Group GHG emissions (tCO2-e) decreasing • Progress on achievement of Te Atakura implementation plan.

3	Reduced exposure to external costs[4] (e.g., landfill levies, carbon, and fuel) that impact wastewater and sludge management[5]	WCC's aims at enabling and accelerating GHG reduction. Council also works on having adequate planning and prioritisation when it comes to financial management policies and procedures. There are also risk registers which recognise gaps and mitigation responses.	Te Atakura, Wellington Resilience Strategy[6] (Programme 3.2 Water and Natural Environment, Explore options for sewage sludge disposal) LTP - Finance and Infrastructure strategy Strategic risk register Procurement strategy **KPI linkages:** • Financial and health impacts on Wellingtonians and on city council (LTP) • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 **Investment-level indicators:** • Lowered costs of sludge disposal to WCC • Less susceptible to increases in landfill levies, carbon, and fuel prices.

4 If the sludge plant is a more expensive solution to disposing sludge compared with the base case, it does not mean there isn't a financial benefit as the comparison would need to be with the alternative future costs.

5 Resilience co-benefits: This project directly addresses the stress on infrastructure and puts in place a suite of investment options that mitigate future capacity issues. At the same time, the city's financial exposure to carbon markets will be reduced. Additionally, a better sludge disposal operation can be linked to energy production, making Wellington less dependent on external energy supply. Finally, the status quo is not consistent with how Wellington perceives itself environmentally. A better disposal option will bring Wellington's aspirations into alignment with what happens on the ground.

6 Wellington Resilience Strategy

4	Reduction in operational risks and costs to dispose of sludge[7] (e.g., asset management/ renewal costs, financial, environmental, service, and reputational risks)	Council adheres to principles of financial affordability and sustainability, which support consistent and effective financial and investment decisions.This may include: • Minimising whole-of-life cost. • Considering investment in large capital cost in order to reduce long-term operational costs. • Focusing on providing resilient infrastructure that is not prone to failure, does not expose its ratepayers to elevated operational costs, and meets the needs of a growing city. • Thorough development of a comprehensive business plan and following robust process for the business case, decision-making, construction, and operation will demonstrate that we are mitigating our "Inadequate Asset Management Planning" risk.	WCC Risk Register (Strategic Risks) **KPI linkages:** • Te Atakura: Viable sewage sludge processing solution in place • Te Atakura: Reduction in landfill waste by a third by 2026 **Investment-level indicators:** • Maintenance and operational costs • A reduction in the risk rating expressed as per Council's risk standard.

7 If the sludge plant is a more expensive solution to disposing sludge compared with the base case, it does not mean there isn't a financial benefit as the comparison would need to be with the alternative future costs.

5	Improved commitment to reflecting Mana Whenua values and principles	Council strengthens partnerships with Mana Whenua. Council values alignment and recognition of Mana Whenua values into design and delivery processes. Council is also committed to ensuring Mana Whenua and Māori meaningfully participate in, contribute to, and inform Council decisions. Improved partnerships and capacity building are the cornerstones of this new strategic direction. Council gives effect to Tākai Here - the Mana Whenua Partnership Agreement and key priorities. Identify opportunities for the codesign and development of public and streetscape projects, physical environment, green belts and waterways projects. Find codesigning opportunities within the Waste minimisation, food waste, climate change space to collaborate and support mutual outcomes that work together for our whenua and taiao.	LTP, Objective 6 Strong partnerships with Mana Whenua Tākai Here - Mana Whenua Partnership Agreement **KPI linkages:** • The level of involvement of our Mana Whenua partners in this whole process. • Strong partnership with Mana Whenua. • Reflecting Mana Whenua values in the project. **Investment-level indicators:** • The selected treatment method reflects Mana Whenua values • Support for our consent process • Involvement of a Mana Whenua representative throughout the project • Asking Mana Whenua to gift a name to the project • Participation of Mana Whenua in appropriate ceremony or ceremonies.

The below table outlines the benefits and measures, including the link to the relevant strategic imperative and KPI, including the logic as to how the investment will contribute strategically to the KPI.

Table 2: Benefits realisation management plan

ID	Benefit Name	Strategic Imperative (and KPI) Linkage	Benefit Measure (Including calculation method)	Benefit Owner
B1	Contribution to the Wellington Regional Waste Minimisation and Management Plan	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) **KPI linkages:** (Waste minimisation activities) Volume of waste diverted from landfill (tonnes)	Calculation method would be based on considering and analysing data on volume of waste (including sludge) diverted from landfill provided by the Water, Waste, and Resilience Team/BU (Project Team). There would be comparison of reporting data before the construction of the facility and post construction, expected July 2026. **Baseline:** • WCC internal data (information from SL management) on waste and sludge, including volume at the Southern Landfill • At Southern Landfill, the dewatered sludge is mixed with solid waste at a ratio of 4-parts solid waste to 1-part dewatered sludge. **Target:** • Reduce the mass of sludge disposed at Southern Landfill[8] by at least 80% by 2031. This will represent 20% of volume of waste reduced. • Set enabling conditions for minimisation activities to happen in the future.	Manager, Waste, Water & Resilience

8 The total amount of waste reduction in landfill is not specific enough because the sludge from WWTP is largely affected by population growth. Accordingly, projection will need to cover population growth over the projection period.

B2	Contribution to Te Atakura (WCC's Zero Carbon Plan) Volume of waste diverted from landfill (tonnes)	LTP, Objective 5 (An accelerating zero-carbon and waste-free transition) Te Atakura: GHG Reduction Focus **KPI linkages:** (Waste minimisation activities and energy conservation): Te Atakura: Viable sewage sludge processing solution in place Te Atakura: Reduction in landfill waste by a third by 2026	On completion of project (July 2026), upon the request of the Project Team, consultants or specialist services are engaged to measure[9] the GHG emissions generated from the sludge product produced by the SMF. WCC efforts in waste (namely sludge) minimisation through the SMF project are tracked annually. Baseline and target are both emission levels and will be measured by the SMF operators and/or specialist/consultants. The project team needs to identify the costs of engaging external specialists/consultants and incorporate these within the project budget. For establishing the baseline: prior to detailed design and construction the Project Team will need to check with WWTP whether we have data on the current amount of GHG emission from per tonne of sludge. In addition, they may ask the Information Management Support Team to provide information on carbon production aligned to the level of waste. **Baseline:** • Amount of GHG emission per tonne of sludge per year (prior to the operation of SMF) • Data on the amount of sludge entering the landfill (preferably on an annual basis so a trend can be established) • Establish a 2026 measurement to use as a baseline once the SMF is operational (separate out the additional GHG reduction enabled by the SMF). The Operations Team at the SMF would be responsible for measurement. **Target:** • x% reduction of GHG emission per tonne of the product from SMF versus the unprocessed sludge per annum • TCO2e reduced per annum • Reduction in waste volume (via the reduced amount of sludge) • GHG reduction certainty.	Manager, Waste, Water & Resilience

9 Measurement of this benefits would focus on the following: What is the sludge product doing from a GHG emission perspective? Is the sludge product from the SMF still emitting GHG? If so, how much? This is asking whether the SMF is reducing the ongoing decomposition of the sludge from WWTP. Another carbon measurement that would be of interest is the embodied carbon in the construction of the SMF.

B3	Reduced exposure to external costs (e.g., landfill levies, carbon, and fuel) that impact wastewater and sludge management	Te Atakura, Wellington Resilience Strategy[10] (Programme 3.2 Water and Natural Environment, Explore options for sewage sludge disposal) LTP - Finance and Infrastructure strategy Strategic risk register Procurement strategy **KPI linkages:** Financial and health impacts on Wellingtonians and on city council (LTP) Te Atakura: Viable sewage sludge processing solution in place Te Atakura: Reduction in landfill waste by a third by 2026	On completion of project (July 2026), upon the request of the Project Team, the Finance Business Partnering Unit will draw comparison between external costs (landfill levies, carbon, and fuel) before and after the project. A post-implementation report would be issued on this. Baseline and target would need to be calculated by the Project Team, and/or the Finance Business Partnering Unit based on assumptions about waste volumes, levies, etc. **Baseline:** Forecast costs for disposal of sludge through existing disposal arrangements at the Southern Landfill. **Target:** The forecast level of reduction in cost in sewerage sludge disposal.	Manager, Waste, Water & Resilience
B4	Reduction in operational risks and costs to dispose of sludge Note: A potential risk is if the sludge pipeline between Moa Point and the landfill fails (environmental, financial, and reputational risks).	WCC Risk Register (Strategic Risks) **KPI linkages:** Te Atakura: Viable sewage sludge processing solution in place Te Atakura: Reduction in landfill waste by a third by 2026	When the plant is commissioned (July 2026), the Project Team would assess the current and future risk levels using the organisational risk framework: • Operational Risk Register Template Feb 2022.xlsm • WCC Operational Risk Reference Tables.pdf The operational cost component of this benefit could be combined with B3, focused on reducing forecast disposal costs. **Baseline:** The current risk exposure of sludge disposal. **Target:** Reducing the level of risk associated with sludge disposal.	Manager, Waste, Water & Resilience

10 Wellington Resilience Strategy

B5	Improved commitment to reflecting Mana Whenua values and principles	LTP, Objective 6 Strong partnerships with Mana Whenua **KPI linkages:** The level of involvement of our Mana Whenua partners in this whole process. Strong partnership with Mana Whenua. Reflecting Mana Whenua values in the project.	To start realizing this benefit, the Project Team will contact Manager Iwi Partnerships –Māori Outcomes to establish partnership with Mana Whenua. After the completion of the project, the Project Team would contract with a researcher to conduct post-construction evaluation using an appropriate Kapuapa Māori method (relying on qualitative interviews) with the Taranaki Whānui, Te Ati Awa, and Ngāti Toa. The project team will engage with Taranaki Whānui, Te Ati Awa and Ngāti Toa to work together and codesign the project. Notes on establishing the baseline: Pre-construction/plant commissioning (the mixed-methods survey**11** will be administered by the Research and Evaluation Team that would engage a Kapuapa Māori practitioner**12** for the existing facility. **Baseline:** Current sludge management practices in the Southern Landfill are not aligned with Mana Whenua values. **Target:** • Strengthened partnership with Mana Whenua. • Codesign throughout the whole process. • Improving our consenting processes with Mana Whenua. • Alignment and recognition of Mana Whenua values. • Wellbeing of the environment.	Manager, Waste, Water & Resilience

11 Survey questions will need to be developed. Applicable questions will need to be ascertained in collaboration with the Research Evaluation Team and the Project Team. This will be confirmed during the Plan Stage of the IDF.

12 Find out how much the costs of this engagement would be and include in the budget.

Assurance

The management case confirms arrangements needed to ensure successful delivery and benefits realisation. One of the key arrangements is the current assurance plan.

This assurance plan based on the following principles:

1. A formal governance framework is in place whereby:

   a. Governance group includes senior WCC leaders and industry experts.

   b. The Governance Group formally meets monthly.

2. The project is subject to normal WCC PMO reporting requirements, including alignment to the WCC Investment Delivery Framework (IDF)

3. The project team maintains appropriate controls on cost, schedule, and quality.

4. The project team reviews risks and opportunities on a monthly basis and these are reported to both Governance Group and PMO.

5. A project control group is established for the ECI phase and that control group meets weekly.

6. A project control group is established for the Construction phase and that control group meets monthly or more regularly as required.

7. All project documentation is centralised in a Project Sharepoint site.

8. Documents that require a formal approval are “Controlled” and subject to formal change control.

9. Key project documentation are reviewed at project stage gates, and any other times when material change happens in the Project.

10. There is monthly reporting of schedule and cost performance to both Governance Group and PMO.

11. Independent assurance is in place for engineering and design (via the Peer Reviewer).

12. Independent assurance is in place for capital costs (via the Independent Cost Manager).

13. The supoplier of the Thermal

14. Reference sites will be visited (internationally) to obtain lessons learnt in the design, construction, commissioning and operation of similar facilities. These lessons learnt will be incorporated in the terms of reference for the ECI phase.

15. Representatives of the operator of the existing facility will be engaged to support ECI and detailed design phases.

Risk

The following risks have been identified:

Table 3: Project Risk Summary

Risk	Likelihood	Impact	Mitigation
Project progress may be hindered by resource limitations.	High	High	Early engagement of consultant and contractor organisations. Assurance of their commitment to the project. Regular proactive monitoring of progress/performance, and incentivisation of contracts.
If the sludge feedstock and system flows are not adequately characterized (grit content, chemical compositions, solids distribution, etc.), then the long-term performance will not be optimised, and mechanical reliability will be greatly impacted.	Medium	High	Undertake a detailed sludge characterisation and pilot testing campaign. Commissioning independent detailed analysis of sludge input flows / loads during preliminary design.
WCC will need to cover any difference between the approved budget and actual expenditures if financial close is late.	High	High	Maintain a high level of engagement with CIP to align project delivery to the financial close process and gain assurance that suitable interest from funding markets.
The project delivery cost may increase and/or the project schedule may be pushed back if the global supply chain is unreliable.	Medium	High	Early identification and procurement of long lead packages. Appointment of nominated package manager / expediter for long lead packages.
It is not guaranteed that Wellington city will be able to take over and operate the SMF facility.	Medium	High	Early engagement with Wellington Water and Veolia (operator of existing facility) to ensure adequate knowledge transfer. Ensure the WCC project team remains the custodian for asset and operational information until the operating asset is fully transferred to the future water services entity. Consideration of recruiting THP specialised into the team in Wellington (or sharing that resource with Watercare).
WCC may have operational risks if water reforms are prolonged and the new water entity is not fully established as the project nears completion.	Low	High	Early engagement with Wellington Water and Veolia (operator of existing facility) to ensure adequate knowledge transfer. Ensure the WCC project team remains the custodian for asset and operational information until the operating asset is fully transferred to the future water services entity. Consideration of recruiting THP specialists into the team in Wellington (or sharing that resource with Watercare).
A construction contract that does not adequately allocate risks for project delivery performance (cost, time, HSE, etc.) will not be appropriately incentivized and will lack the mechanisms to motivate the contractors.	Low	High	Documentation of the risk appetite of WCC and the key measures of success for the main works contract. Ensure the WCC risk appetite informs incentivisation of the main works contract.
If the existing assets are not adequately invested, then there may be a negative feedback effect on the SMF.	High	High	Undertake a critical review the long-term asset strategy documentation from Wellington Water (for Moa Point, Carey's Gully and the sludge pipelines).
A substantial capital expenditure will be required at the Moa Point WWTP in conjunction with the SMF project, if the existing facility is not sufficiently scalable in the long-term.	High	High	Identify short-, medium- and long-term interventions to alleviate this capacity constraint. Consider whether any interventions could/should be rolled into the SMF project given contractor and project team will be mobilised.
The project and the resultant facility may not have inherent safety if construction and operation hazards are not identified and managed.	Medium	High	Follow standard set of process safety reviews that would be expected for a complex process facility (HAZID, HAZOP, LOPA etc).
Construction activities that are constrained by space will result in higher construction costs, slower schedules, and more hazards on site due to congestion and worker interactions.	High	Medium	Early engagement of contractor to support layout design and construction logistics/planning. Incorporate appropriate contingencies into cost estimates. Investigate nearby areas that could be occupied for construction laydown.

Construction market perceptions of a high-risk project may cause a lack of competitive tension for the contract and WCC to have difficulty finding a reasonable risk allocation.	Medium	Medium	Undertake market soundings with potential contractors to understand likely risk position prior to drafting the project procurement strategy. Early commencement of the formal tendering process.
If the facility has onerous resource consent conditions due to the proximity of other businesses (Cyclotek, WIAL, etc), then the cost may increase (consents could constrain materials and time or add additional complexity to the process).	Low	Medium	Stakeholder engagement with nearby businesses (especially Cyclotek, WIAL and CAA) early in consenting. Early review of draft consent documentation with the regulator's technical specialists.
When rare plants and animals are found at the site, extraordinary protection measures will increase cost and delay the commencement of work.	Low	Medium	Undertake ecological assessment as part of consenting work.
A reversal of the resource consents will delay the construction programme, and the project deadline is at risk.	Low	Medium	Complete a wide stakeholder engagement campaign to identify groups that are not supportive and develop specific engagement plans for those groups. Ensure there is adequate stakeholder management resource as part of the WCC project team. Ensure alignment with other WCC waste minimisation initiatives.
If the overall schedule deadline is to be achieved (operational in Q2 2026), then design detail may not be sufficiently progressed to sufficiently inform consenting discussions. This could result in unnecessarily onerous consent conditions or prolonged consenting periods.	Medium	Medium	Early engagement with consenting authorities to set expectations on level of detail to be provided with consent application.
Assuming the overall schedule deadline (operational in Q2 2026) is to be met, then parallel design and consenting activities will need to be undertaken, which may restrict the design.	Low	Medium	Close co-ordination between consenting and design team (possibly engaging both services from same organisation). Consider pushing out consenting assessments into post-lodgement documents.

Wellington City may fall behind schedule or be unable to deliver the project if the City lacks construction expertise.	Medium	Medium	Early procurement of main works contractor. Active engagement with that contractor on local skills required. Active engagement with the contractor on resourcing and skill set requirements.
Risk allocation may not create best value if the long-term risk position (in particular, for process performance, functional performance, and mechanical reliability) for WCC is not well quantified prior to the main works contract agreement.	Medium	Medium	Complete a failure mode analysis for process performance and mechanical reliability. Quantify the cost of each failure mode to inform risk allocation decisions prior to agreement of the main works contract.
The funding may be at risk if WCC or the Funder find the reconciled cost estimate unacceptable.	Low	Medium	Ensure clear expectations for estimate classification. Maintain a high level of engagement with CIP to align with estimate deliverables. Identify potential cost items that could be omitted or deferred for future construction.
If there is not enough time to prepare for resource consent hearings, then the consent conditions may be onerous, or the consent may be granted late.	Low	Medium	Early engagement with consenting authorities to set expectations on level of detail to be provided with the onset application.
The timeline for Financial Close may need to be extended if the process of acquiring land is prolonged.	Medium	Medium	Early development of a Heads of Terms for land acquisition to align WCC and WIAL. Precise definition of the areas and boundary conditions required for the site and construction laydown. Careful schedule management with identification of the Critical Path.
Physical works will be delayed if the process of finalising land acquisition is prolonged.	Low	Medium	Early definition of the logical enabling works that can confidently be delivered alongside ECI/design activities. Careful schedule management with identification of the Critical Path.

Consultation or stakeholder engagement activities that generate significant negative responses may cause consent timelines to be prolonged.	Medium	Medium	Develop a stakeholder management plan and consenting strategy. Engage a professional stakeholder engagement lead to guide the stakeholder engagement activities.
It will be impossible to assess whether the project aligns with tikanga principles and to obtain iwi endorsement if Iwi are not properly engaged.	Medium	Medium	Ensure Iwi engagement prior to consent documentation being finalised. Enable Iwi to review and comment on the optioneering processes to date. Invite Iwi representatives into the project governance group. Invite iwi to co-design alternate long term solids disposal and waste minimisation initiatives. Invite iwi into the determination of critical success factors for the main works.
The WCC may need to seek a short-term extension to existing permissions if the project is not completed on time.	Low	Medium	Investigate options for extending Southern Landfill consents as back-up. Identify options to transport treated solids product to alternate landfills for disposal.
An insufficient amount of engagement in the ECI process will result in a sub-optimal outcome (cost, time, quality of construction).	Low	Medium	Create formal terms of reference for the ECI discussion, and make sure consultants and contractors sign off on that document and the ECI process described before ECI begins.

Change Management

Change management practices are in place and governed by the delegations policy. Refinement of these practises to suit the relevant parties will be made throughout the ECI phase and to align with the contractual agreement put in place for the Main Works Contractor.

There are well established change management principles embedded in the NEC4 contract suite and this will utilised.

Change management will be facilitated through project director and technical director roles during the design and construction phases.

As part of change management, government reform processes would need to be considered. The Three Water reform programme is progressing at pace and has the potential to impact the SMF project toward the end of construction and during commissioning. In the absence of legislation, the risk is perceived, however it is reasonable to think that enhanced regulations for wastewater processing and disposal are a possibility.

In addition, the potential handover timing of wastewater assets from WCC to the new Water Service Entity is right in the middle of the main works contract, which may provide some complications on project reporting and accounting. The SMF project will keep a watching brief as these reforms develop and pivot as required.

Stakeholder Communications and Engagement

Stakeholder engagement is being managed by an external specialist organisation with extensive experience assisting local bodies and water entities. A summary of the stakeholder engagement to date is contained above in the strategic case. A formal engagement plan is being developed and is currently in the review stages, with sign off to be provided by the Governance Group in due course. The stakeholder management plan is a fluid document reflecting the need for the SMF project to be capable of delivering relevant and positive information to all interested parties at and during the different phases of the project.

Next Steps

- Develop Benefits Realisation Plan
- Develop reporting framework to the Project lenders
- Develop cost estimates and programmes that have suitable confidence for baselining.
- Update the Project Management Plan.
- Develop a post project evaluation plan.

Appendix One

Overview

This document outlines the underlying methodology, inputs and assumptions to the Cost Benefit Analysis (CBA) Model used in the Economic Case of the Sludge Minimisation Facility (SMF) Single Stage Business Case (SSBC).

The inputs for the CBA have been collated from a cost model provided by WCC along with desktop research. Specifically:

- WCC's Opex model (opex model) was the primary source of information for the CBA. The inputs and calculations from this model have been replicated in the CBA model with only minor inflation adjustments to rebase prices to 2022.
- Outputs from the Base Case Workshop held in January 2022 were used to supplement base case inputs. Primary inclusions were additional trucking costs to Bonny Glen, asset renewal costs, and revised sludge disposal costs.
- Quantified benefits assessments have been included in the model. Desktop research was completed for two quantifiable benefit categories - biogas and resilience.

The outputs of an ancillary carbon model provided by WCC has not been included in the CBA - because all carbon costs are assumed to be internalised in the price of sludge management activities.[3]

Base Case

In all economic assessments, the determination of a 'Base Case' is as important as the options to be tested. The Base Case should 'start' from the current state and then be a realistic interpretation of what costs, benefits and impacts would accrue if no investment was made.

As agreed in a technical workshop, in which experts from WCC and Wellington Water were present, and subsequent multi-criteria analysis, the Landfill + trucking Base Case option was determined to be the most viable Base Case.

Under the Base Case, sludge will be treated at Moa Point then piped to the Southern Landfill where it is dewatered (≈20-25% solid) and disposed, as is the current approach. This will take place until 2026, when the current Southern Landfill consent expires. After this point, a trucking solution (service contract) will be sought to transport dewatered sludge from the Southern Landfill to a regional facility, Bonny Glen. Bonny Glen has sufficient capacity to be able to accommodate Wellington's sludge over the modelling period.

Practically this assumption translates to:

- Forecast sludge volumes will grow at a constant rate that is derived from mid population growth in the Wellington region.
- The Southern Landfill will operate under business-as-usual conditions until 2026 when the current landfill consent expires. This means the existing cost profile of the Southern Landfill and sludge management will stay the same until 2026.
- After 2026, sludge will continue to be treated at Moa Point and piped to the Southern Landfill for dewatering, however it will then be transported to Bonny Glen via truck.
- The trucking solution is assumed to be a service contract that will be negotiated in relation to expected volume of sludge.
- Asset renewals for Moa Point, the pipeline, and the Dewatering facility are expected to be incorporated.

Short list options are compared against the Base Case to determine the preferred way forward.

Investment Options

As noted in the Economic Case, a long list of Investment Options was identified using inputs from technical experts. From this long list a short list of options was chosen through a three stage Multi-criteria-analysis (MCA), starting with a fatal flaw analysis, from which the options were further developed to enable MCA and an assessment of how these options meet the Investment Objectives of this project.

The short list options are:

- Lysis-Digestion and Thermal Drying;
- Digestion-Lysis-Digestion and Thermal Drying;
- Mesophilic Anaerobic Digestion and Thermal Drying; and
- Thermal Drying and Gasification.

In general, the first three shortlist options involve feeding sludge through a digestion step after which the sludge is stabilised and then dewatered. After dewatering the sludge is thermally dried. The Thermal Drying and Gasification option differs from the first three options. In the Thermal Drying and Gasification option sludge is put through a thermal dryer and then the dry solids are gasified.

Lysis-Digestion and Thermal Drying

In this option Moa Point sludge is thickened and mixed with Karori sludge. The blend is fed to a Thermal Hydrolysis followed by anaerobic digestion. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. During the process Biogas can be used to satisfy the heat requirements of the hydrolysis process and/or the dryer.

Digestion-Lysis-Digestion and Thermal Drying

In this option Moa Point sludge is thickened and Karori sludge is mixed in. The Moa Point sludge and the blend is fed to a process consisting of two anaerobic digestion steps with thermal hydrolysis in-between. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. Biogas can be used to satisfy the heat requirements of the hydrolysis process and/or the dryer.

Mesophilic Anaerobic Digestion and Thermal Drying

In this option Moa Point sludge is thickened and Karori sludge is mixed in. The blend is fed to an anaerobic digestion step. After stabilisation the sludge is dewatered, thermally dried, and disposed of at the Southern Landfill. Biogas can be used to satisfy the heat requirements of the dryer.

Thermal Drying and Gasification

In this option Moa Point sludge is dewatered and combined with the Karori sludge in a thermal dryer. The dry solids are gasified. The biosolids are disposed of at the Southern Landfill. Syngas can be used to partially satisfy the thermal dyer's energy needs.

Input Assumptions

The following outlines the high-level structure of the cost benefit model for the WCC SMF CBA.

Core parameters

CBA Item	Detailed requirement
Sludge growth	Sludge will grow at a constant rate that is derived from population growth in the Wellington region.
Timeframes	• Time period of the model is 50 years, 2022/2023 - 2071/2072. • The modelling has been conducted on an annual basis. With a Financial Year 1 July - 30 June assumed.
Cost escalation	Cost escalation is not included in the Economic model as per Treasury guidance. All prices are real, NZD (2022).
Discount rate	Default government infrastructure discount rate of 5% applies.

Timing flags

The timing flags used in this model are as follows.

CBA Item	Detailed requirement	Applicability to options				
		BC	LD+TD	DLD	MAD+TD	TD+GAS
Model Date	Duration of Model	FY 1 - FY 50 2022/2023 - 2071/2072				
Construction period	All four investment options are estimated to have a three-year physical construction period.	N/A	FY 2 - FY 4 2023/2024 - 2025/2026			
Benefits period	Benefits that are experienced by the four investment options occur from the completion of construction to the end of the modelling period.	N/A	FY 5 - FY 50 2026/2027 - 2071/2072			
Pre 2026 operations	The Base Case is business as usual until the Southern Landfill consent expires in 2026. This also applies to all four investment options.	FY 1 - FY 4 2022/2023 - 2025/2026				

Post 2026 operations	After 2026 in the Base Case a trucking contract (and disposal costs at Bony Glen) will commence and run until the end of the modelling period. All four investment options then have different operating profiles over this period as noted in this technical annex.	FY 5 - FY 50 2026/2027 - 2071/2072	
Decommissioning period	Under the four investment options the pipeline will be decommissioned when the new facilities become operational.	N/A	FY 5 2026/2027

Indexation

The underlying opex model uses operating cost estimates from 2018-2019. The CBA Model rebases these prices to 2022 prices using the below indices.

Cost Category	Description	Values	Source
Consumer Price Index (CPI)	The consumer price index has been used to inflate prices to the base year.	2.15%	RBNZ
Labour Cost Index (LCI)	The LCI has been used to inflate the price of labour to the base year.	3.5%	RBNZ

Capital Costs

The derivation of capital costs for all Investment Options was as follows:

- Level 1 estimates, in accordance with Wellington Water's Cost Estimation Manual, were produced for all shortlisted options in June 2020. These were based on high level estimates of vendor plant and equipment costs and the use of international vendor databases, rates for construction from other typical projects, and general allowances for project and funding contingency. These estimates were produced for comparative purposes as part of the MCA.
- Since production of the Level 1 estimates and the MCA, further development has occurred of the preferred Option (LD + TD), which has enabled the production of a Level 2 estimate in accordance with Wellington Water's Cost Estimation Manual. This has enabled a better understanding of quantities and risks which reflect more up to date cost information for this option.
- To ensure an even comparison between LD+TD and the other options, the Level 1 estimates for the options have been adjusted by scaling them based on the quantum of change of individual items for between the level 1 and level 2 estimate for the LD+TD. This provides for a more reasonable comparison of cost between the options.

Cost estimates have also been updated to 2022 prices.

Cost inputs

All options have the same costs up until 2026. After 2026 the cost structures deviate.

Base

Cost Category	Description	Key inputs	Values	Source	Timing
Sludge volumes	The volume of sludge growth Y.o.Y	Sludge volume grows in line with linear population growth Relevant values grow in line with sludge volume	2023 - 1,944.6 m3/d 2073 - 2,506.3 m3/d	WCC opex model - derived from technical report forecasting sludge / population over the assessment period	Annual
		Operating costs pre-2026			
Chemical costs	Yearly chemical costs for cationic powder polymer used for dewatering	Chemical consumption	147kg/d	CHBDC Supplier	Annual
		Chemical cost	$7.5/kg		
		Chemical costs are driven by sludge volume and time (days operational)			
Power costs - digestion plant / dewatering plant	Yearly power costs for operating the dewatering plant	Electricity cost	$0.1359/kWh	Energy in New Zealand 2021 (mbie.govt.nz) - PP26	Annual
		Power consumption	5067.8kWh/d		
		Power costs are driven by sludge volume and time (days operational)			
Power costs - pipeline	Yearly costs to transport sludge via pipeline to the Southern Landfill	Electricity cost	$0.1359/kWh	Underlying Opex model	Annual
		Power consumption	600,000 kWh/ year		
		Power costs are driven by sludge volume and time (days operational)			
Labour costs	Yearly labour costs for plant operators to manage the plant and transfer pump stations	FTE cost	$100,000	FTE cost was derived from a market scan and investigation of WWL Operations contract 1 FTE estimate provided by Veolia	Annual

Maintenance - Moa Point	Yearly maintenance costs to existing assets at Moa Point	Capital cost	$2,940,000	Underlying Opex model	Annual
		Allowance for maintenance	2%		
Maintenance - Pipeline	Yearly maintenance costs to the pipeline	Capital Cost	$62,000,000	Underlying Opex model	Annual
		Allowance for maintenance	0.5%		
Fuel cost	Yearly fuel costs	The Base Case does not have fuel costs			N/A
Sludge transport costs	Yearly transport cost of sludge to the Southern Landfill	Moa Point to Careys Gully		Underlying Opex model	Annual
		Transport cost	$35.1m3		
		Karori to Moa Point			
		Transport cost	$42.50m3		
		Transport costs are driven by sludge volumes and transport distances			
Sludge disposal costs	Yearly disposal cost of sludge at the Southern Landfill	Landfill gate rate fee	$202.5/tonne	Underlying Opex model	Annual
Additional operating cost's post 2026					
Asset renewal costs	Assumed these assets are replaced once - at current replacement value - over the modelling period	Pipeline	$62,000,000	WCC	2040
		Dewatering plant	$20,000,000		2030
Additional trucking costs	A services contract will be negotiated to transport treated and dewatered sludge from Southern Landfill to Bonny Glen	Trucking cost per unit	$0.85 km/tonne	Base Case Workshop	Annual from 2026 onwards
		Distance	176 - 178km (depending on Karori or Carey's Gully start point)	Goggle maps	
Bonny Glen disposal fees	A fee applies to the disposal of sludge at Bonny Glen	Waste disposal fee	$160/tonne	WCC	Annual from 2026 onwards
		Sludge production	20,160 kg/d		
		%DS	22.5%		
Capital costs					
Capex	The cost of new capital	This option has no capital costs			N/A

Lysis-Digestion and Thermal Drying

Cost Category	Description	Key inputs	Values	Source	Timing
Sludge volumes	The volume of sludge growth Y.o.Y	Sludge volume grows in line with linear population growth Relevant values grow in line with sludge volume	2023 - 1,944.6 m3/d 2073 - 2,506.3 m3/d	WCC opex model - derived from technical report forecasting sludge / population over the assessment period	Annual
Operating costs pre-2026					
Chemical costs	Yearly chemical costs for cationic powder polymer used for dewatering	Chemical consumption - pre dewatering	52.5kg/d	CHBDC Supplier	Annual
		Chemical consumption - post dewatering	88.3kg/d		
		Chemical cost - pre dewatering	$7.5/kg		
		Chemical costs are driven by sludge volume and time (days operational)			
Power costs - digestion plant / dewatering plant	Yearly power costs for digestion, dewatering and thermal drying plant	Electricity cost	$0.1359/kWh	Energy in New Zealand 2021 (mbie.govt.nz) - PP26	Annual
		Power consumption	4,945kWh/d		
		Power costs are also driven by sludge volume and time (days operational)			
Power costs - pipeline	Yearly costs to transport sludge via the pipeline to the Southern Landfill	This option does not have power costs for the pipeline			N/A
Labour costs	Yearly labour costs for plant operators to manage the plant and transfer stations	FTE cost	$100,000	FTE cost was derived from a market scan and investigation of WWL Operations contract FTE estimate provided by Veolia	Annual
		Number of FTEs	3		

Maintenance - Moa Point	Yearly maintenance costs to assets at Moa Point	Capital cost	$174,562,000	Underlying Opex model	Annual
		Allowance for maintenance	2%		
Maintenance - Pipeline	Maintenance costs to the pipeline	This option does not have pipeline maintenance			N/A
Fuel cost	Yearly fuel costs	This option does not have fuel costs			N/A
Sludge transport costs	Yearly transport cost of sludge to the Southern Landfill	Moa Point to Careys Gully		Underlying Opex model	Annual
		Transport cost	$35.1m3		
		Karori to Moa Point			
		Transport cost	$42.50m3		
		Transport cost is also driven by sludge volumes and transport distances			
Sludge disposal costs	Yearly disposal cost of sludge at the Southern Landfill	Landfill gate rate fee	$202.5/tonne	Underlying Opex model	Annual
Decommis-sioning costs	The cost of decommissioning the pipeline	Pipeline	$1,000,000	WCC	2027
Capital Costs					
Capex	Capital cost occurs at Moa Point which is inclusive of land acquisition at Carey's Gully and WWL management fee (5%)	Cost splits: 37% FY23 36% FY24 27% FY25	$186,524,000	Underlying Opex model	One off

Digestion-Lysis-Digestion and Thermal Drying

Cost Category	Description	Key inputs	Values	Source	Timing
Sludge volumes	The volume of sludge growth Y.o.Y	Sludge volume grows in line with linear population growth Relevant values grow in line with sludge volume	2023 - 1,944.6 m3/d 2073 - 2,506.3 m3/d	WCC opex model - derived from technical report forecasting sludge / population over the assessment period	Annual
Operating costs					
Chemical costs	Yearly chemical costs for cationic liquid polymer and cationic powder polymer used during thickening and dewatering	Chemical consumption - thickening pre digestion	50.4kg/d	CHBDC Supplier	Annual
		Chemical consumption - dewatering post digestion	69.8kg/d		
		Chemical cost - thickening pre digestion	$11.5/kg		
		Chemical cost - dewatering post digestion	$7.5/kg		
		Chemical costs are also driven by sludge volume and time (days operational)			
Power costs - dewatering plant / digestion plant	Yearly power costs for thickening, digestion, dewatering, thermal drying	Electricity Cost	$0.1359/kWh	Underlying Opex model	Annual
		Power consumption	2,471kWh/d		
		Power costs are also driven by sludge volume and time (days operational)			
Power costs - pipeline	Yearly power costs to transport sludge via the pipeline to the Southern Landfill	This option does not have power costs for the pipeline			N/A

Labour costs	Yearly labour costs for plant operators to manage the plant and transfer stations	FTE cost	$100,000	FTE cost was derived from a market scan and investigation of WWL Operations contract FTE estimate provided by Veolia	Annual
		Number of FTEs	3		
Maintenance - Moa Point	Yearly maintenance costs to assets at Moa Point	Capital cost	$183,205,000	Underlying Opex model	Annual
		Allowance for maintenance	2%		
Maintenance - Pipeline	Yearly maintenance costs to the pipeline	This option does not have pipeline maintenance			N/A
Fuel cost	Yearly fuel costs	This option does not have fuel costs			N/A
Sludge transport costs	Yearly transport cost of sludge to the Southern Landfill	Moa Point to Careys Gully		Underlying Opex model	Annual
		Transport cost	$35.1m3		
		Karori to Moa Point			
		Transport cost	$42.50m3		
		Transport cost is also driven by sludge volumes and transport distances			
Sludge disposal costs	Yearly disposal cost of sludge at the Southern Landfill	Landfill gate rate fee	$202.5/tonne	Underlying Opex model	Annual
Decommis-sioning costs	The cost of decommissioning the pipeline	Pipeline	$1,000,000	WCC	2027
Capital Costs					
Capex	Capital cost occurs at Moa Point which is inclusive of land acquisition at Carey's Gully and WWL management fee (5%)	Cost splits: 37% FY23 36% FY24 27% FY25	$208,100,000	Underlying Opex model	One off

Mesophilic Anaerobic Digestion and Thermal Drying

Cost Category	Description	Key inputs	Values	Source	Timing
Sludge volumes	The volume of sludge growth Y.o.Y	Sludge volume grows in line with linear population growth Relevant values grow in line with sludge volume	2023 - 1,944.6 m3/d 2073 - 2,506.3 m3/d	WCC opex model - derived from technical report forecasting sludge / population over the assessment period	Annual
Operating costs					
Chemical costs	Yearly chemical costs for cationic liquid polymer and cationic powder polymer used during thickening and dewatering	Chemical consumption - thickening	50.4kg/d	CHBDC Supplier	Annual
		Chemical consumption - dewatering	94.0kg/d		
		Chemical cost - thickening	$11.5/kg		
		Chemical cost - dewatering	$7.5/kg		
		Chemical costs are also driven by sludge volume and time (days operational)			
Power costs - dewatering plant / digestion plant	Yearly power costs for thickening, mesophilic anaerobic digestion, dewatering and thermal drying	Electricity Cost	$0.1359/kWh	Underlying Opex model	Annual
		Power consumption	18,968kWh/d		
		Power costs are also driven by sludge volume and time (days operational)			
Power costs - pipeline	Yearly power costs to transport sludge via the pipeline to the Southern Landfill	This option does not have power costs for the pipeline			N/A

Labour costs	Yearly labour costs for plant operators to manage the plant and transfer stations	FTE cost	$100,000	FTE cost was derived from a market scan and investigation of WWL Operations contract FTE estimate provided by Veolia	Annual
		Number of FTEs	2		
Maintenance - Moa Point	Yearly maintenance costs to assets at Moa Point	Capital cost	$196,784,000	Underlying Opex model	Annual
		Allowance for maintenance	2%		
Maintenance - Pipeline	Yearly maintenance costs to the pipeline	This option does not have pipeline maintenance			N/A
Fuel cost	Yearly fuel costs	This option does not have fuel costs			N/A
Sludge transport costs	Yearly transport cost of sludge to the Southern Landfill	Moa Point to Careys Gully		Underlying Opex model	Annual
		Transport cost	$35.1m3		
		Karori to Moa Point			
		Transport cost	$42.50m3		
		Transport cost is also driven by sludge volumes and transport distances			
Sludge disposal costs	Yearly disposal cost of sludge at the Southern Landfill	Landfill gate rate fee	$202.5/tonne	Underlying Opex model	Annual
Decommis-sioning costs	The cost of decommissioning the pipeline	Pipeline	$1,000,000	WCC	2027
Capital Costs					
Capex	Capital cost occurs at Moa Point which is inclusive of land acquisition at Carey's Gully and WWL management fee (5%)	Cost splits: 37% FY23 36% FY24 27% FY25	$210,550,000	Underlying Opex model	One off

Thermal Drying and Gasification

Cost Category	Description	Key inputs	Values	Source	Timing
Sludge volumes	The volume of sludge growth Y.o.Y	Sludge volume grows in line with linear population growth Relevant values grow in line with sludge volume	2023 - 1,944.6 m3/d 2073 - 2,506.3 m3/d	WCC opex model - derived from technical report forecasting sludge / population over the assessment period	Annual
Operating costs					
Chemical costs	Yearly chemical costs for Chemical dosing - SOx and NOx emissions reduction	Chemical consumption	164.4kg/d	CHBDC Supplier	Annual
		Chemical cost	$1.06/kg		
		Chemical costs are also driven by sludge volume and time (days operational)			
Power costs - Gasification plant / dewatering plant	Yearly power costs for thermal drying and dewatering	Electricity Cost	$0.1359/kWh	Underlying Opex model	Annual
		Power consumption	7,209kWh/d		
		Power costs are also driven by sludge volume and time (days operational)			
Power costs - pipeline	Yearly power costs to transport sludge via the pipeline to the Southern Landfill	This option does not have power costs for the pipeline			N/A
Labour costs	Yearly labour costs for plant operators to manage the plant and transfer stations	FTE cost	$100,000	FTE cost was derived from a market scan and investigation of WWL Operations contract FTE estimate provided by Veolia	Annual
		Number of FTEs	3		
Maintenance - Moa Point	Yearly maintenance costs to assets at Moa Point	Capital cost	$188,432,000	Underlying Opex model	Annual
		Allowance for maintenance	2%		
Maintenance - Pipeline	Yearly maintenance costs to the pipeline	This option does not have pipeline maintenance			N/A

Fuel cost	Yearly fuel costs	Fuel consumption	30L/d	Underlying Opex model	Annual
		Fuel cost	$27.02/GJ		
Sludge transport costs	Yearly transport cost of sludge to the Southern Landfill	Moa Point to Careys Gully		Underlying Opex model	Annual
		Transport cost	$35.1m3		
		Karori to Moa Point			
		Transport cost	$42.50m3		
		Transport cost is also driven by sludge volumes and transport distances			
Sludge disposal costs	Yearly disposal cost of sludge at the Southern Landfill	Landfill gate rate fee	$202.5/tonne	Underlying Opex model	Annual
Decommis-sioning costs	The cost of decommissioning the pipeline	Pipeline	$1,000,000	WCC	2027
Capital Costs					
Capex	Capital cost occurs at Moa Point which is inclusive of land acquisition at Carey's Gully and WWL management fee (5%)	Cost splits: 37% FY23 36% FY24 27% FY25	$201,781,00	Underlying Opex model	One off

Benefits

Both qualitative and quantitative benefits have been identified. Only the quantitative benefits have been included in this CBA.

Base Case

The base case has no quantifiable benefits.

Investment Options

All four investment options have the same generalised quantified benefit profile as demonstrated in the table below. Under this benefit assessment the majority of quantifiable benefits come in the form of avoided operating costs.

- Biogas production which can be used for onsite purposes or to be sold to nearby users. The 'price' is constant across all four investment options, but the amount of biogas production varies by option and this drives slightly different benefit calculations across the four investment options.
- Resilience benefits through a decommissioning of the pipeline (and hence reduced risk of breakage/ disruption) can be considered a quantified benefit. This benefit is consistent across all four investment options.

Benefit Category	Description	Key inputs	Values	Source	Timing
Biogas	The investment options constantly produce biogas	Electricity costs	$0.1359/kWh	Energy in New Zealand 2021 (mbie.govt.nz) - PP26	Annual
		Discount applied	20%	WCC	
Resilience	The investment options have a resilience benefit from not using the pipeline from Moa Point to the Southern Landfill	Value	$20,000,000 per event	Derived from the cost of the recent 2019/2020 pipeline outage cost	Annualised - i.e. probability weighted benefit
		Probability	4%	WCC and project team estimate	

Appendix Two

Sensitivity Analysis

There are a range of assumptions that have been made to develop a reasonable cost and benefit analysis for this investment. Sensitivity testing can provide decision makers with a sense of the extent to which the analysis is affected by core assumptions and therefore provide greater confidence in the findings.

While the use of sensitivity testing is recommended, the level of effort on any proposed analysis should be fit for purpose for the decision being sought and should generally focus on the assumptions that have the biggest impact on the decision.

For this particular investment three major sensitivities are considered:

- Capital cost escalation
- Operating cost - increased trucking costs
- Operating costs - increased landfill disposal.

Capital cost estimates

A 12.5% increase in capital costs of the investment options has been modelled. Considerable cost escalation has been seen in the construction market in the last 12 - 18 months and a 12.5% sensitivity represents a reasonable midpoint that is used as a sensitivity for future cost escalation.

The results of the sensitivity analysis show that the relativities between options remains the same - Option 10M (LD and TD) has the lowest undiscounted costs, while the Base Case has the lowest discounted costs (with Option 10M still the second lowest cost option). However, under this sensitivity, each investment option increases in total net cost by between $43.4 and $49m (undiscounted) or 10.2% - 11.4% of total net undiscounted costs.

Table X: Undiscounted costs and benefits

Undiscounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	19.0	18.5	19.0	21.9	4.1
Power Costs - Dewatering / Digestion plant	11.1	10.9	5.8	39.5	15.5
Power Costs - Pipeline	4.7	0.3	0.3	0.3	0.3
Labour Costs	5.4	15.2	15.2	10.3	15.2
Maintenance Cost - Moa Point	3.3	180.9	189.9	203.9	195.3
Maintenance Cost - Pipeline	15.5	1.2	1.2	1.2	1.2
Fuel Costs	-	-	-	-	0.1
Sludge Transport Costs	78.9	33.1	31.9	33.4	33.4
Sludge Disposal Fees (southern landfill)	18.8	46.6	40.8	48.4	48.4
Asset Renewal Costs	82.0	-	-	-	-
Additional Trucking Cost (Bony Glen)	182.6	-	-	-	-
Alternative Disposal Fees (Bony Glen)	194.4	-	-	-	-
Decommissioning costs	-	1.0	1.0	1.0	1.0
Total Operating Costs	615.7	307.8	305.2	360.0	314.5
Capital costs	0	209.8	234.1	236.9	227.0
Total Costs - Undiscounted	615.7	517.6	539.3	596.8	541.5
Benefits	0	72.4	78.9	76.9	36.8
Net Costs - Undiscounted	615.7	445.2	460.4	520.0	504.7
Difference vs final CBA results ($m)	0.4	43.4	47.1	49.0	46.9
Difference vs final CBA results (%)	0.1%	10.8%	11.4%	10.4%	10.2%

Table X: Discounted costs and benefits

Discounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	6.6	6.5	6.6	7.5	2.1
Power Costs - Dewatering / Digestion plant	3.9	3.8	2.2	12.6	5.2
Power Costs - Pipeline	1.6	0.3	0.3	0.3	0.3
Labour Costs	2.0	5.1	5.1	3.5	5.1
Maintenance Cost - Moa Point	1.2	58.0	60.9	65.4	62.6
Maintenance Cost - Pipeline	5.7	1.1	1.1	1.1	1.1
Fuel Costs	-	-	-	-	0.0
Sludge Transport Costs	27.5	13.4	13.0	13.5	13.5
Sludge Disposal Fees (southern landfill)	16.6	25.2	23.4	25.7	25.7
Asset Renewal Costs	39.3	-	-	-	-
Additional Trucking Cost (Bony Glen)	56.1	-	-	-	-
Alternative Disposal Fees (Bony Glen)	59.7	-	-	-	-
Decommissioning costs	-	0.8	0.8	0.8	0.8
Total Operating Costs	220.2	114.2	113.5	130.4	116.4
Capital costs	0	182.3	203.4	205.9	197.3
Total Costs - Discounted	220.2	296.5	316.9	336.3	313.7
Benefits	0	22.7	24.7	24.1	11.8
Net Costs - Discounted	220.2	273.8	292.2	312.2	302.0
Difference vs final CBA results ($m)	0.1	26.7	29.4	30.1	28.9
Difference vs final CBA results (%)	0.1%	10.8%	11.2%	10.7%	10.6%

Operating Costs - Increased trucking costs

A 25% increase in the cost of trucking sludge across all scenarios has been modelled. In the past six months there has been a significant increase in the cost of crude oil (as well as petrol and diesel prices) and 25% sensitivity represents a reasonable sensitivity for near term cost escalation.

The results of the sensitivity analysis show that the relativities between options remains the same - Option 10M (LD and TD) has the lowest undiscounted costs, while the Base Case has the lowest discounted costs (with Option 10M still the second lowest cost option). However:

- The Base Case increases in total net cost by $65.4m (undiscounted) or 10.6%.
- Each investment option increases in total net cost by between $8.0m and $8.3m (undiscounted) or between 1.6% and 1.9%.

If a 40% trucking cost increase sensitivity is assumed, then Option 10M (LD and TD) is the preferred option under discounted and undiscounted analysis.

Table X: Undiscounted costs and benefits

Undiscounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	19.0	18.5	19.0	21.9	4.1
Power Costs - Dewatering / Digestion plant	11.1	10.9	5.8	39.5	15.5
Power Costs - Pipeline	4.7	0.3	0.3	0.3	0.3
Labour Costs	5.4	15.2	15.2	10.3	15.2
Maintenance Cost - Moa Point	2 .9	160.8	168.8	181.3	173.6
Maintenance Cost - Pipeline	15.5	1.2	1.2	1.2	1.2
Fuel Costs	-	-	-	-	0.1
Sludge Transport Costs	98.6	41.4	39.9	41.7	41.7
Sludge Disposal Fees (southern landfill)	18.8	46.6	40.8	48.4	48.4
Asset Renewal Costs	82.0	-	-	-	-
Additional Trucking Cost (Bony Glen)	228.3	-	-	-	-
Alternative Disposal Fees (Bony Glen)	194.4	-	-	-	-
Decommissioning costs	-	1.0	1.0	1.0	1.0
Total Operating Costs	680.7	296.0	292.0	345.6	301.2
Capital costs	0	186.5	208.1	210.6	201.8
Total Costs - Undiscounted	680.7	482.5	500.1	556.2	503.0
Benefits	0	72.4	78.9	76.9	36.8
Net Costs - Undiscounted	680.7	410.1	421.2	479.3	466.2
Difference vs final CBA results ($m)	65.4	8.3	8.0	8.3	8.3
Difference vs final CBA results (%)	10.6%	1.9%	1.7%	1.6%	1.7%

Table X: Discounted costs and benefits

Discounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	6.6	6.5	6.6	7.5	2.1
Power Costs - Dewatering / Digestion plant	3.9	3.8	2.2	12.6	5.2
Power Costs - Pipeline	1.6	0.3	0.3	0.3	0.3
Labour Costs	2.0	5.1	5.1	3.5	5.1
Maintenance Cost - Moa Point	1.1	51.6	54.1	58.1	5.7
Maintenance Cost - Pipeline	5.7	1.1	1.1	1.1	1.1
Fuel Costs	-	-	-	-	0.0
Sludge Transport Costs	34.4	16.8	16.3	16.9	16.9
Sludge Disposal Fees (southern landfill)	16.6	25.2	23.4	25.7	25.7
Asset Renewal Costs	39.3	-	-	-	-
Additional Trucking Cost (Bony Glen)	70.1	-	-	-	-
Alternative Disposal Fees (Bony Glen)	59.7	-	-	-	-
Decommissioning costs	-	0.8	0.8	0.8	0.8
Total Operating Costs	241.0	111.1	110.0	126.5	112.8
Capital costs	0	162.1	180.8	183.0	175.4
Total Costs - Discounted	241.0	273.1	290.8	309.5	288.2
Benefits	0	22.7	24.7	24.1	11.8
Net Costs - Discounted	241.0	250.4	266.1	285.5	276.5
Difference vs final CBA results ($m)	20.9	3.4	3.3	3.4	3.4
Difference vs final CBA results (%)	9.5%	1.2%	1.1%	1.1%	1.1%

Operating costs - increased landfill disposal

A 25% increase in the cost of disposing of sludge across all scenarios has been modelled.

The results of the sensitivity analysis show that the relativities between options remains the same - Option 10M (LD and TD) has the lowest undiscounted costs, while the Base Case has the lowest discounted costs (with Option 10M still the second lowest cost option). However:

- The Base Case increases in total net cost by $53.3m (undiscounted) or 8.7%.
- Each investment option increases in total net cost by between 10.2m and 12.1m (undiscounted) or between 2.5% and 2.9%.

Table X: Undiscounted costs and benefits

Undiscounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	19.0	18.5	19.0	21.9	4.1
Power Costs - Dewatering / Digestion plant	11.1	10.9	5.8	39.5	15.5
Power Costs - Pipeline	4.7	0.3	0.3	0.3	0.3
Labour Costs	5.4	15.2	15.2	10.3	15.2
Maintenance Cost - Moa Point	2 .9	160.8	168.8	181.3	173.6
Maintenance Cost - Pipeline	15.5	1.2	1.2	1.2	1.2
Fuel Costs	-	-	-	-	0.1
Sludge Transport Costs	78.9	33.1	31.9	33.4	33.4
Sludge Disposal Fees (southern landfill)	23.5	58.2	51.0	60.5	60.5
Asset Renewal Costs	82.0	-	-	-	-
Additional Trucking Cost (Bony Glen)	182.6	-	-	-	-
Alternative Disposal Fees (Bony Glen)	243.0	-	-	-	-
Decommissioning costs	-	1.0	1.0	1.0	1.0
Total Operating Costs	668.6	299.3	294.3	349.4	304.9
Capital costs	0	186.5	208.1	210.6	201.8
Total Costs - Undiscounted	668.6	485.9	502.4	559.9	506.7
Benefits	0	72.4	78.9	76.9	36.8
Net Costs - Undiscounted	668.6	413.4	423.5	483.1	469.9
Difference vs final CBA results ($m)	53.3	11.7	10.2	12.1	12.1
Difference vs final CBA results (%)	8.7%	2.9%	2.5%	2.6%	2.6%

Table X: Discounted costs and benefits

Discounted Costs and Benefits	Options				
	1	10M	12M	17M	19M
Costs ($'m)					
Chemical Costs	6.6	6.5	6.6	7.5	2.1
Power Costs - Dewatering / Digestion plant	3.9	3.8	2.2	12.6	5.2
Power Costs - Pipeline	1.6	0.3	0.3	0.3	0.3
Labour Costs	2.0	5.1	5.1	3.5	5.1
Maintenance Cost - Moa Point	1.1	51.6	54.1	58.1	55.7
Maintenance Cost - Pipeline	5.7	1.1	1.1	1.1	1.1
Fuel Costs	-	-	-	-	0.0
Sludge Transport Costs	27.5	13.4	13.0	13.5	13.5
Sludge Disposal Fees (southern landfill)	20.8	31.5	29.2	32.2	32.2
Asset Renewal Costs	39.3	-	-	-	-
Additional Trucking Cost (Bony Glen)	56.1	-	-	-	-
Alternative Disposal Fees (Bony Glen)	74.7	-	-	-	-
Decommissioning costs	-	0.8	0.8	0.8	0.8
Total Operating Costs	239.2	114.0	112.5	129.6	115.9
Capital costs	0	162.1	180.8	183.0	175.4
Total Costs - Discounted	239.2	276.1	293.4	312.6	291.3
Benefits	0	22.7	24.7	24.1	11.8
Net Costs - Discounted	239.2	253.3	268.6	288.5	279.5
Difference vs final CBA results ($m)	19.1	6.3	5.8	6.4	6.4
Difference vs final CBA results (%)	8.7%	2.5%	2.2%	2.3%	2.4%

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