Assessment of Alternatives

Project title and description

Northern Interceptor Wastewater Project

prepared for Watercare by:

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SUSTAINABILITY REPORTING AWARDS

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Watercare Services Limited

Northern Interceptor - Assessment of Alternatives

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Section 171(1)(b) of the Resource Management Act 1991 ("RMA") requires that; when making a recommendation on a Notice of Requirement ("NoR"), a territorial authority shall consider whether adequate regard has been given to alternative sites, routes or methods of undertaking the work if the requiring authority does not have an interest in the land sufficient for undertaking the work, or it is likely that the work will have a significant adverse effect on the environment.

With regards to the Northern Interceptor Project, Watercare (the Requiring Authority) does not have sufficient interest in the land for undertaking the work and as such, an assessment of whether adequate consideration has been given to alternative sites, routes and methods of undertaking the work is required.

The purpose of this report is to document the development of alternatives and the process used to assess and compare options to identify the preferred solution – the proposed Northern Interceptor – in order to provide the information necessary to inform an assessment under Section 171(1)(b).

The following flow diagram provides a summary of the process undertaken to consider alternative options for the Northern Interceptor Project:

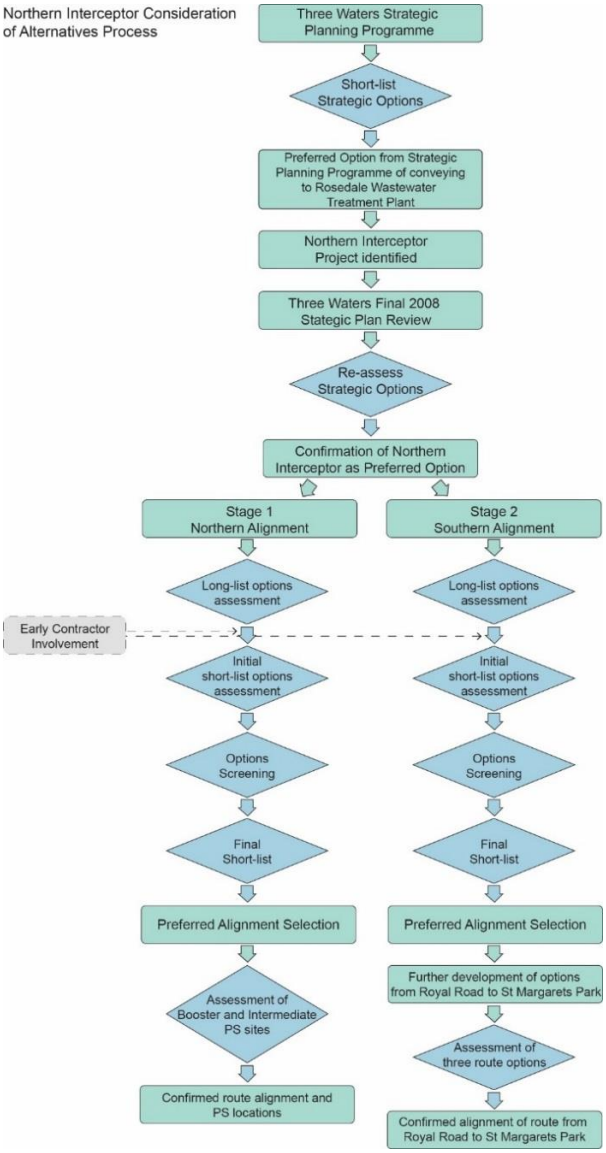


Figure 1-1: Northern Interceptor Consideration of Alternatives Process

1.1 Issues

Prior to the amalgamation of the legacy Auckland Councils in 2010, the former Waitakere City Council ("WCC") identified that the north western area of the city had insufficient zoned land to meet the demands of projected growth within the area. To address the situation, the Northern Strategic Growth Area ("NorSGA") project was initiated in partnership with land developers with the intention of delivering new employment and housing opportunities in the area. Three plan changes were made operative to facilitate the anticipated growth.

Post Auckland Council amalgamation, ownership of the NorSGA project (renamed the North West Transformation Area) transferred to Council. Council largely adopted the growth vision for this area in its Auckland Plan, and identified Auckland's North West as one of the eight priority areas for growth and development within the Auckland region. Stage 1 of the development is currently underway. This stage entails 435 hectares consisting of Hobsonville Point, Hobsonville Corridor, and Westgate/Massey North. As such, the Northern Waitakere area, including the North West Transformation Area ("NWTA") is subject to significant growth pressure.

Growth forecasts indicate that population in the Northern Waitakere area will increase from 75,000 to over 200,000 people within the next 50 years. Proposed land use zoning as part of the Proposed Auckland Unitary Plan ("PAUP") suggests that growth could exceed these figures. Watercare's assessment of the latest development plans provided by Auckland Council shows that ultimate (complete build out) growth in these areas will result in an estimated total population of 350,000 people by 2070.

The requirement to respond to the needs of the Northern Waitakere area, inclusive of the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas, is well established. These areas are collectively referred to as the "Service Catchment" in this Report (see Figure 1 below). To summarise, the key wastewater issues relevant to the Service Catchment include:

1. Growth forecasts indicate that population in the Service Catchment area will increase from 75,000 to potentially over 300,000 people within the next 50 years;
2. At present, local infrastructure (e.g. household and local wastewater pipes) is at capacity which overloads the network, causing public health and environmental issues which need to be addressed;
3. Major components of Auckland's wastewater infrastructure are near or at capacity in Central Auckland, some of which cannot be maintained because they flow full for significant periods of time. Flows from the Service Catchment add to this issue, as it presently utilises this conveyance system;
4. The risk of wastewater overflows is increasing over time due to capacity and growth issues;
5. At projected population growth rates, the Mangere Wastewater Treatment Plant ("WWTP") which presently treats all wastewater flows within the Service Area Catchment is expected to reach its capacity in about 2027. It is anticipated that any further urban growth within the Service Catchment will likely need to be directed and treated elsewhere;
6. The present wastewater conveyance and capacity is a constraint on residential growth in Auckland, as the number of households it can service is finite.

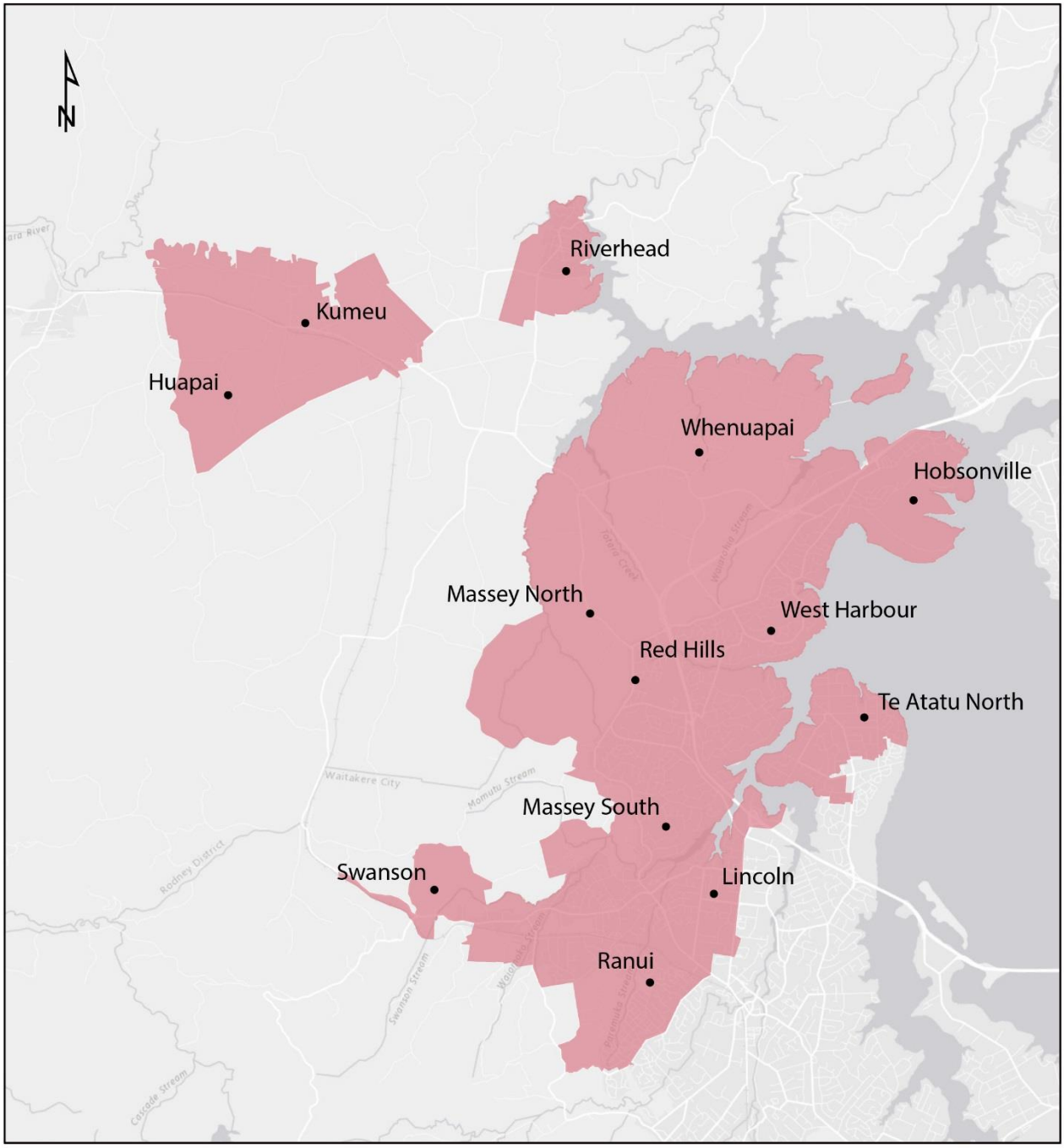


Figure 1-2: Northern Interceptor Service Catchment (Shaded Red)

1.2 Watercare's Strategic Intent

In accordance with the Local Government Act 2002 ("LGA") Watercare is required to develop and to be consistent with a Statement of Intent. The Watercare Strategic Intent 2015 – 2018 outlines four strategic priorities – these priorities reflect the organisation's focus on (amongst other things) continuing to consistently deliver reliable, affordable, high quality, sustainable wastewater services. The four strategic priorities are as follows:

- **Customer Focus** – Putting customers at the heart of our business by aligning processes, people and systems to deliver exceptional performance at minimum cost;
- **Business Excellence** - We deliver positive customer outcomes by being a commercially-savvy, performance-based organisation that prioritises the development and well-being of our people and the long-term resilience of our assets;
- **Financial Responsibility** – We are a financially responsible and efficient business, balancing our long-term financial obligations with our requirement to be a minimum cost provider; and
- **Fully Sustainable** - As custodians of the environment, we effectively manage and minimise the impact of our operations on the environment and embed sustainability into all aspects of our business.

1.3 Project Objectives

The project objectives are derived from the issues outlined above, and Watercare's Strategic Intent. The Project Objectives are as follows:

- To provide additional capacity in the wastewater network for growth and development in North West Auckland in a manner that:
    a. Protects public health;
    b. Is consistent with Watercare's Strategic priority of being a minimum cost service provider;
    c. Avoids, remedies or mitigates adverse environmental, cultural and social effects to the greatest extent practicable; and
    d. Provides for flexibility of construction staging to recognise the uncertainties of projected growth.
- To provide statutory protection for the Northern Interceptor and to enable its future construction, operation and maintenance.

2 Consideration of Alternatives

2.1 Background

In response to the issues summarised above at Section 1.2, Watercare has undertaken a number of studies to:

- Understand the network capacity and performance of wastewater infrastructure within the Service Catchment; and
- To investigate the potential options for responding to the issues that the Service Catchment currently faces and can expect to face in the future.

Subsequently, a proposed solution to the wastewater needs of the Service Catchment has been in development since at least 2008. Over this period of time a wide variety of alternative options have been considered and summarised through numerous reports.

The following sections of this Report provide further details of the processes of considering alternative options to address the issues outlined above in Section 1.2.

2.1.1 Three Waters Strategic Planning Programme (2008)

The Three Waters Strategic Planning Programme was a Watercare-led initiative that investigated ways to deliver the future water supply, wastewater and stormwater services in the Auckland region. The primary drivers behind this programme, as identified by Watercare, were the need to service growth, to deliver specified levels of service, and to meet their requirements as a service provider under various legislation (e.g. the LGA).

The outcome of this programme was the development of the *Three Waters Final 2008 Strategic Plan* which provided an overview of the investigations undertaken by that Project Team. The Plan covered potential long-term strategies and options to address urgent and developing wastewater issues, which was identified as the most pressing three waters issue facing the region.

In identifying a long-term solution to addressing the region's trunk wastewater issues for the next 50 years, the following options assessment and process was undertaken:

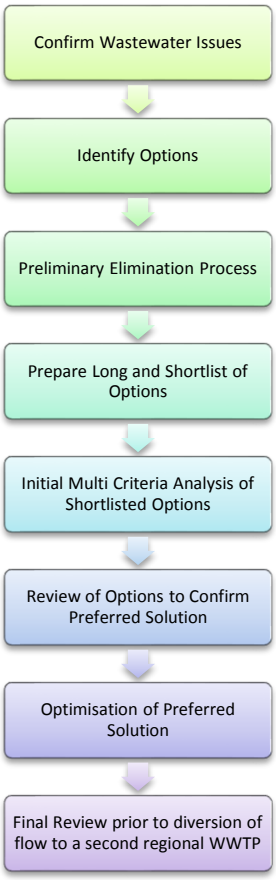
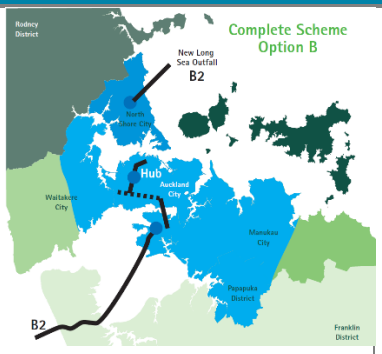
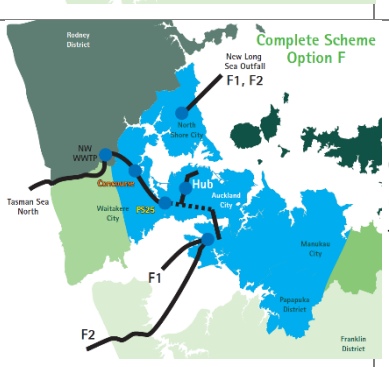
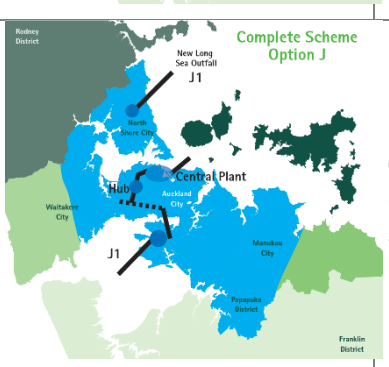
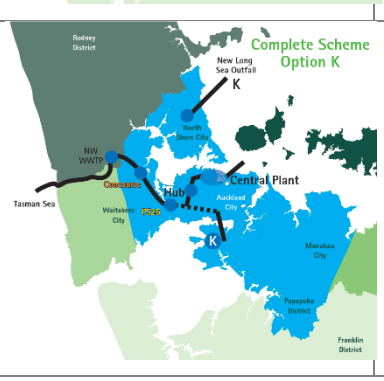


Figure 2-1: Process to identify a Long-Term Solution to Auckland's Wastewater Needs

In developing long-term solutions, Watercare undertook a series of investigations to identify an appropriate approach to managing wastewater in the Auckland region. These initial investigations focussed on the strategic use of existing, and the potential need for new, regional treatment plant facilities. From this, 14 potential options were shortlisted, which can be categorised into four broad scenarios, which utilise either existing or new regional treatment plan facilities. The four broad scenarios were as follows:

Table 2-1: Broad Scenarios to Address Growth in the Auckland Region

Scenario	Description
Scenario 1	 Combination of utilising existing North Eastern (Rosedale) and the existing South Western (Mangere) WWTP sites.
Scenario 2	 Combination of utilising the existing North Eastern (Rosedale), new North Western (Taupaki) WWTP and the existing South Western (Mangere) WWTP.
Scenario 3	 Combination of utilising the existing North Eastern (Rosedale), a new Central WWTP and the existing South Western (Mangere) WWTP.
Scenario 4	 Combination of utilising the existing North Eastern (Rosedale), a new North Western (Taupaki), new Central treatment facility and the existing South Western (Mangere) WWTP.

Once the 14 shortlist options were identified, four specialist groups were organised to assess the options against social, cultural and environmental criteria as well as legal, technical, risk and timing issues.

A separate process was used to consider economic well-being, whereby detailed estimates were prepared and internally and externally peer reviewed. All options were scored against the economic goals by the Project Team and then peer reviewed.

The following conclusions were drawn from the evaluation process:

- Estimated whole of life costs for all options were within 15% of the average and hence were all within the bounds of estimating accuracy. Consequently, whole of life costs could not be used as a reliable basis for differentiating between options;
- When options were compared on the basis of scores from the specialist social, cultural and environmental groups, most Options were broadly comparable;
- Most options were broadly comparable on legal, technical, risk and timing grounds, as all option assessed were technically feasible and the cost estimates provided for differences; and
- If the ability to proceed without undue delay were to become important, Option E, a sub-option of Scenario 1 would have advantages over other sub-options and would leave the greatest flexibility for the future as it would build on existing plants, leaving other opportunities open.

Overall, Option E (a derivative of Scenario 1), which comprised a combination of utilising a North Eastern (Rosedale) and South Western (Mangere) WWTP was favoured by the Project Team for the following reasons:

- Not considered to result in a significant increase in effects, if any, compared to existing consented limits with respect to discharges;
- Considered to have lowest adverse effects on communities overall;
- Deemed to best addresses cultural issues, of the options available;
- Maximises benefits of existing resources and investment at Rosedale and the associated outfall;
- Requires less energy to pump wastewater to the treatment plant unless a new north west site is chosen; and
- Considered to have the lowest overall construction risk.

2.1.2 Three Waters Strategy Review

Between 2013 and 2014, Watercare undertook further work to:

- Review and develop the broad approaches to the Three Waters Strategy shortlist options with regards to the Service Catchment; and
- Summarise the development of these options, and identify the preferred solution.

In giving further consideration to the shortlist options, key Project Drivers were identified by the Project Team (Consultants and Watercare staff). These Project Drivers were utilised to identify and assess alternative options and are described below:

- **Future growth estimates** - Growth forecasts indicate that population in the Service Catchment will increase from 75,000 to over 350,000 people within the next 50 years.
- **The conveyance capacity** - There are capacity constraints within the existing network, and the growth proposed by Auckland Council ("Council") in northwest Auckland will result in wastewater flows exceeding the system capacity.
- **The treatment capacity and consents** - The key findings of the *Three Waters Final Strategic Plan* relating to the treatment capacity were:
    - The Rosedale WWTP should be developed as a second regional wastewater treatment facility; and

- Given the imposed volume limits and remaining available capacity at the Mangere WWTP, Watercare identified the need to transfer some of the projected growth within the Mangere WWTP service area to an alternate location for treatment. Rosedale WWTP has the ability to receive flows transferred from the Mangere WWTP service area, and to service projected growth in southern Auckland (e.g. Papakura).

- **Level of service** – To meet the requirements of Watercare's regional network discharge consent, which requires no more than two dry weather overflows per annum unless an alternate has been determined through a Best Practicable Option ("BPO") process.

2.1.2.1 Option Identification

Having regard to the Project Drivers and further analysis undertaken, the strategic review focussed on five broad options.

2.1.2.2 Option 1 – Do Nothing

This option provides no additional wastewater conveyance or treatment capacity for the Service Catchment and would constrain urban development. This option would not meet targets for wastewater overflows, nor Watercare's Statement of Intent. Therefore, this option was not considered further.

2.1.2.3 Option 2 – Mangere WWTP

This option is an extension and expansion of the existing wastewater infrastructure to increase the transfer capacity through the Whenuapai trunk wastewater network and the upper sections of the Western Interceptor. This option would be intended to connect the Western Interceptor to the proposed Central Interceptor to convey all flows to the Mangere WWTP.

Option 2 requires the following infrastructure upgrades:

- A new pipeline from the Hobsonville Pump Station ("PS") to the Western PS – both to address the capacity issues in the Whenuapai Branch sewer (outlined in section 4 of this report) and to convey flows from the Service Catchment;
- Capacity upgrade for the Western PS;
- A new pipeline from the Western PS to the proposed Central Interceptor, connecting at the St George PS – to address capacity issues in the Western Interceptor;
- Additional capacity allocation in the proposed Central Interceptor;
- Mangere WWTP upgrades.

2.1.2.4 Option 3 – Rosedale and Mangere WWTPs

This option includes a new Northern Interceptor to collect wastewater flows from the Service Catchment and would transfer these across the Upper Waitemata Harbour to the Rosedale WWTP. This would be combined with upgrades to the upper sections of the Western Interceptor to convey the projected increased flows from the northwest Auckland to Mangere WWTP via the proposed Central Interceptor.

Option 3 requires the following infrastructure upgrades:

- A new Northern Interceptor pipeline from the Hobsonville PS to the Rosedale WWTP;
- Rosedale WWTP upgrades to service growth;
- Capacity upgrade for the Western PS;
- A new pipeline from the Western PS to the proposed Central Interceptor, connecting at the St George PS – to address capacity issues in the Western Interceptor;

- Additional capacity allocation in the proposed Central Interceptor;
- Mangere WWTP upgrades to service growth.

2.1.2.5 Option 4 – Rosedale WWTP

This option seeks to limit flows in the Whenuapai Branch sewer and the upper sections of the Western Interceptor to current design capacities by constructing a new Northern Interceptor to collect all wastewater flows from the Service Catchment, and transfer these across the Upper Waitemata Harbour to Rosedale WWTP.

Option 4 requires the following infrastructure upgrades:

- A new Northern Interceptor pipeline from the Concourse Storage Tank to the Rosedale WWTP;
- Rosedale WWTP upgrades to service growth.

2.1.2.6 Option 5 – North Western Regional WWTP

This option was originally considered under the *Three Waters Final Strategic Plan*. The concept was to construct a new North Western Regional WWTP and associated conveyance system to service wastewater needs for the Service Catchment. The proposed WWTP would discharge treated wastewater to the Tasman Sea via a long gravity outfall.

This option requires the following infrastructure upgrades:

- A new North Western WWTP providing partial biological nutrient removal with similar treated wastewater standards to Rosedale WWTP;
- A gravity treated wastewater outfall to the west coast comprising tunnel and pipeline sections with overall length of approximately 15km;
- Tasman long sea outfall.

2.1.2.7 Analysis of Options

These options were assessed against qualitative (technical, operational, risk, environmental, social and cultural) and quantitative (economic) criteria to identify a preferred solution. The assessment criteria and attributes are described in the table below:

Table 2-2: Final Assessment Criteria for Northern Interceptor

Assessment criteria	Assessment attributes
Technical	Reliability, flexibility, constructability and opportunities for additional benefits
Operational	Safety, complexity, maintenance, odour and corrosion, long-term resilience
Risk	Watercare risk management framework in accordance with AS/NZS ISO 31000:2009
Environmental/Social/Cultural	Impacts/effects of construction and long-term operations on the environment, community and cultural well being
Economic	Capital and long-term operational costs in the form of a net present value (“NPV”)

The analysis of the five options for the Northern Interceptor Project against the criteria listed above is contained in Table 2-3 below.

Table 2-3: Final Assessment of Northern Interceptor Options Against Assessment Criteria

Assessment Criteria	Option 1 – Do Nothing	Option 2 – All flows to Mangere WWTP	Option 3 – Flows to Mangere and Rosedale WWTP	Option 4 – All flows to Rosedale WWTP	Option 5 – New Northwestern WWTP
Meets Watercare's key drivers	No	Yes	Yes	Yes	Yes
Technical	No technical issues	This option is not as flexible as options 3 and 4 in terms of capacity upgrade/construction requirements. It is technically feasible and constructible.	Similar technical issues to Option 2 in terms of wastewater conveyance to Mangere WWTP. Additional technical complexities in terms of conveying wastewater to Rosedale WWTP which are similar to Option 4, but considered feasible and constructible.	Offers the most flexibility of all options in terms of the ability to stage infrastructure over time. Similar to Options 2 and 3 in terms of other technical issues around constructability and feasibility.	Of all options which adequately meet Watercare's drivers this one presents the greatest technical challenges in terms of feasibility and constructability. The treated wastewater outfall to the Tasman Sea presents a significant technical challenge and is not flexible in terms of staging.
Operational	Overflow response requirements will increase over time	Issues in terms of odour and corrosion resulting from conveying septic wastewater long distances. Impacts on operational requirements for odour treatment, ventilation and operations of the proposed Central Interceptor.	Similar operational issues to Options 2 and 4, including risk of corrosion and odour control requirements.	Similar operational issues to Options 2 and 3 in terms of managing odour and corrosion issues. Will require pumping stations with high heads.	Significant operational requirements in terms of running a new treatment plant.
Risk	High risk of increasing overflows resulting from growth	Primary risks include risk of corrosion and odour problems, and risk of exceeding existing Mangere WWTP	Lower risks than Option 2 due to distribution of wastewater between Mangere and Rosedale WWTPs.	This option is considered to have the lowest risk in terms of the ability to achieve all project drivers within the constraints of	Risks are higher than Options 2 through 4 including treatment plant performance and construction of a new long sea outfall.

Assessment Criteria	Option 1 – Do Nothing	Option 2 – All flows to Mangere WWTP	Option 3 – Flows to Mangere and Rosedale WWTP	Option 4 – All flows to Rosedale WWTP	Option 5 – New Northwestern WWTP
	and development.	consent limits in terms of allowable flows and discharge volume.		existing treatment plant consents given available capacity at the Rosedale WWTP and utilisation of the new long sea outfall.	
Environmental **Social** **Cultural**	Significant in terms of the effects of increasing overflows.	Significant effects due to long distances of construction which include working in residential areas. Effects associated with conveyance of wastewater to Mangere WWTP in terms of existing consent limits and discharge to the Manukau Harbour.	Less effects than Option 2 in terms of reduced flows to the Mangere WWTP, but wider area of effects due to construction through a longer corridor.	The environmental, social and cultural effects are lower than Options 2, 3 and 5 given the use of the Rosedale WWTP long sea outfall and the smaller amount of area impacted by construction.	Significant effects including construction requirements and placement of an additional permanent wastewater treatment facility.
Economic – 50yr NPV (2014 analysis)	Does not meet drivers	$372M	$389M	$363M	$1B

Consideration of whether the option met the Project Drivers (discussed in Section 2.1.2 above) and strategic intent was also undertaken.

2.1.2.8 The Preferred Option

On the basis of the assessment process described in Section 2.1.2.7, Option 4 – Rosedale WWTP was identified as the preferred option for the Service Catchment. To facilitate Option 4, the construction of a new pipeline from the Concourse Storage Tank to the Rosedale WWTP is required.

This Option, referred to as the Northern Interceptor, was selected as the preferred option for the following reasons:

- On a technical basis it provides the most potential flexibility of all options in terms of the potential to stage construction;
- The option provides the additional benefit of more efficiently utilising the existing capacity of the Rosedale WWTP and the consequential reduction in flows and loads to the Mangere WWTP;
- Operationally it is similar to Options 2 and 3, but it has lower operational complexities than Option 5;
- It has the lowest overall risk in terms of treatment requirements given the available capacity at the Rosedale WWTP and the ability to utilise the long ocean outfall;
- The option results in lower environmental, social and cultural effects than Options 2, 3 and 5 given the use of the Rosedale WWTP and the smaller area of construction effects; and
- It has the lowest overall estimated cost in terms of the projected 50-year NPV.

3 Consideration of Alternatives

The consideration of alternative options for the Northern Interceptor Project has adopted the ACRE (Area, Corridor, Route, Easement) methodology for route evaluation and consideration of opportunities and constraints:

- **The Area** – Is identified at Figure 1-1 above as the Service Catchment.
- **The Corridor** – Is identified at Figure 3-1 below as being a route from the Concourse Storage Tank to the Rosedale WWTP.
- **The Route** – Is identified at Figure 4-11 for the Northern alignment (Option 9) and Figure 5-10 for the Southern alignment (Option 8).
- **The Easement** – Is identified as the designation corridor being sought through the three NoRs relevant to the Project.

The Area and the "High Level" Corridor (Concourse Storage Tank to the Rosedale WWTP) have been identified through previous processes discussed in Section 2 above.

As such, this Report focuses on the refinement of the Corridor, and the subsequent identification of the Route and Easement.

The specific objectives of the Corridor, Route and Easement selection process, and consideration of alternatives were:

To identify an optimal wastewater management response to the issues outlined above at Section 1.2 in a manner:

a) Consistent with Watercare's strategic objectives; and

b) Consistent with Section 171(1)(b) of the RMA

In assessing each of the ACRE stages a number of analytical processes, such as Multi-Criteria Analysis ("MCA") have been utilised to narrow the consideration of alternatives from a longlist through a shortlist to a preferred option.

3.1 Ability to Stage the Project

In considering alternative options for the Project, significant emphasis was placed on the ability of an option to stage works. As discussed in Section 2, the Service Catchment is anticipated to increase in population from 75,000 to 350,000 over the next 50 years. However, there is considerable uncertainty as to how this growth will manifest itself in that time. Further, it is important that wastewater infrastructure is sized in a manner that ensures that the system operates efficiently and cost-effectively.

Due to the sensitivity and variability in population models (discussed above), it is difficult to predict how to cater for populations and business/industrial growth in 2070, while maintaining serviceability until that time. For example, to provide infrastructure capacity today to service a 50 year planning horizon would be inefficient, as it would require large capital investment to create new infrastructure to service an 'ultimate' projected population that would go underutilised for an unknown amount of time as growth occurs, creating redundant infrastructure capacity.

Other issues such as septicity and providing the appropriate level of service can arise when infrastructure is not designed or sized appropriately. As such, a key design parameter in the design of the Northern Interceptor has been the ability to stage the construction so as to adequately respond to actual population growth, rather than build an oversized pipeline sized based on conservative population projections. By enabling the staging of the pipeline the Project potentially gains:

- Flexibility to respond in design and delivery to actual future demand;
- Further ability to utilise existing design life in current assets; and
- The ability to defer large capital expenditure until the community has grown to support it.

This also allows capital costs to be spread over a number of years, and to be responsive to actual population growth.

3.2 The High Level Corridor

As noted above, the preferred option is the Northern Interceptor option ("the Project"). The key aspect of the Project comprises the construction of a new pipeline from the Concourse Storage Tank to the Rosedale WWTP. These are considered to be the two "fixed end points" for the Project.

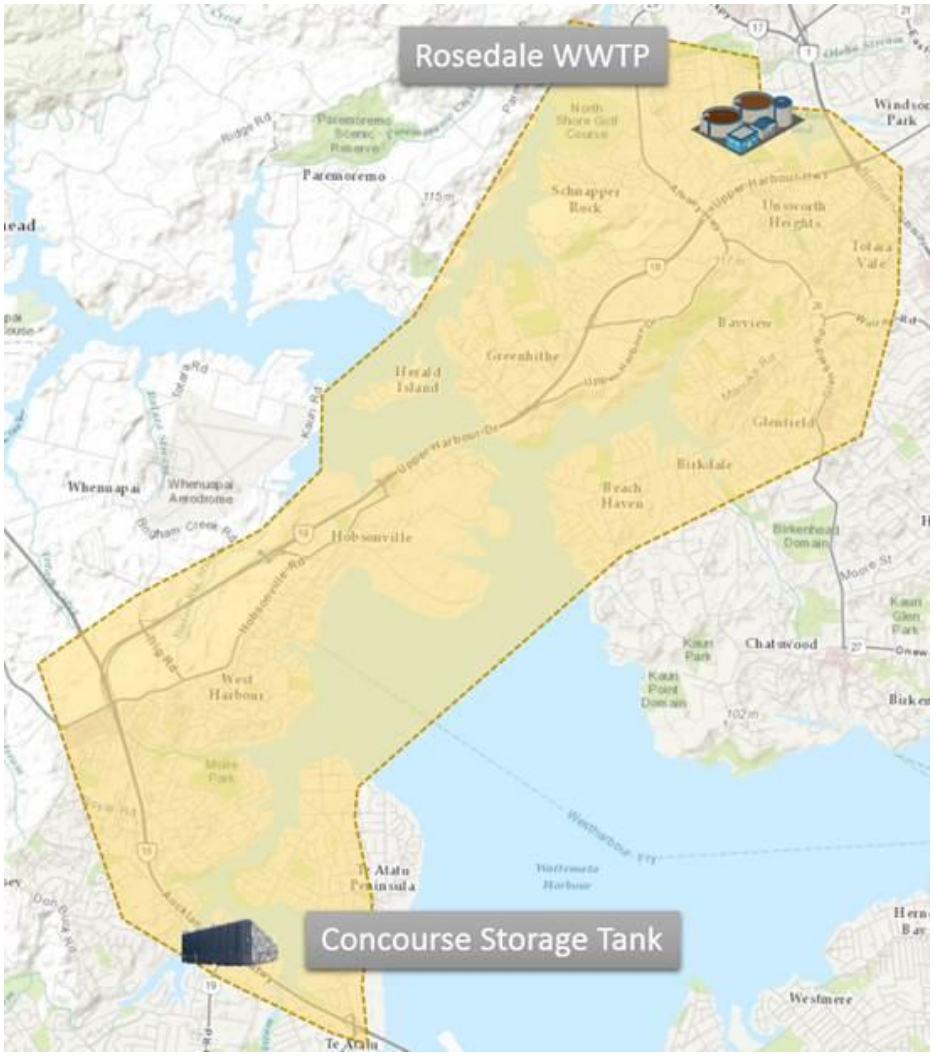


Figure 3-1: High Level Route Envelope adopted for the Northern Interceptors

These two fixed end points are considered significant in the context of the consideration of alternatives associated with the Corridor, Route and Easement of the Project as they are critical and existing components of the Project.

As such, the adoption of the Project as the preferred option inherently means the adoption of the two fixed end points and subsequently any further consideration of alternatives is limited to getting from one of these points to the other

Once the high level Corridor was identified (being the Concourse Storage Tank to the Rosedale WWTP) consideration was given to refine this Corridor.

Initial Corridor investigations considered the feasibility of a direct tunnel option from the Concourse Storage Tank to the Rosedale WWTP.

Benefits of this approach were identified as being:

a) Certainty for developers within the Service Catchment that capacity would be available once constructed as this approach would provide “full NI” capacity from the outset.

b) Limited adverse environmental effects given the depth of the pipeline.

Dis-benefits of this approach were identified as being:

a) Would take a considerable amount of time to construct and subsequently to become operational (anticipated to be no earlier than 2025) and as such existing issues within the Service Catchment network would remain until that time. In addition, constraints on growth within the Service Catchment would remain and likely exacerbate;

b) Would require a significant and inhibitive capital expenditure without the ability to defer costs; and

c) Does not provide any flexibility with regards to construction staging to match increases in wastewater flows.

It was considered that there were significant constraints associated with this approach, in particular the prohibitive capital investment required, the lack of flexibility and the likely timeframes to complete the works. Overall, it was concluded that the dis-benefits outweighed the benefits and subsequently further thought was given to potential staging options. In other words, whether there was a need for, or significant advantage of, identifying more than one Corridor stage.

Through this analysis a staged approach was considered the most practical with the ability to first connect Hobsonville PS to Rosedale WWTP and subsequently extend the NI to also connect with the Concourse Storage Tank.

In light of the above, further consideration of the alternative Corridor alignment was undertaken in two stages; Stage 1 being from the Hobsonville PS to the Rosedale WWTP, and Stage 2 from the Concourse Storage Tank to the Hobsonville PS.

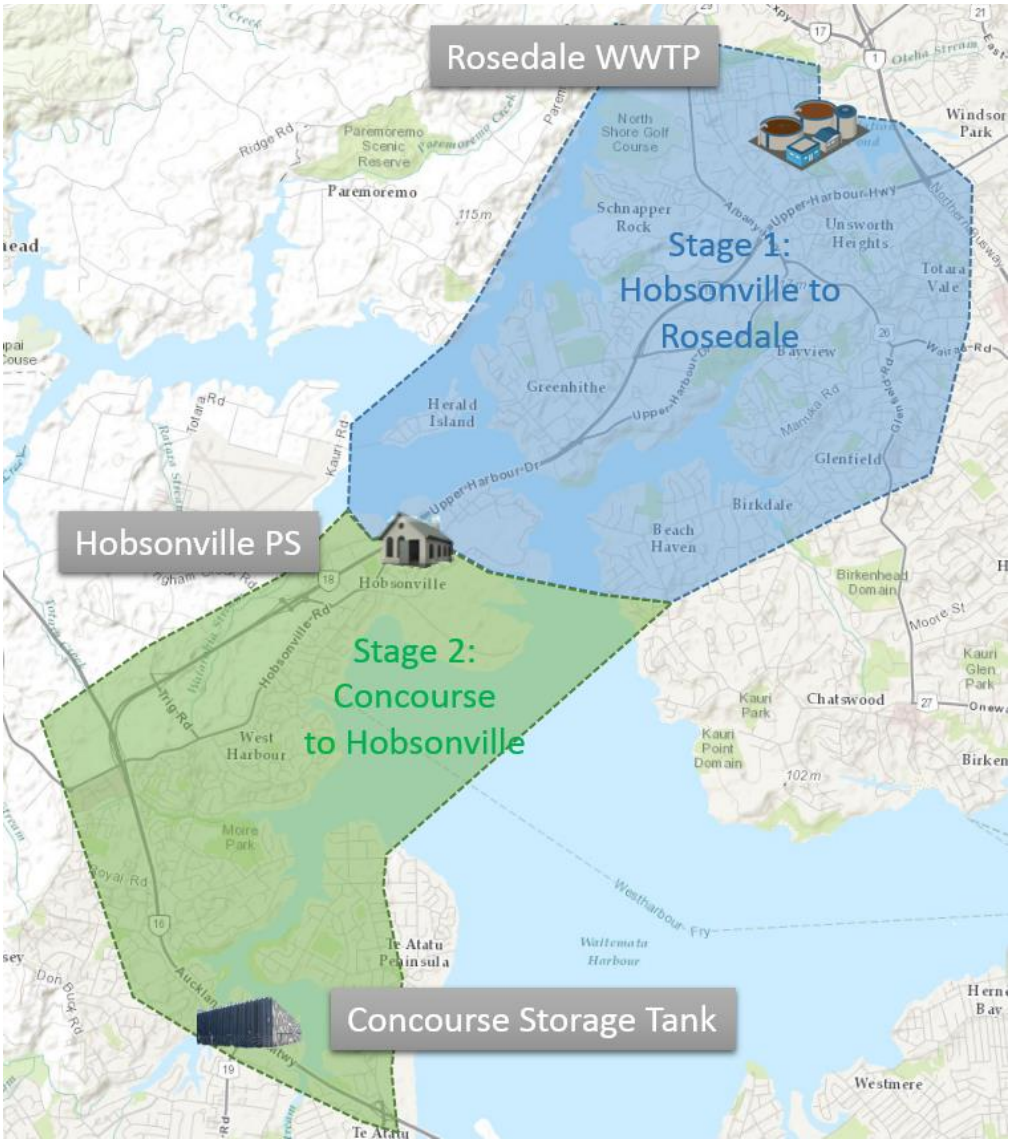


Figure 3-2: Northern and Southern Corridors (Stage 1 and Stage 2), and Fixed Points (Concourse Storage Tank, Hobsonville PS and Rosedale WWTP)

3.3 Broad Concepts

In developing longlist options for each of the two Corridor stages, three broad conceptual approaches to route selection were developed. The purpose of this approach was to ensure flexibility in route selection as the Project progresses and further information becomes available. The three broad conceptual approaches are as follows:

1. Maximise the use of road corridors within the urban environment to facilitate ease of construction and future maintenance of the assets and minimise significant adverse effects on sensitive receiving environments (e.g. private properties, significant ecological areas and the coastal marine area);
2. Minimise the use of road corridors and urbanised areas to minimise disruption to people and communities
3. Adopt the use of deep tunnels for gravity sections which limits impacts on communities and the environment to locations where shafts are situated;

4 Northern Corridor Development: Hobsonville to Rosedale

Figure 4-1: illustrates the options assessment process undertaken for Hobsonville to Rosedale Corridor (Stage 1) of the Project.

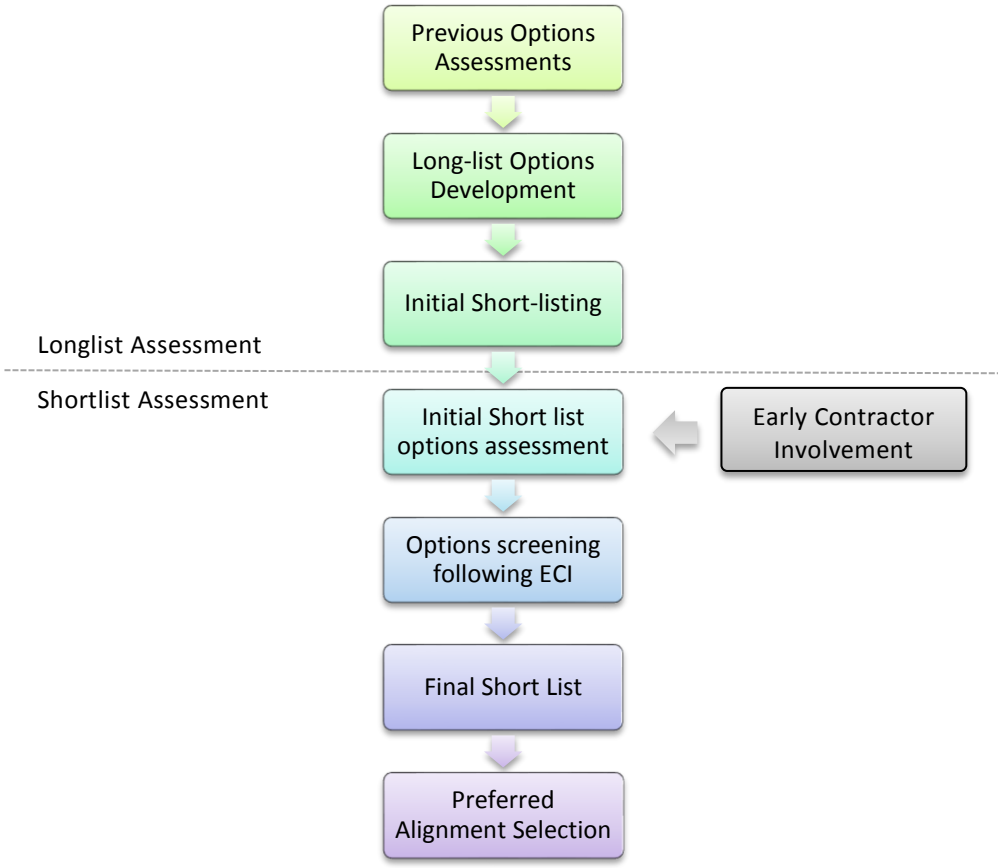


Figure 4-1: Stage 1 Options Assessment Process

A brief summary of the key activities for each stage of the assessment is provided below:

- **Previous Options Assessments** – A review of the previous option development work was undertaken. The preferred options of this previous analysis were identified and considered through the longlist process.
- **Longlist Options Development** – Consistent with the 3 broad concepts described above, 11 longlist options were identified to provide a range of alternative routes for the Project. The longlist options were developed with indicative cost estimates produced, and considered risks and opportunities.
- **Initial Shortlisting** - The longlist options were reviewed by the Project Team and evaluated in a multi-disciplinary workshop using a high level MCA.
- **Initial Shortlist Options Development** – Once the shortlist was identified, further analysis of the options was undertaken including Early Contractor Involvement ("ECI"). This was done to get early advice and involvement from a contractor into the construction methods, risks, costs,

physical impacts of construction works associated with the options, and optimisation of delivering the Project.

- **Options Screening** - A comparison of initial shortlist options after the further analysis was carried out by the Project Team. This screening exercise utilised the additional design development materials, updated cost estimates, contractor's ECI buildability and optimisation inputs and the risk assessments for the options. This produced a final shortlist of options to be adopted.
- **Final Shortlist** - The options on the final shortlist were further developed in order to facilitate a more detailed MCA assessment and updated cost estimates in order to select the preferred option.
- **Preferred Alignment Selection** –Evaluation of the final shortlist of options in a multi-disciplinary workshop using a more detailed MCA, and the selection of the preferred option (route alignment).

4.1 Development of Longlist Options

As noted above, prior to the development of the longlist options for Stage 1 of the Project, two fixed points were identified (Hobsonville PS and Rosedale WWTP). As such, a Corridor envelope was established using these fixed points as a start and end point. The corridor considered for the development of the longlist is illustrated below:

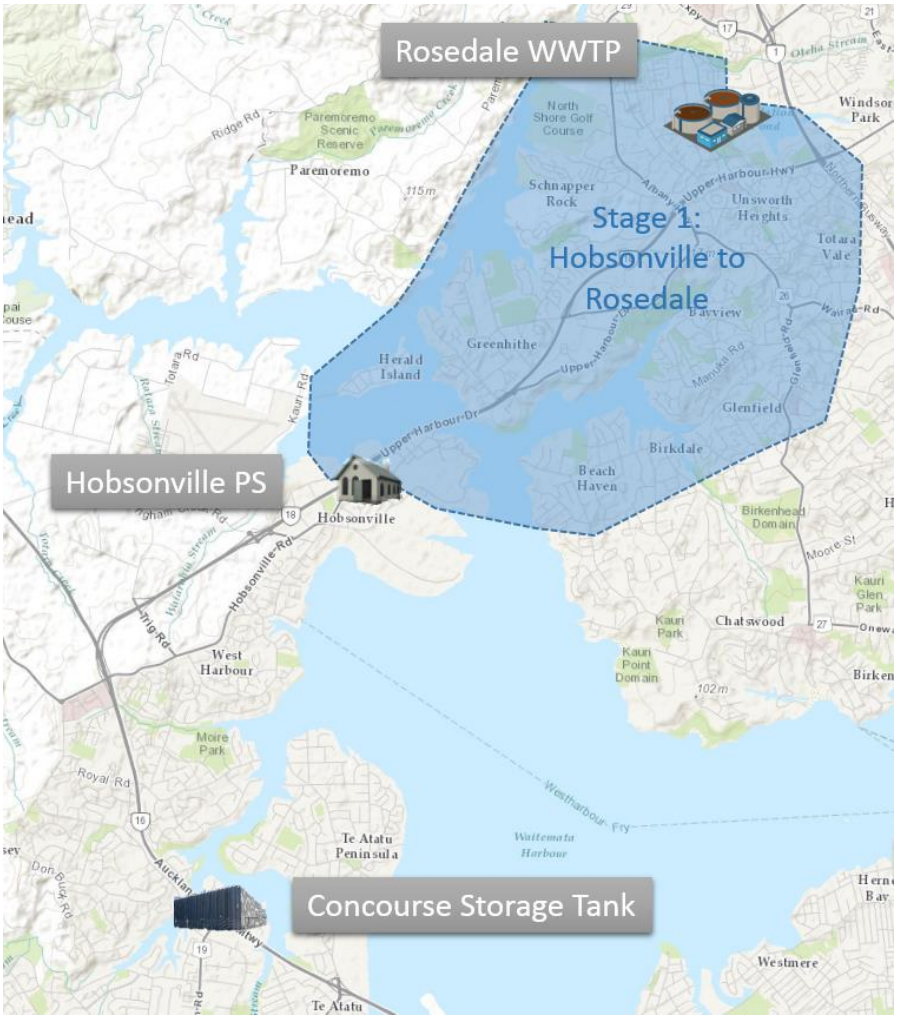


Figure 4-2: Route Envelope Adopted for Development of Longlist

Within this route envelope and adopting the broad concepts described above at 3.3, the following longlist options were identified.

4.1.1 Option 1 – Upper Harbour Drive

This option is based on the broad concept of maximising the use of roads and urban environments (Figure 4-3). From a construction perspective, the need for a crossing of the Coastal Marine Area ("CMA") at the Upper Waitemata Harbour was considered to be the most challenging aspect of this option.

For the purpose of longlist development, it is assumed that the crossing of the Harbour would be constructed by Horizontal Directional Drilling ("HDD") into the flatter coastal area north of the existing bridge as this would reduce HDD length to around 600m but would increase the overall rising main route by approximately 200m. However, early analysis also determined that a crossing to the north of the bridge would also be a preferred option for marine trenching if this technique is preferred. Construction along Upper Harbour Drive would be by micro-tunnelling. As this road runs up along the main ridgeline the micro-tunnelling needs to be very deep under this option.

This option would require new pump stations to be constructed at the Rosedale WWTP and the Concourse Storage Tank.

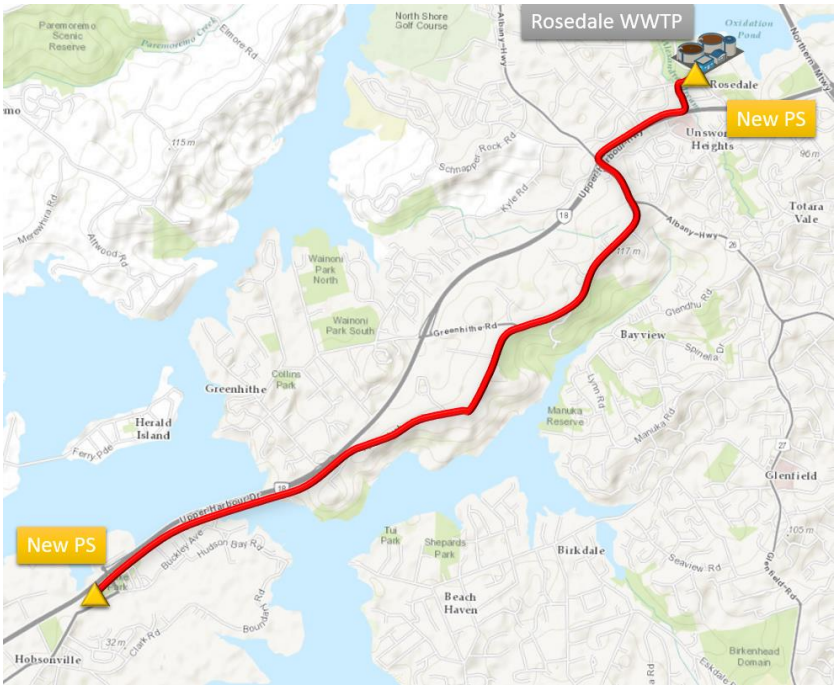


Figure 4-3: Option 1 – Upper Harbour Drive

4.1.2 Option 2 – Beach Haven Road

This option is based on the broad concept of maximising the use of roads and urban environments (Figure 4-4). This option was developed as a predominantly gravity sewer alignment on an easterly approach to Rosedale from Hobsonville. Preliminary investigations suggest that the main challenge with this alignment is likely to be the harbour crossing which is anticipated to require deep micro-tunnelling and thus increase the overall gravity sewer depth and pumping head requirements compared to other options.

For the purpose of longlist development it was assumed that the crossing of the Harbour would be constructed by marine trenching, and micro-tunnelling would be utilised along Beach Haven Road and Glenfield Road. This option would require new pump stations to be constructed near Glenfield Road and at the existing Hobsonville PS site.

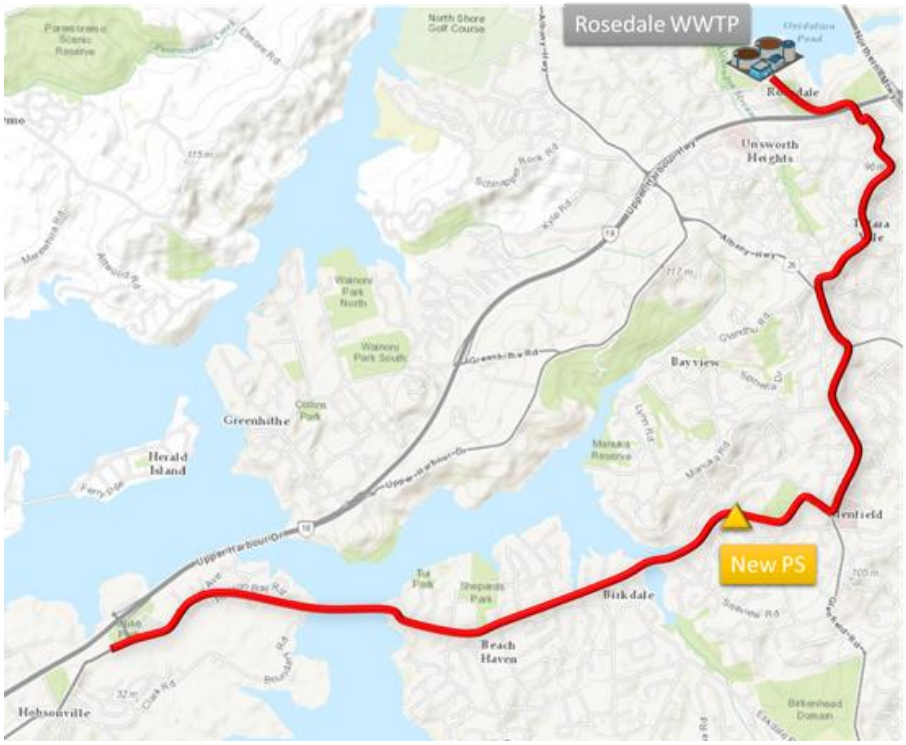


Figure 4-4: Option 2 – Beach Haven Road

4.1.3 Option 3 – Upper Harbour Highway

This option is based on the broad concept of maximising the use of roads and urban environments, and is the most direct road based alignment (Figure 4-5). From a construction perspective, the need for a crossing of the CMA and the deep gravity section along Upper Harbour Highway, were considered to be the most challenge aspects of this option.

For the purpose of longlist development it is assumed that the crossing of the Harbour would be constructed by HDD into the flatter coastal area north of the existing bridge as this would reduce HDD length to around 400m but would increase the overall rising main route by approximately 200m. However, early analysis also determined that a crossing to the north of the bridge would also be a preferred option for marine trenching if this technique is preferred.

With respect to the gravity main, it is assumed that this would be constructed by micro-tunnelling from a break pressure chamber north of the Upper Harbour Bridge to the Rosedale WWTP. This tunnel would be very deep in places (over 50m in parts), and would require micro-tunnel shafts every 250m due to the depth and jacking forces required.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and the Rosedale WWTP.

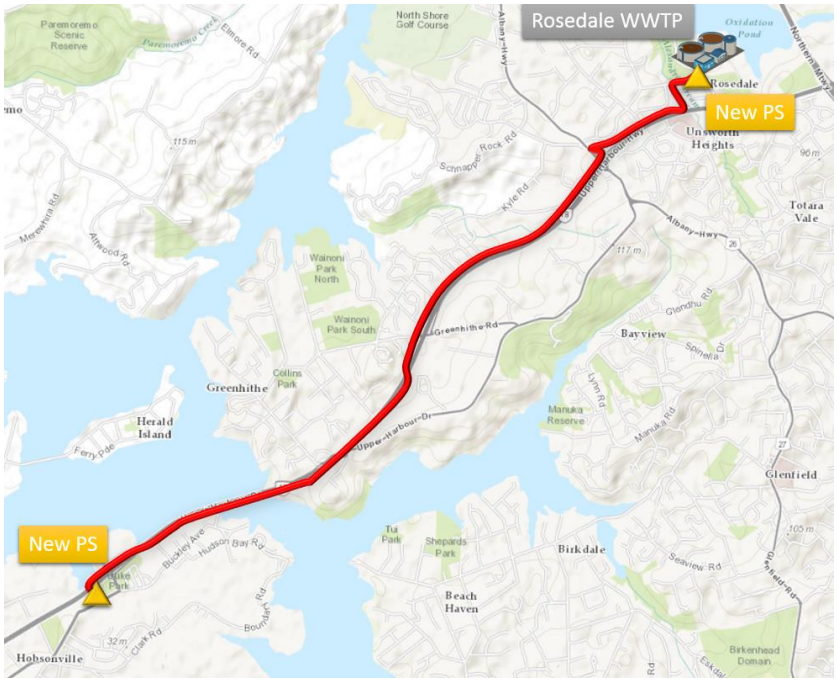


Figure 4-5: Option 3 – Upper Harbour Highway

4.1.4 Option 4 – Kyle Road

This option is based on the broad concept of maximising the use of roads and urban environments (Figure 4-6). This option is a predominantly gravity sewer alignment on a westerly approach. From a construction perspective, the need for two crossings of the CMA, the potential need to reclaim land, and the need to micro-tunnel along the existing North Harbour Water Main were considered to be the most challenging aspects of this option.

For the purpose of longlist development it is assumed that the crossing of the Harbour would be constructed by HDD. Early analysis of marine crossing options noted that a crossing in the shallow area of the harbour (across to Herald Island) may be viable to construct by marine trenching, but the channel between Herald Island and the North Shore is deep, making trenching in this area less viable.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

Figure 4-6: Option 4 – Kyle Road

4.1.5 Option 5 – Lucas Creek – Rising Main and Gravity Sewer

This option is based on the broad concept of avoiding the use of roads and urban environments (Figure 4-7). This option was developed to avoid the higher ridgelines to the south and east of Rosedale by cutting across to Lucas Creek and approach Rosedale from the west. From a construction perspective, the depth of micro-tunnelling through Rosedale's industrial area, the large extent of pipeline within the CMA (including Coastal Protection and Significant Ecological Areas) were considered to be the most challenging aspects of this option.

For the purpose of longlist development, it was assumed that a combination of marine trenching and HDD would be used to construct the rising main components of the pipeline within the marine areas from the north side of Herald Island up to Lucas Creek, and that micro-tunnelling would be used to install the gravity section of the pipeline to the Rosedale WWTP due to the construction depths required (over 50m) in some locations.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and the Rosedale WWTP.

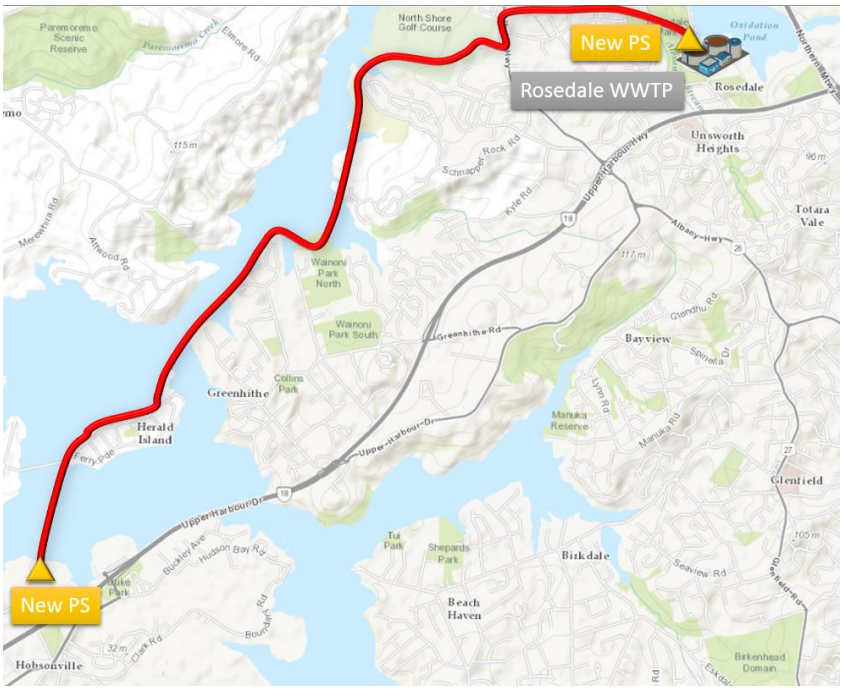


Figure 4-7: Option 5 – Lucas Creek – Rising Main and Gravity Sewer

4.1.6 Option 6 – Lucas Creek – Rising Main only

This option is based on the broad concept of avoiding the use of roads and urban environments (Figure 4-8). This option is a variation on the route above (Lucas Creek) and has been developed as entirely rising mains with no gravity sewer to minimise pipeline construction depths. From a construction perspective, the large extent of pipeline within the CMA (including Coastal Protection and Significant Ecological Areas), the odour risks due to significant retention time, and the potential impact on sites of significance along the route were identified as the most challenging aspects of this option.

For the purpose of longlist development, it was assumed that the pipeline would be constructed by open trenching techniques for both the land-based and marine crossing components. Early analysis indicated that HDD was a viable option for the marine crossing as an alternative.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

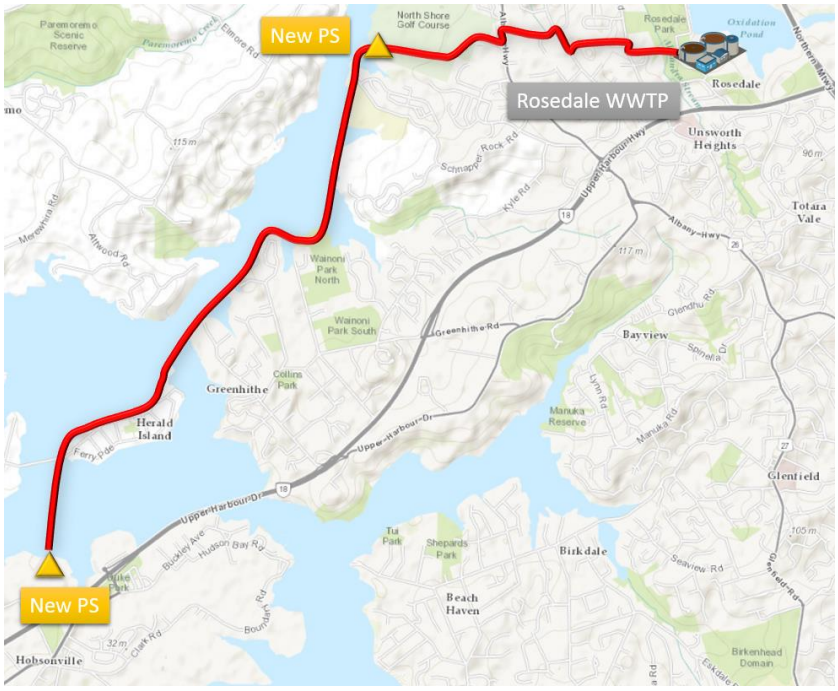


Figure 4-8: Option 6 – Lucas Creek – Rising Main Only

4.1.7 Option 7 – Deep Tunnel – Western Alignment

This option is based on the broad concept of maximising the use of deep tunnels and constitutes the use of a deep gravity tunnel direct from Hobsonville to Rosedale WWTP across the Greenhithe peninsula (Figure 4-9). From a construction perspective, the depth of the tunnel was considered to be the most challenging aspect of this option.

The western alignment was selected to maintain clearance from the Upper Harbour Highway bridge and to provide a number of suitable open space options for the location of tunnel shafts.

For the purpose of longlist development, it was assumed that the pipeline would be installed by a Tunnel Boring Machine ("TBM"). However, uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require a new pump station to be constructed at the Rosedale WWTP.

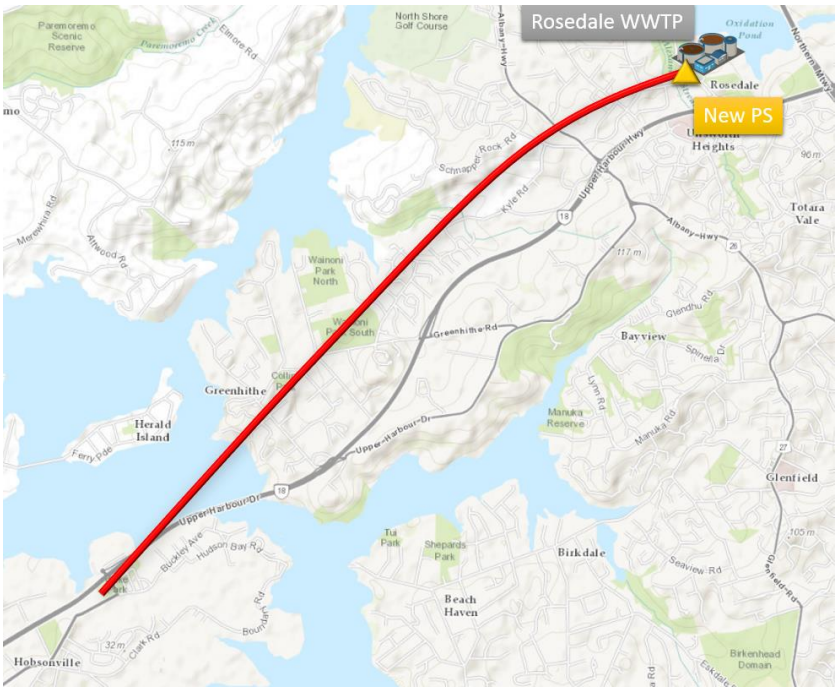


Figure 4-9: Option 7 – Deep Tunnel – Western Alignment

4.1.8 Option 8 – Deep Tunnel – Eastern Alignment

This option is based on the broad concept of maximising the use of deep tunnel and was developed as a deep gravity tunnel direct from Hobsonville to Rosedale WWTP through Beach Haven and then north up to Rosedale (Figure 4-10). From a construction perspective the depth of the tunnel, which would require tunnel shafts of between 30 to 100m, was considered to be the most challenging aspect of this option.

The eastern alignment was selected to maintain clearance from the Upper Harbour Highway Bridge and to provide a number of suitable open space options for the location of tunnel shafts. It also passes adjacent to the main wastewater pumping station at Kahika providing the opportunity to incorporate a large proportion of the lower North Shore into the scheme.

As with the option above, for the purpose of longlist development, it was assumed that the pipeline would be installed by a TBM. However, uncertainty with respect to changes in Health and Safety legislation and the future requirements for additional access shafts was identified as potential risks.

This option would require a new pump station to be constructed at the Rosedale WWTP.

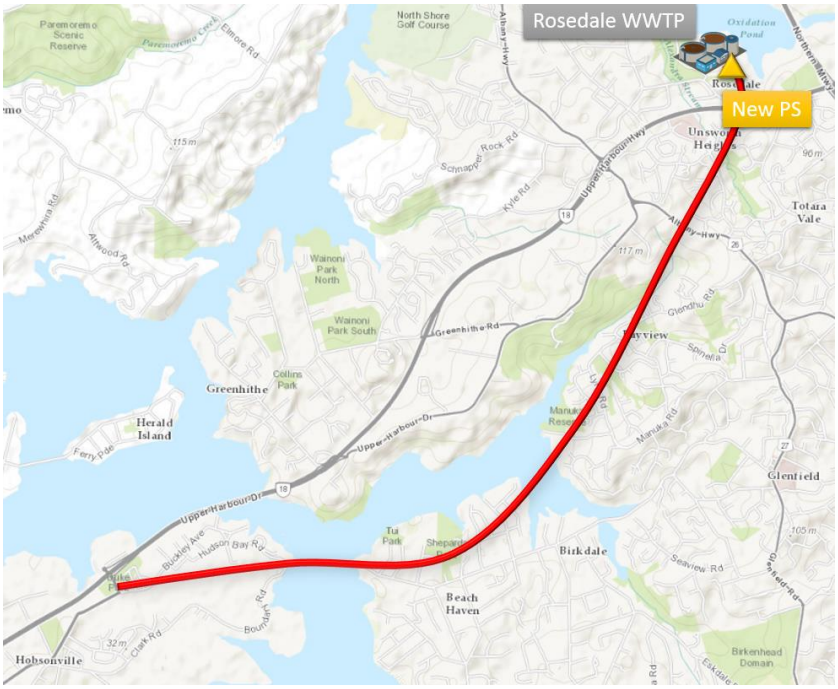


Figure 4-10: Option 8 – Deep Tunnel – Eastern Alignment

4.1.9 Option 9 – Tauhinu Road

This option is based on the broad concept of maximising the use of roads and urban environments, and combines sections from other routes (Figure 4-11). This option was developed to avoid the higher ridgelines to the south and east of Rosedale by cutting across to the upper section of Lucas Creek and approach Rosedale from the west.

From a construction perspective, the need for a crossing of the CMA was considered to be the most challenging aspect of this option. As with Option 1, for the purpose of longlist development it is assumed that the crossing of the Upper Waitemata Harbour would be constructed by HDD into the flatter coastal area north of the existing bridge.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

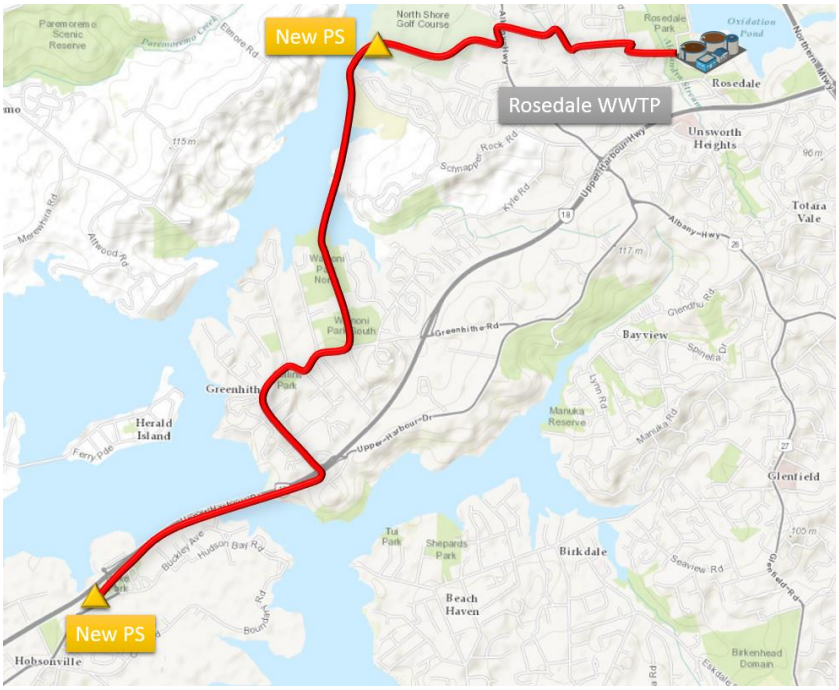


Figure 4-11: Option 9 – Tauhinu Road

4.1.10 Option 10 – Beach Haven Road – Coastal and Deep Tunnel Option

This option is based on the broad concept of avoiding the use of roads and urban environments, as well as on the broad concept of maximising the use of deep tunnels (Figure 4-12). This option was developed to maximise marine pipeline construction along an easterly approach route to Rosedale WWTP with the same alignment as proposed for option 8. Due to the height of the ridgeline along the Albany Highway a tunnel connection to the Rosedale WWTP is proposed.

For the purpose of longlist development, it is assumed that the marine crossing would be construction by marine trenching. However, due to the tidal nature of Sunset Bay (with mudflats at low tide), construction of the rising mains from Hobsonville may be feasible by HDD or trenching through the Hobsonville Point area around the top of the point.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and Rosedale WWTP.

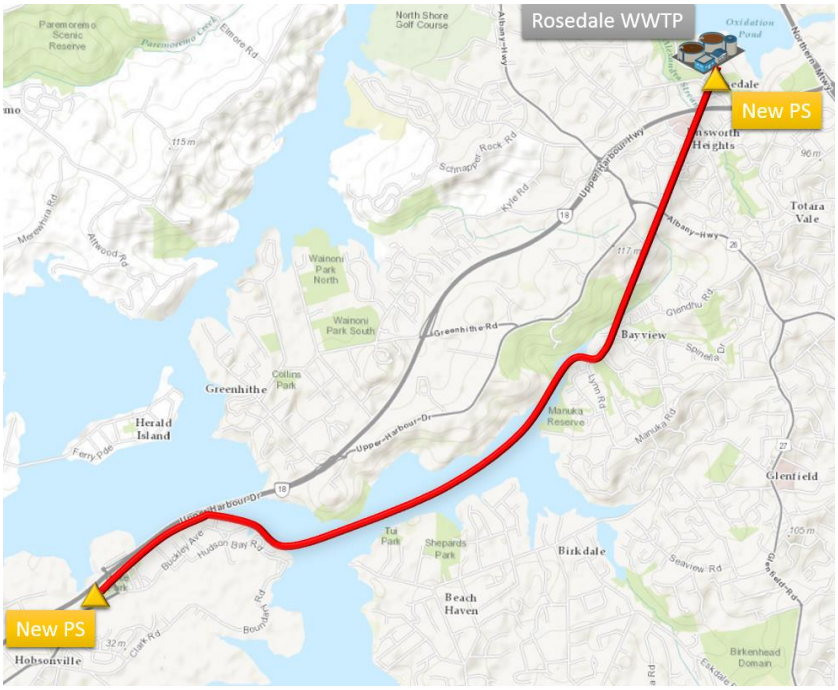


Figure 4-12: Option 11 – Beach Haven – Coastal and Deep Tunnel Option

4.1.11 Option 11 – Shallow Tunnel – Eastern Alignment

This option is based on the broad concept of maximising the use of deep tunnels, and also on the broad concept of avoiding the use of roads and urban environments (Figure 4-13: Option 12 – Shallow Tunnel – Eastern Alignment). This option was developed as a shallow tunnel option to Rosedale following an easterly alignment. The alignment provides for a new pumping station at Hobsonville with rising main to Kahika, connecting to a 3m diameter tunnel section from Kahika to Rosedale and a new pump station at Rosedale to lift flows into the WWTP.

From a construction perspective, the need to avoid existing deep gullies where the pipeline is shallow as well as the need for a crossing of the CMA, were identified as the most challenging aspects of this option.

For the purpose of longlist development it was assumed that the pipeline would be installed by a TBM. However, uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and Rosedale WWTP.

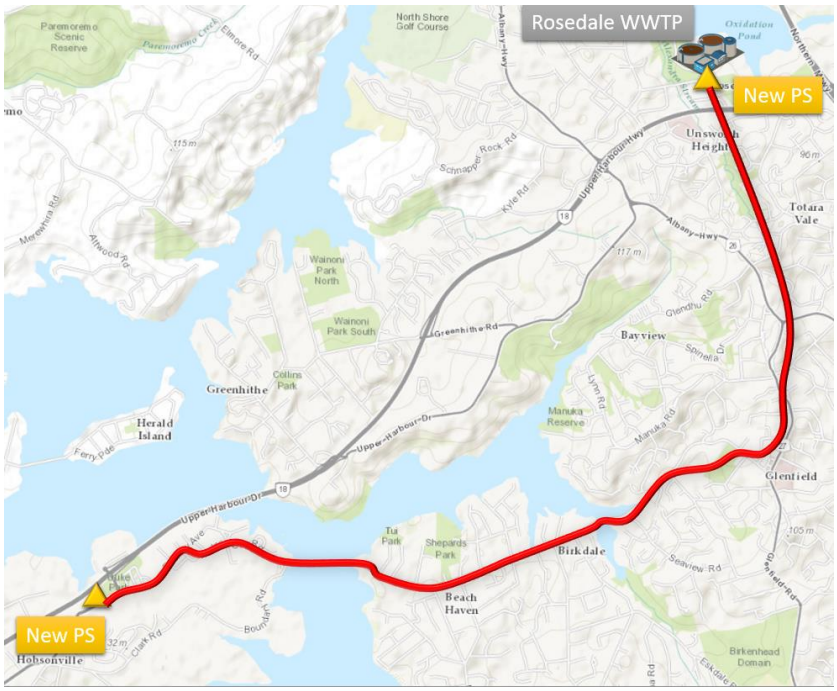


Figure 4-13: Option 12 – Shallow Tunnel – Eastern Alignment

4.2 Qualitative Risk Analysis

Upon identification of the longlist options, consideration was given to qualitative risk factors associated with each Option.

Given the concept design stage of the Project at this point, it was acknowledged that there was varying degrees of uncertainty/risk associated with the cost and non-cost attributes of the Options that could influence the consideration of alternatives process. It was determined that an awareness of the degrees uncertainty/risk was necessary in determining preferred Options. Once identified, the potential uncertainty/risk was rated and subsequently considered along with cost and non-cost attributes.

The outcomes of the uncertainty/risk analysis is summarised in the following table:

Table 4-1: Northern Alignment (Stage 1) Issues and Qualitative Risk Ratings

Option	Route	Issues Identified	Qualitative Risk Rating
1	Upper Harbour Drive	• Potential clashes with proposed route for North Harbour Watermain No.2. • Difficulty of crossing Upper Harbour Highway to get across to Upper Harbour Drive. • Depth of micro-tunnelling is at the limit of the technology and large number of very deep shafts will be required along Upper Harbour Drive	V HIGH
2	Beach Haven Road	• Micro-tunnelling risk under the Upper Harbour – uncertain ground conditions and depth to competent material. • Construction through highly trafficked areas around Beach Haven and Glenfield Road and micro-tunnelling depth close to the limit of the technology in one section	HIGH
3	Upper Harbour Highway	• NZTA conditions for construction alongside the Highway and impacts on traffic during a long construction period. • Location of existing Highway culverts may drive micro-tunnelling deeper. Depth already close to the limit of the technology in one section. • Highway fill embankments have reinforcement.	HIGH
4	Kyle Road	• Existing North Harbour Watermain is located along Kyle Road and could be damaged during construction affecting the entire North Shore. • Construction along southern coastal foreshore of Herald Island likely to be contentious.	MEDIUM
5	Lucas Creek (rising main and gravity sewer)	• Construction along northern coastal foreshore of Herald Island and through the CMA in Lucas Creek likely to be contentious. • Uncertainty associated with marine construction work.	MEDIUM

Option	Route	Issues Identified	Qualitative Risk Rating
		• Access to pipelines for future maintenance and risk of any leakage not being identified quickly.	
6	Lucas Creek (rising main only)	• Construction along northern coastal foreshore of Herald Island and through the CMA in Lucas Creek likely to be contentious. • Uncertainty associated with marine construction work. • Access to pipelines for future maintenance and risk of any leakage not being identified quickly.	HIGH
7	Deep Tunnel (western alignment)	• Very deep tunnel with shafts up to 100m deep. • No geotechnical information at this stage. • Uncertainty about tunnel depth required under the Upper Harbour. • Costs based on 3m dia TBM. Impact of new mining regulations might require this to be increased.	HIGH
8	Deep Tunnel (eastern alignment)	• Very deep tunnel with shafts up to 100m deep. • No geotechnical information at this stage. • Uncertainty about tunnel depth required under the Upper Harbour. • Costs based on 3m dia TBM. Impact of new mining regulations might require this to be increased.	HIGH
9	Tauhinu Road, Greenhithe	• Upper Harbour crossing – uncertain geology and long HDD at limit of the technology. May require marine trenching.	MEDIUM
10	Beach Haven (coastal and tunnel)	• Rising main through long reach of marine and coastal environment maybe contentious. • Costs based on 3m dia TBM. Impact of new mining regulations might require this to be increased. • No geotechnical information at this stage. • Tunnel length of 2.9km without intermediate shaft which would cost extra $15-20M depending on location.	HIGH
11	Shallow Tunnel (eastern alignment)	• Multiple large diameter rising mains through Hobsonville Point and Beach Haven will significantly affect the local communities and traffic and will be contentious. • Very long HDD crossing of the Upper Harbour which is at the limit of the technology and may need to be marine trenching. • Impacts to the operation of the Hobsonville Ferry service.	VERY HIGH

Option	Route	Issues Identified	Qualitative Risk Rating
		• Costs based on 3m dia TBM. Impact of new mining regulations might require this to be increased. • Tunnel length of 3.8km without intermediate shaft which would cost in the order of an additional $10M. • No geotechnical information at this stage.	

4.3 Multi-Criteria Analysis

Once the 11 longlist options were identified, criteria were developed by the Project Team to enable the assessment of the longlist options against an MCA process. The following table outlines the criteria and sub-criteria adopted for the MCA process:

Table 4-2: MCA Criteria and Sub-Criteria

Criteria	Operational	Technical	Environmental	Staging
Sub-Criteria	**Safety:** ability for Watercare staff to operate and maintain the works in a safe manner, includes issues such as confined spaces, working at heights, gas accumulation, accessibility etc.	**Reliability:** whether the option provides for a reliable technology with prior application and proof of performance in NZ	**Cultural/heritage:** impacts on areas of cultural or heritage significance	**Ability to be staged**
	Complexity: degree of difficulty and interdependency of the operation of the works	**Flexibility:** adaptable to change/adjustment to suit future requirements	**Natural Environment:** impacts on areas of environmental significance such as native flora and fauna, CMAs	
	Maintenance: overall requirements and frequency of maintenance activities, degree of difficulty, impacts on system performance during maintenance etc.	**Constructability:** ease of construction, availability of local contractors, need for specialist equipment or techniques	**Community:** impact on community groups and local interests through construction and ongoing operation of new assets	
	Odour/Corrosion: septicity and odour generation, noxious gases, accelerated corrosion rates due to sulphide attack	**Opportunity/benefit:** provides additional benefits beyond the base requirements for the project	**Landowners/property:** impact on individual property owners during construction and ongoing operation	

The MCA process was undertaken within a workshop Project Team. Through the MCA process:

- The workshop participants assessed each longlist option against each of the sub criteria. For each sub criteria a score of 1 - 5 was awarded based on the professional judgement of the collective workshop group. A score of 1 indicates a high risk associated with the criteria (i.e. the option will potentially fail to meet requirements), a score of 5 would indicate a low risk associated with the criteria (i.e. the option is considered reliable);
- Each criteria was weighted evenly; and
- Each longlist option was given a preliminary capital cost estimate and NPV. The capital cost estimates were developed using Watercare Unit Rate Cost Models and estimating data from the Central Interceptor and Associated Works project and the NPV determined by adding the estimated operational power costs over a 50 year period. Other operational costs were considered to be sufficiently similar for each option that they could be excluded from the analysis at this stage.

The following table summarises the northern alignment longlist options, their relative MCA score, capital cost and NPV cost. The full assessment, and comments on select criterion, is contained in Appendix A of this Report.

Table 4-3: Northern Alignment (Stage 1) Longlist Options

Ref	Route	Description	Capital Cost	Capital Cost Rank	NPV (50 year) [1]	NPV Rank	MCA Score	MCA Rank
1	Upper Harbour Drive	This option was developed as the most straightforward road based alignment outside of the motorway corridor.	$253M	5	$271M	5	2.5	9
2	Beach Haven Road	This option is a predominantly gravity sewer alignment on an easterly approach	$284M	9	$301M	8	2.56	7
3	Upper Harbour Highway	This route is the most direct road based alignment.	$246M	4	$266M	4	2.31	11
4	Kyle Road	This options is a predominantly gravity sewer alignment on a westerly approach.	$273M	8	$301M	8	2.51	8
5	Lucas Creek (rising main and gravity sewer)	This option was developed to avoid the higher ridgelines to the south and east of Rosedale by cutting across to Lucas Creek and approach Rosedale from the west.	$296M	10	$314M	10	2.38	10
6	Lucas Creek (rising main only)	This option is a variation on the route above (Lucas Creek) and has been developed as entirely rising mains with no gravity sewer to minimise pipeline construction depths.	$230M	2	$251M	2	2.88	6
7	Deep Tunnel (western alignment)	This option was developed as a deep gravity tunnel direct from	$270M	7	$284M	6	3.56	2

1

Ref	Route	Description	Capital Cost	Capital Cost Rank	NPV (50 year) [1]	NPV Rank	MCA Score	MCA Rank
		Hobsonville to Rosedale WWTP across the Greenhithe peninsula.						
8	Deep Tunnel (eastern alignment)	This option was developed as a deep gravity tunnel direct from Hobsonville to Rosedale WWTP through Beach Haven and then north up to Rosedale.	$323M	11	$338M	11	3.94	1
9	Tauhinu Road, Greenhithe	This option combines sections from other routes.	$210M	1	$234M	1	2.94	4
10	Beach Haven (coastal and tunnel)	This option was developed to maximise marine pipeline construction along an easterly approach route to Rosedale WWTP with the same alignment as proposed for option 8. Due to the height of the ridgeline along the Albany Highway a tunnel connection to the Rosedale WWTP is proposed.	$268M	6	$287M	7	2.94	4
11	Shallow Tunnel (eastern alignment)	This option was developed as a shallow tunnel option to Rosedale following an easterly alignment.	$235M	3	$252M	3	3.06	3

4.4 Identification of Shortlist Options

In comparing the MCA outcomes, capital costs and qualitative risk of each of the longlist options, the following table was developed for comparison:

Table 4-4: Summary of Outcomes Northern Alignment (Stage 1)

Option	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Rank	MCA Score	MCA Rank	Qualitative Risk
1	Upper Harbour Drive	$253M	5	$271M	5	2.5	9	V HIGH
2	Beach Haven Road	$284M	9	$301M	8	2.56	7	HIGH
3	Upper Harbour Highway	$246M	4	$266M	4	2.31	11	HIGH
4	Kyle Road	$273M	8	$301M	8	2.51	8	MEDIUM
5	Lucas Creek (rising main and gravity sewer)	$296M	10	$314M	10	2.38	10	MEDIUM
6	Lucas Creek (rising main only)	$230M	2	$251M	2	2.88	6	HIGH
7	Deep Tunnel (western alignment)	$270M	7	$284M	6	3.56	2	HIGH
8	Deep Tunnel (eastern alignment)	$289M	11	$338M	11	3.94	1	HIGH
9	Tauhinu Road, Greenhithe	$210M	1	$234M	1	2.94	4	MEDIUM
10	Beach Haven (coastal and tunnel)	$268M	6	$287M	7	2.94	4	HIGH
11	Shallow Tunnel (eastern alignment)	$235M	3	$252M	3	3.06	3	VERY HIGH

Following on from the MCA process, capital cost analysis and the Qualitative Risk Assessment, a shortlist (northern shortlist) of 4 options were identified. These are shown in Table 4-5. The full assessment, and comments on select criterion, is contained in Appendix A of this Report.

Table 4-5: Shortlisted Options for the Northern Corridor (Stage 1)

Option	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Rank	MCA Score	MCA Rank	Qualitative Risk
8	Deep Tunnel (eastern alignment)	$289M	11	$338M	11	3.56	1	HIGH
9	Tauhinu Road, Greenhithe	$210M	1	$234M	1	2.94	4	MEDIUM
6	Lucas Creek (rising main only)	$230M	2	$251M	2	2.88	6	HIGH
3	Upper Harbour Highway	$246M	4	$266M	4	2.31	11	HIGH

The shortlisted options were selected on the following basis:

- Option 8 was taken forward because it has the highest overall MCA score of all options. It has the ability to be staged with the section from Hobsonville to the Kahika PS being constructed first. Ultimately this option will enable the Kahika Pump Station to be decommissioned and provides the opportunity to relieve a number of trunk sewers on the lower North Shore. Being a deep tunnel it was assessed as having a high level of risk;
- Option 9 was selected as it has the lowest overall capital and NPV cost and ability to stage the work through construction of one rising main initially. It has the highest MCA score of the options that maximise the use of road corridors and open green space and the highest MCA score of all the options which do not include a deep tunnel. It was assessed as having a medium level of risk;
- Option 6 was selected as it has the second lowest overall capital and NPV cost and ability to stage the work through construction of one rising main initially. It has the highest MCA score of options that maximise the use of the coastal and marine environment and the second highest MCA score of all the options which do not include a deep tunnel. It was assessed as having a high level of risk;
- Option 3 was retained for ongoing project consistency and comparative purposes. On balance of costs, MCA score and risks it was considered to be the preferred option out of Options 1, 2 and 3 which were the three original route options identified as part of the initial work for the Northern Interceptor undertaken by Watercare; and
- The shortlisted options provide a representative range of alternative alignments and pipeline types (gravity v. pumped and tunnel v. pipeline) and as such are considered to align with the concept of retaining flexibility in terms of the broad conceptual options.

Table 4-6 summarises the reasons behind discarding the longlist options.

Table 4-6: Discarded Northern Alignment (Stage 1) Longlist Options

Option	Description	Reasons for discarding the option
1	Upper Harbour Drive	One of the three potential options (Options 1, 2 and 3) that could be carried forward for ongoing comparative purposes. Very high risk associated with the depth of the micro-tunnelling work offset the differences in MCA score and NPV costs compared to Option 3
2	Beach Haven Road	One of the three potential options (Options 1, 2 and 3) that could be carried forward for ongoing comparative purposes. Option 2 has a 13% higher NPV cost but only 11% higher MCA score than Option 3 with a similar qualitative risk
4	Kyle Road	This option maximises the use of road corridors and open space but offers no advantage over Option 9 which has a lower NPV cost and a higher MCA score
5	Lucas Creek Rising Main and Gravity Sewer	This option maximises the use of the coastal and marine environment and has a lower qualitative risk than Option 6 but has a significantly higher NPV cost and lower MCA score than Option 6
7	Deep Tunnel (Western Alignment)	Whilst this deep tunnel option has a 7% lower NPV cost than the preferred deep tunnel option (Option 8), it has an 11% lower MCA score with a similar qualitative risk
10	Beach Haven (coastal and tunnel)	This option was a combination of deep tunnel and shallow pipeline maximising the use of the coastal and

Option	Description	Reasons for discarding the option
		marine environments. This option has a 6% lower NPV cost but a 34% lower MCA score than the preferred deep tunnel Option 8 and a 14% higher NPV cost and only 2% higher MCA score than the preferred coastal and marine Option 6
11	Shallow Tunnel (eastern alignment)	This option maximises the use of road corridors and open space but has a 8% higher NPV cost with only a 4% higher MCA score and a substantially higher qualitative risk than the preferred Option 9

The four shortlisted options were then taken forward for further development and ECI to allow further refinement of the shortlist and subsequently selection of a preferred option. The outcome of this shortlist assessment process is outlined below.

4.4.1 Shortlist Options

Once the preferred shortlist options were identified, further more detailed analysis was undertaken to identify the preferred option. The following figure summarises the shortlist investigation process.

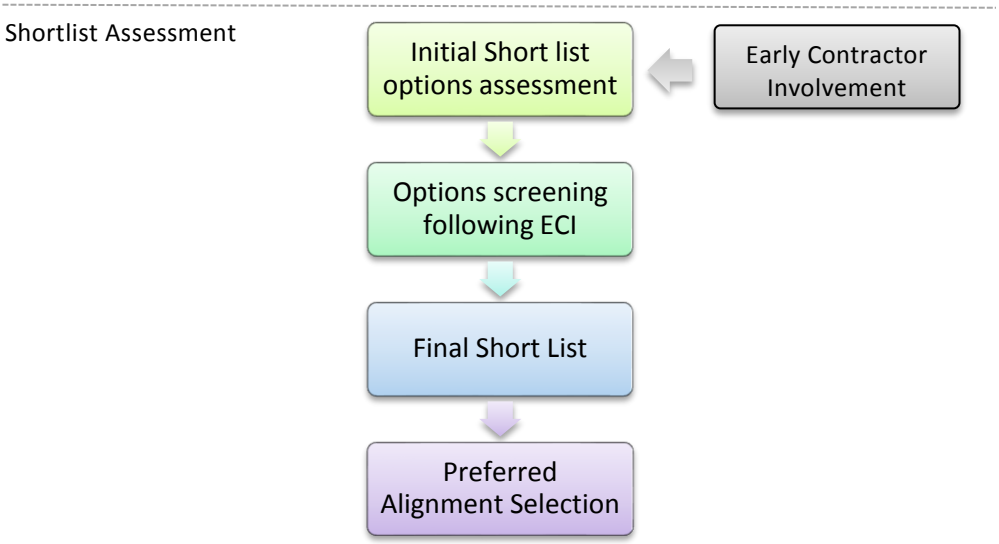


Figure 4-14: Shortlist Development Process

4.4.1.1 Initial Shortlist Option Assessment and ECI Input

The shortlisted options identified through the longlist MCA process were further developed in order to select a preferred route. This development process included:

- Further consideration of forecast growth rates and a review of overall option sizing;
- Preliminary siting of main components;
- Review of alignments for access and constructability; and
- Updating of cost estimates.

Following this further refinement process ECI was sought. The purpose of the ECI was to seek contractor advice on construction methods, potential risks and estimated capital costs. The ECI comprised:

- Briefing/preliminary workshop to review the project; and
- A further workshop to discuss potential methodologies and costs.

These two processes resulted in some modifications to the shortlist options and the identification of advantages and disadvantages of each option. The following table summarises the modifications to the shortlist options and the advantages and disadvantages of each shortlist option that developed from the further detailed investigations and ECI inputs.

Table 4-7: Summary of Modifications Advantages and Disadvantages of Northern Alignment (Stage 1) Shortlist Options

Shortlist option	Finding of further investigations and ECI input	Modifications to the option	Advantages	Disadvantages
Option 3 - Upper Harbour Highway	• Risks with proposed HDD length. Likely that special equipment will need to be imported. • Working within the highway corridor would require the installation of entry and exit gates through the highway barrier systems to facilitate access. It is understood that the highway fill embankments may include reinforcement; HDD and micro-tunnelling would not be suitable through reinforced embankments and therefore the pipeline would need to be outside of any embankments or clearly pass underneath. • Proposed shaft depths will be very costly in terms of time and money.	• Alignment adjustments along the upper harbour highway to facilitate micro-tunnel shaft locations • Increased spacing between jacking pits (shaft locations) • Revised alignment at the northern end through the commercial area and into Rosedale WWTP to reduce depth of pipework, suit construction and the proposed NZTA works at Rosedale WWTP • Development of the proposed Hobsonville pumping station site arrangement.	• Provision of storage prior to Rosedale WWTP, allowing for both flow management and emergency storage • Limited length of rising main, which would suggest reduced septicity in the wastewater flows received at Rosedale WWTP • It is the option with the least number of potentially affected stakeholders • It is the option with the lowest expected impact on the community from environmental, social, cultural and economic viewpoints.	• Limited staging potential resulting in high up-front expenditure • Deep gravity sewer section within highway corridor resulting in highly restricted access • Gravity sewer on very flat grade to limit depth of terminal pumping station at Rosedale WWTP • Challenging HDD section across the Upper Harbour.
Option 6 - Lucas Creek (rising main only)	• Either open trenching or directional drilling could be used for the Hobsonville to Herald Island section of rising main. Trenching would provide better grade control and two different methods for the construction were proposed,	• The pipeline across Herald Island has been relocated to the northern road alignment rather than foreshore due to private moorings and the presence of relatively hard material along the	• Lower capital cost than Option 3 • The alignment is suited to installing a small diameter start-up pipeline	• A longer length of rising main is required compared with other options, which increases potential septicity and odour risks at the booster pumping station site

Shortlist option	Finding of further investigations and ECI input	Modifications to the option	Advantages	Disadvantages
	one of which offered a lower cost method but with potential for significant environmental impacts. • For the rising main on the north of Herald Island it would be possible to trench along the foreshore, however there are a number of small jetties that would need to be removed or the pipeline alignment moved further from the shore to avoid these. Construction within the existing roadway would offer easier construction and have a lower cost than construction in the foreshore. • A directional drilled pipe is a practical option for the main channel crossing. Trenching this crossing would only be possible if the channel floor is East Coast Bays Formation (ECBF) material. If the channel floor is ECBF then a pipe could be laid straight on the channel floor, weighted down and covered with rock armouring. • Construction along Lucas creek could be trenched, as much of the foreshore appears to be ECBF. Alternatively, directional drilling could be undertaken	shoreline which would slow open cut construction. • Potential for construction using long HDD lengths rather than marine trenching along Lucas Creek to reduce environmental impacts. Landing sites for each length of HDD pipeline would be required which would be used for locating permanent air valves.	• Some potential for staging • Shallow pipe depths facilitate both construction and ongoing maintenance • Offers the ability to service some of the Greenhithe area via injection of flows into the rising main.	and at Rosedale WWTP • There are numerous potentially affected stakeholders • Construction is proposed through potentially sensitive park and coastal areas • Challenging construction within a marine environment.

Shortlist option	Finding of further investigations and ECI input	Modifications to the option	Advantages	Disadvantages
	working from points near the foreshore.			
Option 8 - Deep Tunnel (eastern alignment)	• The tunnel would be constructed by an earth pressure balance (EPB) TBM installing concrete segments. A finished tunnel size of at least 3.5m has been proposed. A minimum installation grade of 1 in 1000 can be achieved. • There is no potential for staging development of the tunnel to match flow progression. • Construction of the tunnel would not be weather dependant.	• Preferred construction and permanent access shaft locations were identified • Depth of the inlet pumping station at Rosedale WWTP was determined to be at least 80 m due to the depth of tunnel for the harbour crossing.	• The deep tunnel would minimise impacts on the community and environment • Gravity flow would reduce the risk of septicity and odours at Rosedale • Ease of operation • A deep tunnel provides emergency and balancing storage for Rosedale WWTP • Construction would not be weather dependent.	• Deep sections of tunnel with restrictive access for maintenance • High capital cost • Little ability to stage works effectively.
Option 9 - Tauhinu Road, Greenhithe	• Risks with proposed HDD length. Likely that special equipment will need to be imported. • Construction along Lucas creek could be trenched, as much of the foreshore appears to be ECBF. Alternatively, directional drilling could be undertaken working from points near the foreshore. • This option would require less construction activity in the	• Adjustments to the rising main alignment on the northern side of the upper harbour crossing with the break pressure tank being moved from Tauhinu Road back to chainage 2350m (i.e. same location as proposed for Option 3) • A deeper gravity sewer proposed along Tauhinu Road in place of the previously proposed twin rising mains to reduce the overall pumping lift required at	• Lower capital cost than Option 3 • The alignment is suited to installing a small diameter start-up pipeline • Some potential for staging • Shallow pipe depths facilitate both construction and ongoing maintenance	• A longer length of rising main is required compared with other options, which increases potential septicity and odour risks • There are numerous potentially affected stakeholders • Construction is proposed through

Shortlist option	Finding of further investigations and ECI input	Modifications to the option	Advantages	Disadvantages
	coastal environment than option 3.	Hobsonville and avoid having a long falling section of rising main • micro-tunnelling is proposed through Wainoni Park • Minor alignment adjustments through the commercial area to suit recent property developments • Addition of a pipe bridge across a deep gully in Rosedale Park which could include a public footbridge • Addition of a balancing tank at the inlet of Rosedale WWTP to reduce inlet works impacts from stop-start pumping flows • Development of the proposed Hobsonville pumping station site arrangement.	• Offers the ability to service some of the Greenhithe area via the gravity sewer section or injection into the rising main.	potentially sensitive park and coastal areas • Challenging HDD section across the Upper Harbour.

4.5 Comparative Costs

Preliminary capital cost estimates for the shortlist options were further developed from a range of sources including the Watercare Unit Cost database, escalated tender prices from the South West Interceptor and the Kohimarama Storage Tank and additional cost information provided by Fletchers and McConnell Dowell.

The median capital cost estimates are shown in the table below. In summary:

- Option 9 has the lowest estimated capital cost; and
- Option 8 has the highest estimated capital cost.

Table 4-8: Comparative Cost Summary – Estimated Costs

Costs	Option 8	Option 9	Option 6	Option 3
Median Capital Costs Estimate $M	$292	$199	$208	$229

4.6 Initial Screening Process

Following on from the above process, further comparison of the four shortlist options was carried out by the Project Team. This screening exercise utilised the additional design development materials, updated cost estimates, contractor's ECI inputs and the earlier Qualitative Risk Assessments for the options. The Project Team concluded that:

- The estimated capital costs used in the shortlisting process were reasonable and are generally in line with the ECI estimates;
- There remains uncertainty in the forecast growth rates for the Service Catchment due to the potential impacts of the PAUP and the development of Special Housing Areas ("SHA") and as such the ability to stage the Northern Interceptor works is of significant importance;
- The MCA score for Option 8 is 34% higher than for the lowest cost Option 9 but the capital cost is 46% higher and the Qualitative risk is higher. Being a full length tunnel, Option 8 cannot be effectively staged as was evidenced with the discarding of Option 11. Therefore, Option 8 is not a preferred option;
- Options 6 and 9 both approach Rosedale WWTP from the west and with the further design development now have quite similar costs. Option 9 still has a slightly lower cost and has a higher MCA score and lower overall risk. Therefore Option 6 is not a preferred option; and
- With regards to Option 3, through the ECI engagement process it was identified that this option may have significantly lower capital cost than initially estimated. One Contractor estimated the capital cost to be in the range of $50m less than the cost identified in Table 4-8 above. As such it was determined that Option 3 should be further developed alongside the most favoured route alignment Option 9.

Therefore Options 3 and 9 were selected as the alignments for further design development and MCA assessment.

4.7 Preferred Option Selection

The preferred option was selected comparing the shortlist options through the use of an MCA tool and comparing preliminary capital costs.

The MCA criteria were evenly weighted and the MCA scores were discussed and agreed at a workshop attended by the MWH Project team and wider Watercare participants. Each assessment point was given a score from 1 to 5, with the lower scores representing better outcomes. These scores were then averaged to give a total MCA score for each option. The MCA framework is as follows:

Table 4-9: MCA Criteria and Basis of Assessment (Northern Alignment, Stage 1)

Assessment Framework		Basis for Assessment
Functionality	Baseline requirements	Options consistent with the Three Waters Strategy, particularly the future utilisation of treatment capacity Rosedale vs Mangere, providing for increasing network capacity to **service** growth the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas
		Capacity to **support** growth and development in the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas
	Additional requirements	Ability to intercept catchments and allow the decommissioning of local pump stations
		Ability to delay or replace local and wastewater network upgrades
		Provide benefit or alignment with other utilities or public services

Assessment Framework		Basis for Assessment
Operational & Maintenance		Site location and space available for on-going operational and maintenance access requirements (e.g. at shaft sites)
		Site appropriately buffered from surrounding community
		Provides for future operational flexibility (e.g. how easy will it be to deal with a significant increase in flow)
Constructability		Potential for construction risks that may hold up, stop or adversely affect construction time
		Ability for construction techniques to be delivered by a number of Contractors allowing competitive tenders to be obtained
		Potential for construction risks that result in significant cost overruns
Assessment of Environmental Effects	Environmental	Potential construction impacts on coastal and freshwater quality
		Potential construction effects on terrestrial ecosystems. Sites located in close proximity to SEA-Land and/or riparian margins will have a greater impact on habitats, flora fauna
		Potential effects on protected trees during construction
		Potential construction effects on landscape/neutral character values, and their ability to be mitigated
		Potential construction on coastal ecosystems. Construction activities that are near to the CMA and/or are within the CMA (e.g. marine trenching) will have a greater impact on coastal ecosystems
		Sensitivity of ecosystems from operational overflow discharges. Assume dilution and dispersion is better at the head of creeks in the CMA
	Social	Distance from site to arterial road for operational and maintenance purposes
		Likelihood of adverse effects on local roads resulting from construction activities
		Operational effects on residential properties with line of sight of permanent structures e.g. pump stations). This includes effects relating to visual amenity, noise, and odour
		Impact to neighbouring properties within 200m of construction sites resulting from construction activity (visual, dust noise, odour, traffic)
		Short-term impact on community facilities resulting from construction activities (e.g. reduced access to community facilities (e.g. Beach, sports club, community hall, playground, etc.)
		Proximity of construction activities to sensitive community facilities (e.g. School, play centre, medical facility) located on likely construction traffic route

Assessment Framework		Basis for Assessment
		Extent to which construction works will reduce access to parks and reserves when considering the ability to operate parks/reserves 'as usual' during construction, and the amount of reserve required for construction activities. This considers the sensitivity of the users of the reserve (e.g. North Shore Memorial Park and mourners)
		Effects arising from potential operational odour discharges (e.g. at break pressure chamber sites and pump station sties)
		Impact to neighbouring properties from operation and maintenance activity (includes visual, dust, noise, odour, traffic) and risk of operational failures
		Number of properties above the centreline of the pipeline
	Cultural	Potential impacts waahi tapu sites identified in District Plan and impact on heritage and traditional sites for Mana Whenua
		Effects on mauri of waterbodies through wastewater overflows
		Impact on cemetery (as an urupā)
	Economic	Excavations in alluvium with risk of settlement of sensitive structures
		Number of private property purchases required to facilitate the construction of the pipeline
		Potential for short-term business disruption during construction
		Disruption to existing services and utility providers
		Energy use required for operating the facility (pump stations sties)

The results of the MCA assessment are summarised in Table 4-10 below. As noted above, lower scores represent the better outcome and scores that are within 0.3 of each other are considered to score equally. Whilst the options have different impacts associated with each of the criteria, overall the total scores are almost the same for each.

Table 4-10: MCA Score Summary (Northern Alignment, Stage 1)

MCA Criteria		Option 3	Option 9
Functionality		2.9	2.4
O&M		3.0	2.0
Constructability		3.2	2.7
Assessment of Environmental Effects	Environmental	2.2	2.8
	Social	2.1	3.3
	Cultural	2.0	3.0

MCA Criteria		Option 3	Option 9
	Economic	2.8	3.4
	TOTAL	2.6	2.8

4.8 Final Shortlist Development

The two options on the final shortlist were developed in further detail in order to facilitate a more detailed MCA assessment taking into account the impacts during construction and ongoing operation of the assets. The development process included:

- Identification of location of key services and assets that may influence the design;
- Detailed inspection of full pipe route, with particular attention for location of key assets such as pump stations, shafts and receiving pits;
- Identification of initial locations for micro-tunnelling shafts and for establishment of HDD equipment;
- Meeting with ECI contractors to further discuss constructability issues and construction rates;
- Preparing full alignment plan and sections for both options;
- Using a multi-criteria analysis to assess non-cost option attributes; and
- Refinement of cost estimates based on alignment modifications and revised construction rates.

Preliminary capital cost estimates for the options were further developed and then compared as part of the selection process. The comparative assessment of the cost estimates found:

- Option 9 has the ability to initially defer approximately $50M of works whilst for option 3 this is approximately $23M;
- Based on the higher cost range the differences in capital cost estimates become more significant with option 3 ($320M) being circa $35M higher than option 9 ($285M); and
- Operating costs for the options are not substantially different. Chemical dosing costs for all options are expected to be similar. Power costs for option 3 are approximately 25% lower than for option 9 due to the lower overall pump head required. On an NPV basis, the overall difference in power costs is expected to be less than $3M in total through to 2060.

4.8.1 Preferred Option

The MCA scores and cost estimates for the options were compared and a preferred option agreed by the Project team. The comparison concluded that there are negligible differences in the MCA scores for the non-price attributes. However there is a significant difference between the capital costs with Option 9 - Tauhinu Road, Greenhithe, offering a lower capital cost and greater potential for staging of works compared to Option 3 –Upper Harbour Highway (Table 4-11).

Therefore Option 9 is preferred in comparison with Option 3 alignment for the Hobsonville to Rosedale WWTP works.

Table 4-11 below, provides a summary of the results.

Table 4-11: Summary of MCA Scores and Cost Estimates (Northern Alignment Options)

Option	Description	Capital Cost	MCA Score	Overall MCA Rank
Option 3	Upper Harbour highway	$246.5M - $252.8M	2.6	1
Option 9	Tauhinu Road – Base Option	$231.0m	2.8	2

5 Southern Corridor Development: Concourse to Hobsonville

Figure 5-1: illustrates the options assessment process undertaken for Concourse to Hobsonville (Stage 2) of the Project. This assessment process is slightly different to that undertaken for Stage 1 in that a second round of ECI inputs was not required. The Contractor inputs from Stage 1 which included advice on constructability issues and costs were able to be directly applied during the longlist options development and initial shortlisting as such it should be noted that whilst ECI is not identified in the following flowchart, it was undertaken through Stage 1 and is directly relevant to and has informed Stage 2.

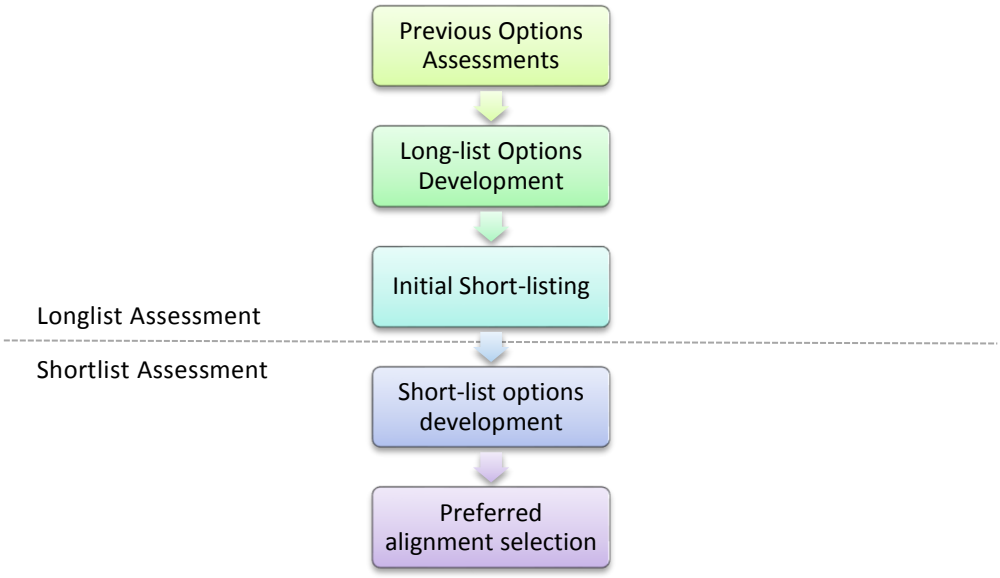


Figure 5-1: Stage 2 Options Assessment Process

A brief summary of the key activities for each stage of the options assessment is provided below:

- **Previous Options Assessments** – A review of the previous option development work undertaken by Watercare was undertaken. The preferred options of this previous analysis were identified and taken forward for consideration through the longlist process.
- **Longlist Options Development** –13 longlist alternative routes were developed with indicative cost estimates produced and risks and opportunities associated with their implementation.
- **Initial Shortlisting** - The longlist options were reviewed by the Project Team and evaluated in a multi-disciplinary workshop using a high level MCA.
- **Initial Shortlist Options Development** – The options on the initial shortlist were further developed through a review of overall sizing, siting of main components, development of overall route alignments and longitudinal sections, assessment of likely construction methods, major risks and estimated capital costs using cost data developed for the longlist supported with construction rates supplied through the Early Contractor Involvement ("ECI") process.
- **Shortlist options development** - The options on the initial shortlist were further developed through a review of overall sizing, siting of main components, review of alignments, and through discussions with Contractors on construction methods, major risks and estimated capital costs.

- **Preferred Alignment Selection** - Selection of the preferred option was carried out at a MCA workshop. The options were assessed using a more detailed project-specific MCA tool with additional consideration of the estimated option costs.

5.1 Development of Longlist Options

As noted previously, prior to the development of the longlist options for Stage 2 of the Project, two fixed points were identified (Concourse Storage Tank and Hobsonville PS). As such, a route envelope was established using these fixed points as a start and end point. The corridor considered for the development of the longlist is illustrated below:

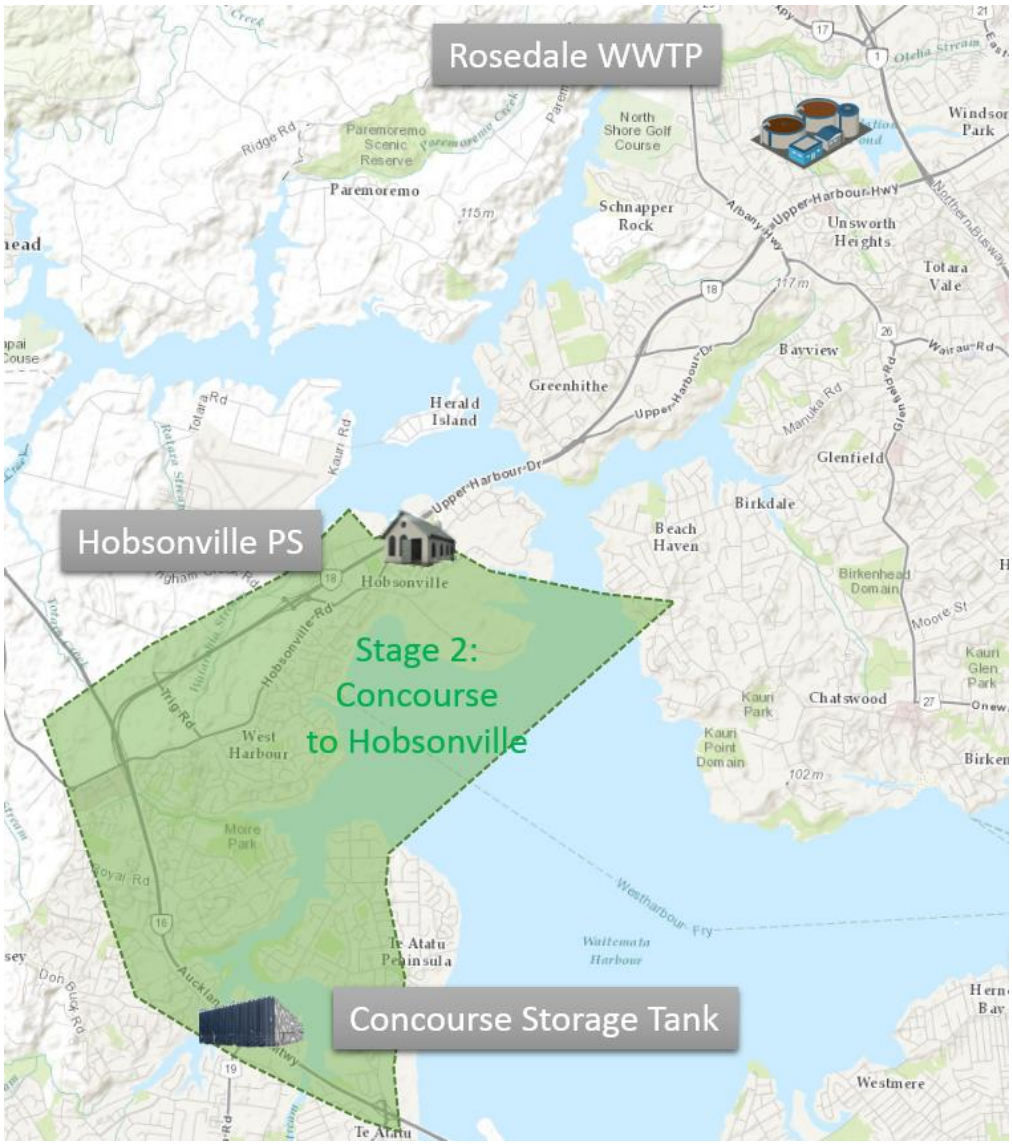


Figure 5-2: Route Envelope Adopted for Development of Longlist

Within this Corridor and adopting the broad concepts described above at Section 3.3, the following longlist options were identified.

5.1.1 Option 1 – Te Atatu Road

This option is based on the broad concepts of maximising the use of roads and urban environments for the first component of works (to Luckens Point), an on the broad concept of avoiding urban environments for the second component, from Luckens Point to Limeburners Bay (Figure 5-3). This option is considered to be the most straightforward alignment for the Concourse to Hobsonville section of the project.

From a construction perspective, the need for a crossing of the CMA over long distances, the potential impacts on the coastal environment, and the poor ground conditions near the existing marina were considered to be the most challenging aspects of this option.

For the purposes of this option it is assumed that the rising main from Concourse will cross Henderson Creek using HDD through to KunWoo Park/Rutherford College, and then be trenched along Toru Street and Te Atatu Road. The crossing of the harbour and the alignment through to Hobsonville PS will be micro-tunnelled. At 500m long the crossing of the harbour is seen as the greatest challenge and may require some additional micro-tunnel shafts to be constructed within the marine environment. This option would require a new pump station to be constructed at the existing Concourse Storage Tank site.

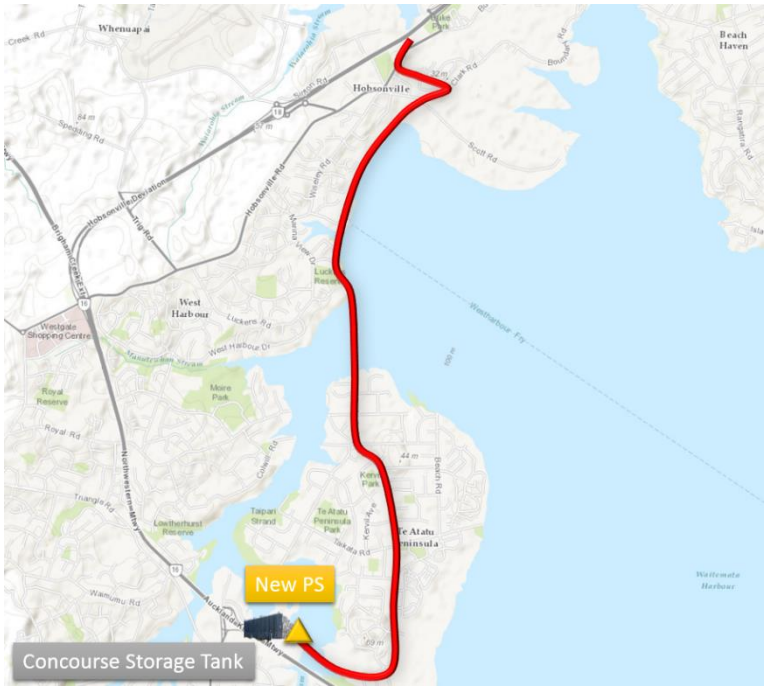


Figure 5-3: Option 1 – Te Atatu Road

5.1.2 Option 2 – Te Atatu Road – Avoiding Difficult Coastal Areas

This option is based on the broad concept of maximising the use of roads and urban environments, and was developed as a variation to Option 1 (Figure 5-4). In this option, the route has been altered to minimise the overall length of the harbour crossing section and to avoid construction in the potentially difficult coastal areas.

The overall construction techniques are the same as for Option 1, however, from a construction perspective, the deep sections of micro-tunnelling around Lukens Road and Marina View Drive and the need to set up construction activities on the reef off Orukuwai Point, were considered to be the most challenging aspects of this option.

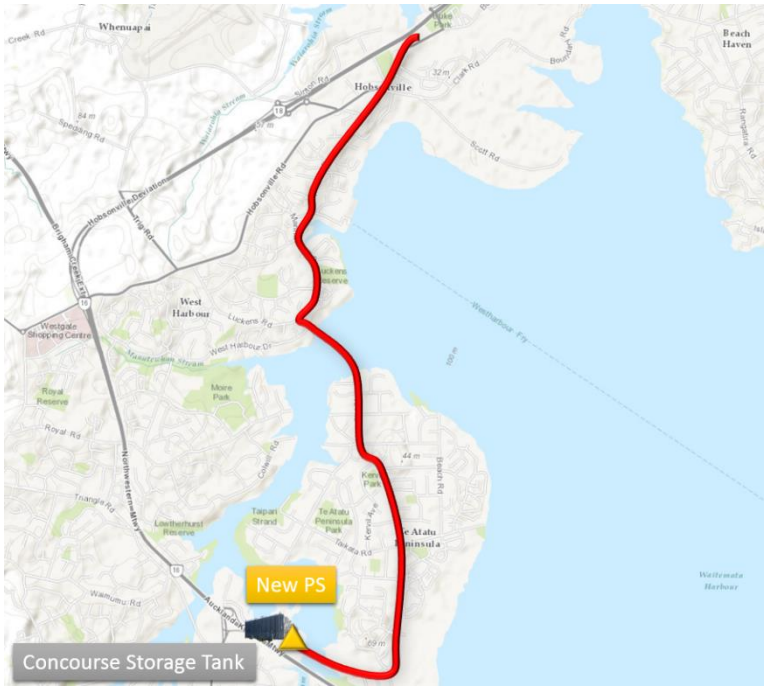


Figure 5-4: Option 2 – Te Atatu Road (Avoiding Difficult Coastal Areas)

5.1.3 Option 3 - Te Atatu Road – Avoiding Difficult Coastal Areas and the Use of Deep Tunnels

This option is based on the broad concept of maximising the use of roads and urban environments, and maximising the use of deep tunnels (Figure 5-5Figure 5-5:). This option was developed as a variation to Option 2, and uses the same overall construction approach as Options 1 and 2 but seeks to avoid the need for the deepest micro-tunnelling shaft (on Luckens Road) by tunnelling under private property from the West Harbour esplanade reserve to Luckens Road.

This option would also require a new pump station to be constructed at the existing Concourse Storage Tank site.

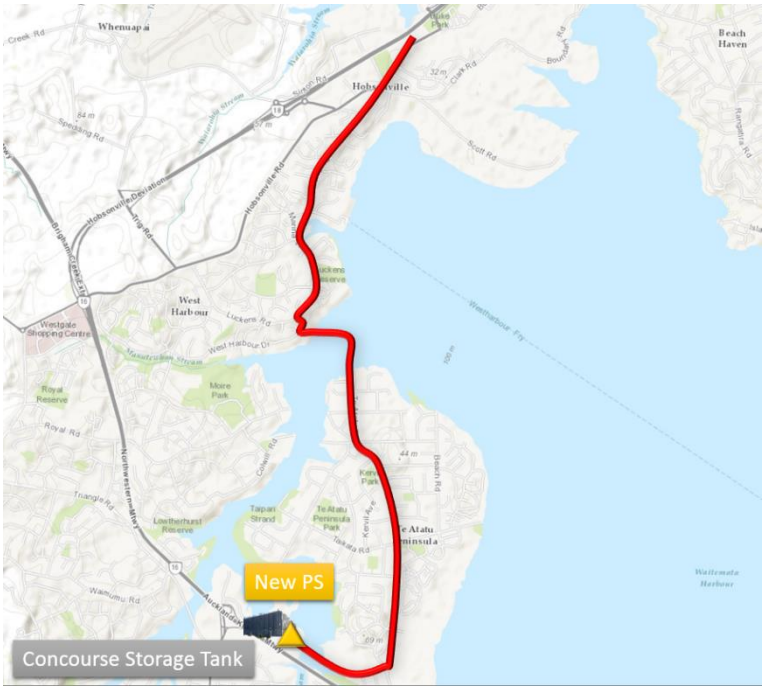


Figure 5-5: Option 3 – Te Atatu Road – Avoiding Difficult Coastal Areas and the use of Deep Tunnels

5.1.4 Option 4 - Te Atatu Road – Avoiding Difficult Coastal Areas and the Use of Deep Tunnels with Alternate Harbour Crossing

Similar to Option 3, this option is based on the broad concept of maximising the use of roads and urban environments, and maximising the use of deep tunnels (Figure 5-6). This option was also developed as a variation to Option 2, and seeks to avoid the need for a deep tunnelling shaft (on Luckens Road) by tunnelling under private property from the West Harbour esplanade reserve to Luckens Road, and altering the location of the marine crossing. This alignment is more direct than Options 2 and 3 but passes under a larger number of private properties.

This option would also require a new pump station to be constructed at the existing Concourse Storage Tank site.

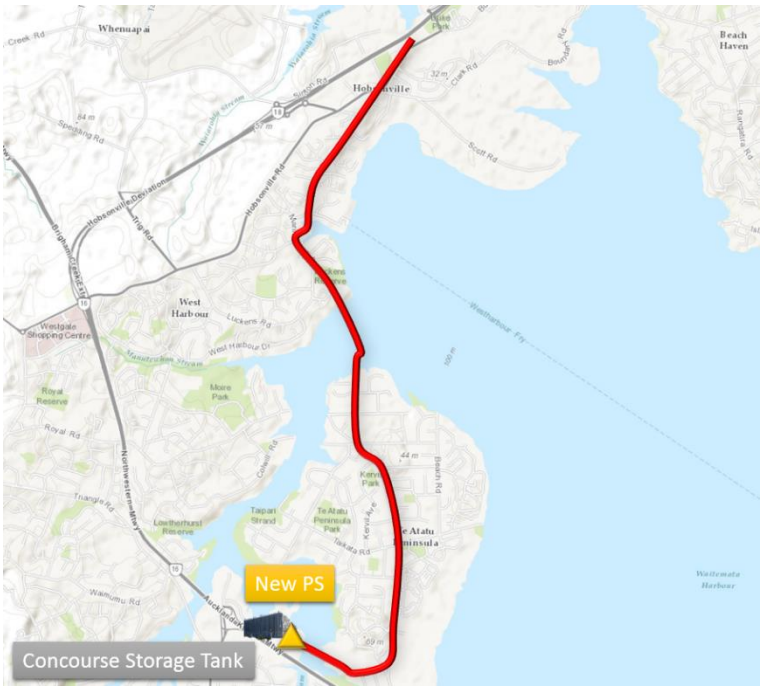


Figure 5-6: Option 4 – Te Atatu Road – Avoiding Difficult Coastal Areas and the Use of Deep Tunnels with Alternative Harbour Crossing

5.1.5 Option 5 – Matipo Road

This option is based on the broad concepts of maximising the use of roads and urban environments for the first component of works (to Te Atatu Road), an on the broad concept of avoiding urban environments for the second component (to the esplanade reserve near Scott Road) (Figure 5-7). For the purposes of longlist development it is assumed that the initial gravity section from Concourse under Henderson Creek and through the Te Atatu peninsula will be constructed by micro-tunnelling. The rising main across the harbour through to Scott Road will be constructed using a combination of marine trenching and HDD and the remaining gravity section from Scott Road to Hobsonville PS will be constructed by micro-tunnelling.

From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- Finding a satisfactory site to locate the new pump station at the top of the Te Atatu peninsula;
- The limited area available to set up a HDD landing site on the northern end of the crossing (near Scott Road);
- The need to construct the pipe under private properties;
- The construction and environmental risks associated with long HDD drives; and
- The need to set up construction activities on the reef off Orukuwai Point.

For the purpose of longlist development it is assumed that the marine crossing would be constructed by HDD. This option would require a new pump station to be constructed at the Te Atatu peninsula rather than at Concourse.

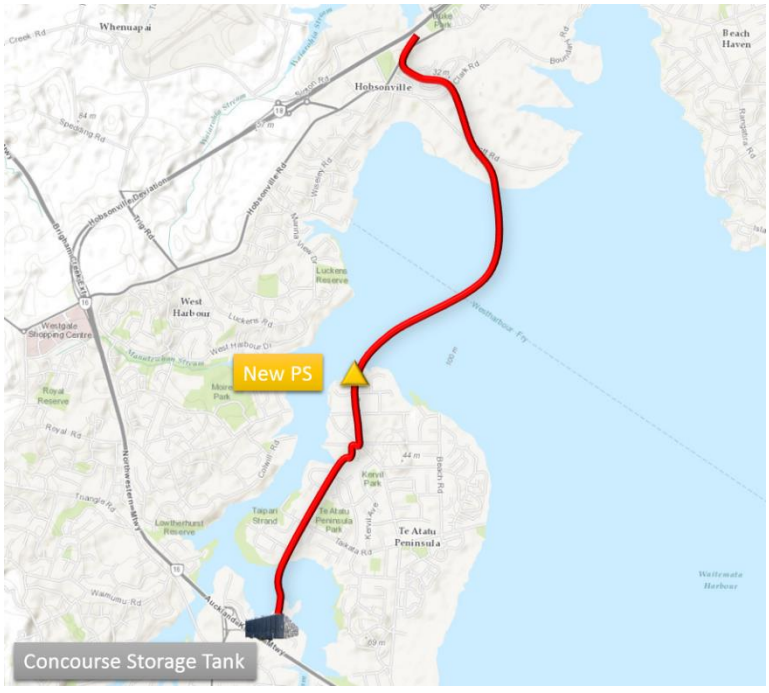


Figure 5-7: Option 5 – Matipo Road

5.1.6 Option 6 – Matipo Road – Alternate Pipeline Alignment

This option is based on the broad concept of maximising the use of roads and urban environments (Figure 5-8). It has a similar configuration as Option 5 with a gravity section from Concourse to new pumping station to be located Te Atatu point; a rising main section under the harbour through to a break pressure tank, and a second gravity section through to Hobsonville PS.

The alignment and construction approach for Option 6 is the same as for Option 5 through to Te Atatu point. The rising main across the harbour through to Luckens Reserve will be constructed using HDD and then by open trenching through to a break pressure chamber to be located in Wiseley Road. The remaining gravity section to Hobsonville PS will be constructed by micro-tunnelling.

This option comprises of a shorter marine crossing, with a landing point at Luckens Point. From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- Finding a satisfactory site to locate the new pump station at the top of the Te Atatu peninsula;
- The limited area available to set up a HDD landing site on the northern end of the crossing (at the coastal end of Luckens Reserve); and
- The construction and environmental risks associated with long HDD drives;

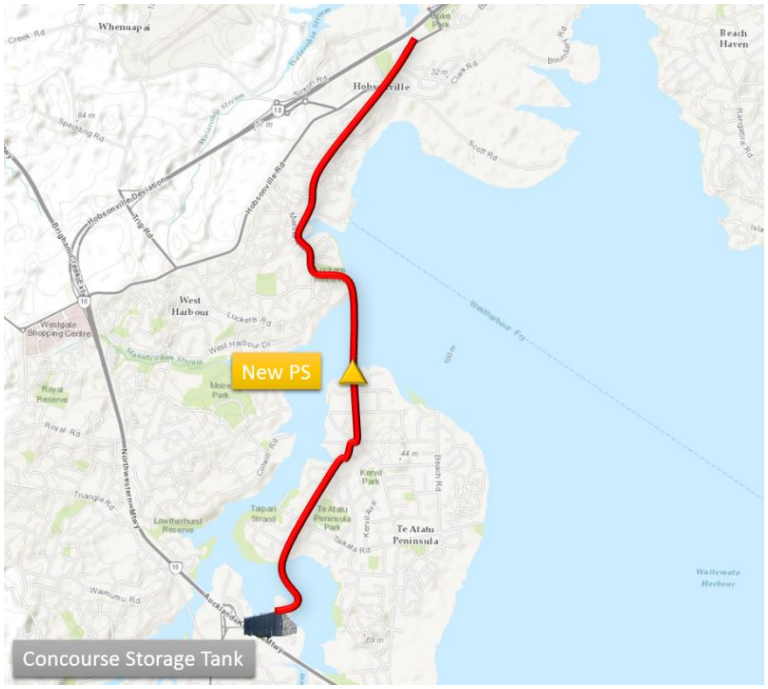


Figure 5-8: Option 6 – Matipo Road – Alternative Pipeline Alignment

5.1.7 Option 7 – Henderson Creek

Option 7 considers an alternate route from the Concourse Storage Tank, to a new pumping station at Te Atatu point (Figure 5-9). From here the route alignment could follow either route Option 5 or 6 to Hobsonville PS and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of avoiding urban environments for the first component of the route from Concourse to Te Atatu point and maximising the use of roads and urban environments for the second component.

The section of gravity pipeline along Hendersons Creek would be constructed by micro-tunnelling but will require a number of shafts to be constructed within the coastal reserve.

From a construction perspective, the need for multiple crossings of Henderson Creek, the associated environmental and cultural impacts, and the potentially long drive lengths, were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

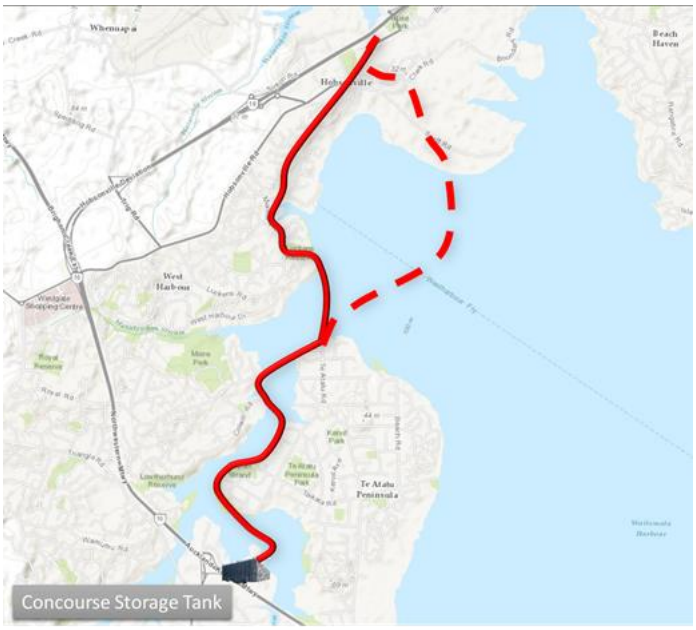


Figure 5-9: Option 7 – Henderson Creek

5.1.8 Option 8 – North Western Motorway

This option is based on the broad concept of maximising the use of roads and urban environments, and follows the alignment of the North Western Motorway (Figure 5-10).

For the purposes of this option it was assumed that the rising main from Concourse will cross Henderson Creek using HDD and run alongside the motorway (but not in the motorway corridor) to a break pressure chamber at around RL35m where it will change to gravity sewer constructed by micro-tunnelling.

From a construction perspective, the need to build the pipeline in or alongside the motorway corridor, the need for a marine crossing, the relatively deep micro-tunnel and shafts (35m+ in some locations to cross under ridgelines at Royal Road, Fred Taylor Drive and Trig Road) and the high static pumping head, were considered to be the most challenging aspects of this option.

This option would require a new pump station to be constructed at the existing Concourse Storage Tank site.

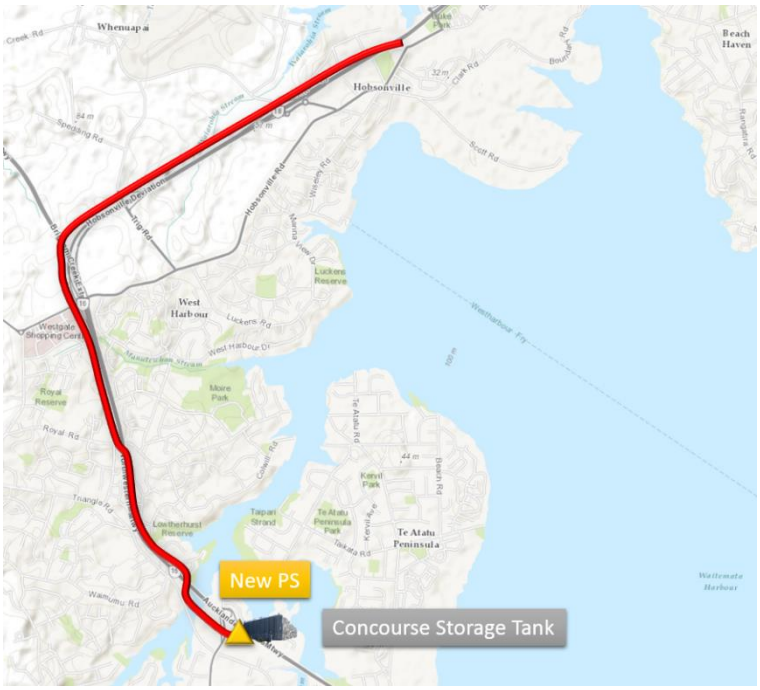


Figure 5-10: Option 8 – North Western Motorway

5.1.9 Option 9 – Gloria Road

This option combines two broad concepts: that of maximising the use of roads and urban environments, and avoiding urban environments. Option 9 considers an alternate route from the Concourse Storage Tank, to a new pumping station at Te Atatu point (Figure 5-11). From here the route alignment either follows route Option 5 or 6 to Hobsonville PS, and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of maximising the use of roads and urban environments.

The section of gravity pipeline from Concourse to Te-Atatu point would be constructed by micro-tunnelling. A tunnel drive of 400m is proposed under Henderson Creek through to Gloria Park.

From a construction perspective, the long micro-tunnel drive lengths, the limited area available for construction activities, and the need to micro-tunnel under private property immediately to the north of the Concourse storage tank were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

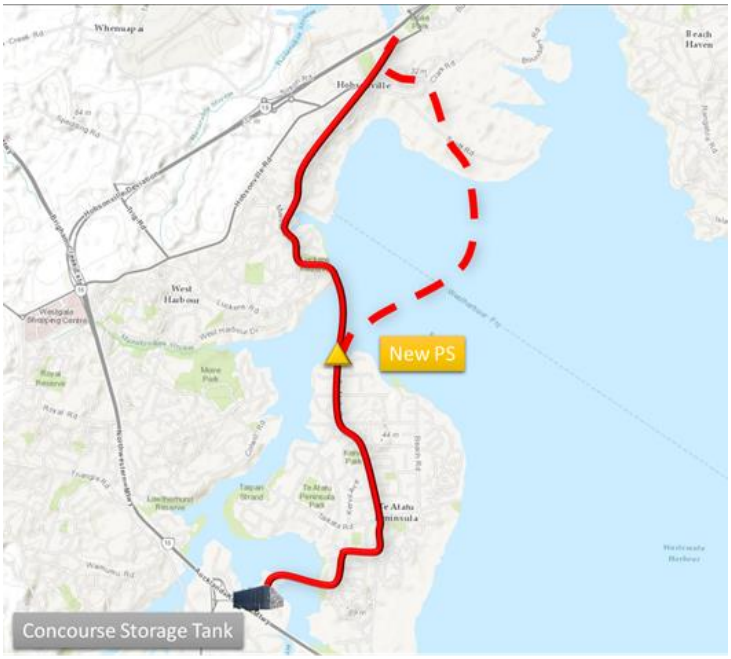


Figure 5-11: Option 9 – Gloria Road

5.1.10 Option 10 – Direct to Te Atatu Road

This option combines two broad concepts: that of maximising the use of roads and urban environments, and avoiding urban environments. Option 10 considers an alternate route from the Concourse Storage Tank, to the Te Atatu peninsula (Figure 5-12). From here the route alignment either follows route 5 or 6 to Hobsonville PS70, and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of maximising the use of roads and urban environments.

The section of gravity pipeline from Concourse to Te-Atatu point would be constructed by micro-tunnelling. A tunnel drive of 500m is proposed under Henderson Creek through to the coastal area at the southern end of Edgerton Road.

From a construction perspective, the long micro-tunnel drive lengths, the limited area available for construction activities, and the need to micro-tunnel under private property immediately to the north of the Concourse Storage Tank, and a number of residential properties were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

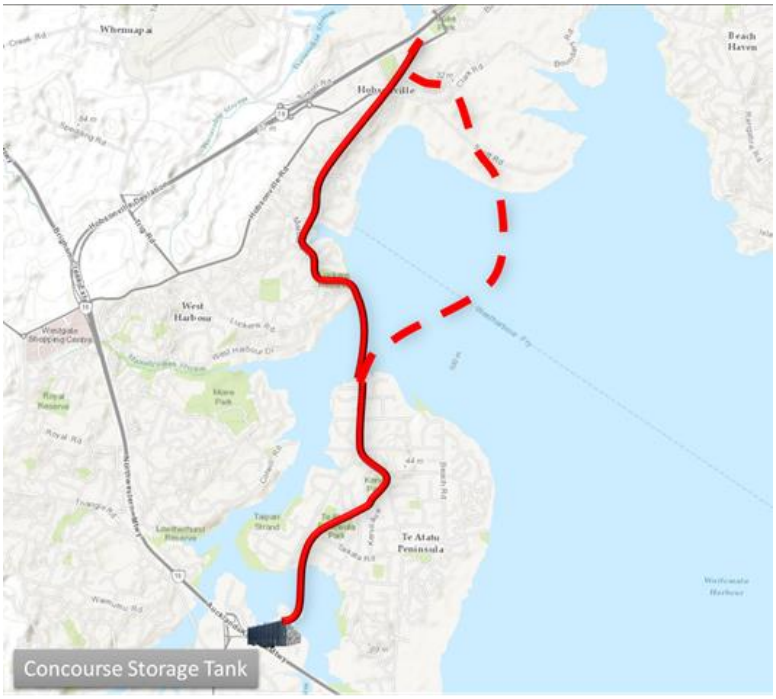


Figure 5-12: Option 10 – Direct to Te Atatu Road

5.1.11 Option 11 – Tunnel

This option is based on the broad concept of maximising the use of deep tunnels, and is considered to be a more direct route from Concourse to the Hobsonville PS (Figure 5-13). From a construction perspective, the need to construct the pipeline under private property, the grade requirements for the tunnel, and construction safety were considered to be the most challenging aspects of this option.

For the purpose of longlist development, it is assumed that the tunnel would comprise of a 3m bored tunnel to allow for longer driver lengths, and would require a shaft in Moire Park and Picasso Reserve. Uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require a new pump station at the existing Hobsonville Pump Station site.

Figure 5-13: Option 11 – Tunnel

5.1.12 Option 12 – Gravity Micro-Tunnel

This option is based on the broad concept of maximising the use of roads and urban environments, and combines alignments from other options (Option 6 for the southern component, and Option 3 for the northern component) (Figure 5-14). From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- The limited area available to set up a HDD landing site on the northern end of the crossing (near Scott Road);
- The need for long micro-tunnel drives;
- The need to set up construction activities on the reef off Orukuwai Point;
- Difficult/constrained access to multiple deep shafts; and
- Very deep pipe sections of 55m+

For the purpose of longlist development, it is assumed that the entire pipeline would be installed by micro-tunnelling.

Figure 5-14: Option 12 – Gravity Micro-Tunnel

5.1.13 Option 13 – Full Route Rising Main

This option has been developed to maximise the overall length of rising main in order to minimise pipeline construction depths (Figure 5-15). This option is based on the broad concept of avoiding urban environments, with the pipeline constructed primarily within the CMA.

The rising main would be constructed from a new pumping station at Concourse along Henderson Creek, Waipareira Bay and Limeburners Bay to a break pressure chamber at Scott Road. The pipeline would then be gravity from Scott Road to Hobsonville PS.

For the purpose of longlist development, it was assumed that the pipeline would be constructed by a combination of HDD and open trenching techniques.

From a construction perspective, the large extent of pipeline within coastal strip, long HDD drives required for marine pipeline construction, the difficulty in accessing HDD setup points, septicity and odour issues and friction loss were considered to be the most challenging aspects of this option.

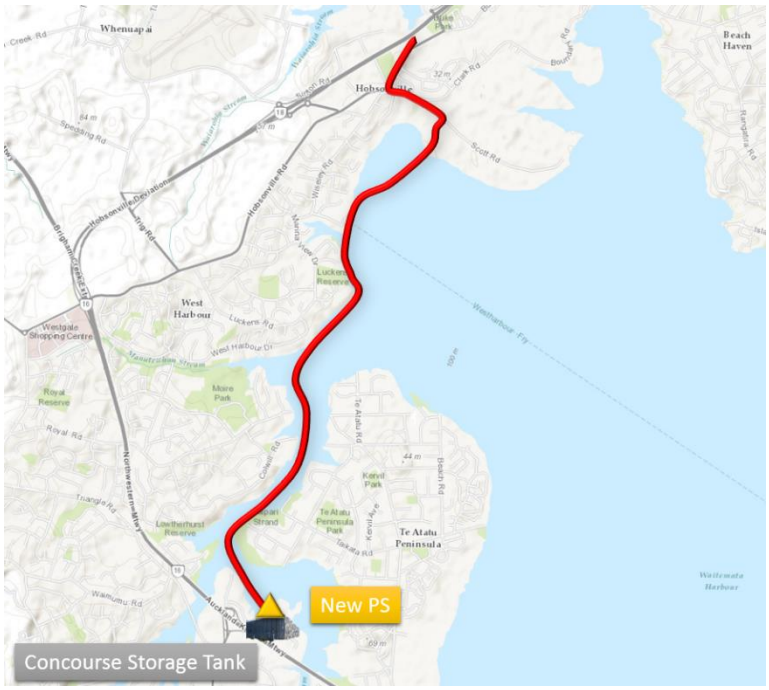


Figure 5-15: Option 13 – Full Route Rising Main

5.2 Qualitative Risk Analysis

Upon identification of the longlist options, consideration was given to qualitative risk factors associated with each Option.

Given the concept design stage of the Project at this point, it was acknowledged that there was varying degrees of uncertainty/risk associated with the cost and non-cost attributes of the Options that could influence the consideration of alternatives process. It was determined that an awareness of the degrees of uncertainty/risk was necessary in determining preferred Options. Once identified, the potential uncertainty/risk was rated and subsequently considered along with cost and non-cost attributes.

The outcomes of the uncertainty/risk analysis is summarised in the following table:

Table 5-1: Southern Alignment (Stage 2) Issues and Qualitative Risk Ratings

Option	Route	Issues Identified	Qualitative Risk Rating
1	Option 1 – Te Atatu Road	Harbour crossing, limited geotechnical information, poor ground conditions near the marina which may result in increased depth for gravity sewer and Hobsonville PS, Some micro tunnel shaft sites in coastal foreshore areas.	HIGH
2	Option 2 – Te Atatu Road – avoiding difficult coastal areas	Harbour crossing, limited geotechnical information, deep sections of micro-tunnel near limit of the technology with deep shafts in residential urban areas. Shaft site on Orukuwai Point reef would likely be required.	HIGH
3	Option 3 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels	Harbour crossing, limited geotechnical information, deep sections of micro-tunnel near limit of the technology with deep shafts in residential urban areas. Shaft site on Orukuwai Point reef would likely be required.	HIGH
4	Option 4 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing	Harbour crossing, limited geotechnical information, deep sections of micro-tunnel near limit of the technology with deep shafts in residential urban areas. Shaft site on Orukuwai Point reef would likely be required.	HIGH
5	Option 5 – Matipo Road	Marine trenching through Orukuwai Point reef, long pipeline crossing across main channel to the marina, limited geotechnical information, relatively (>30m) deep micro tunnel shafts along narrow Matipo Road	VERY HIGH
6	Option 6 – Matipo Road – alternate pipeline alignment	Harbour crossing, limited geotechnical information, relatively (>30m) deep micro tunnel shafts along narrow Matipo Road	MEDIUM

Option	Route	Issues Identified	Qualitative Risk Rating
7	Option 7 – Henderson Creek	Harbour crossing, limited geotechnical information, Micro tunnel shaft sites in coastal foreshore areas.	HIGH
8	Option 8 – North Western Motorway	Deep gullies may force gravity pipeline lower and increase micro tunnel shaft depths. Limited geotechnical information. Crossing of Henderson Creek using marine trenching or long HDD pipeline	MEDIUM
9	Option 9 – Gloria Road	Long micro tunnel drives under residential property (>25m deep) Limited geotechnical information	MEDIUM
10	Option 10 – Direct to Te Atatu Road	Long micro tunnel drives under residential property (>25m deep) Limited geotechnical information	MEDIUM
11	Option 11 – Tunnel	No geotechnical information at this stage. Costs based on 3m dia TBM. Impact of new mining regulations might require this to be increased. Construction under residential property, may require tunnel to be deeper impacting on the depth of the Hobsonville PS.	HIGH
12	Option 12 – Gravity Micro-Tunnel	Harbour crossing, limited geotechnical information, deep sections of micro-tunnel near limit of the technology with deep shafts in residential urban areas	HIGH
13	Option 13 – Full Route Rising Main	Construction within the marine and coastal environment. Limited geotechnical information, poor ground conditions near the marina which may result in increased depth or need for HDD construction.	HIGH

5.3 Multi-Criteria Analysis

Once the 13 longlist options were identified, criteria were developed by the Project Team to enable the assessment of the longlist options against an MCA process (similar to the MCA process that was developed for the Hobsonville to Rosedale route selection process). The following table outlines the criteria and sub-criteria adopted for the MCA process:

Table 5-2: MCA Criteria and Sub-Criteria

Criteria	Operational	Technical	Environmental	Staging
Sub-Criteria	**Safety:** ability for Watercare staff to operate and maintain the works in a safe manner, includes issues such as confined spaces, working at heights, gas accumulation, accessibility etc.	**Reliability:** whether the option provides for a reliable technology with prior application and proof of performance in NZ	**Cultural/heritage:** impacts on areas of cultural or heritage significance	**Ability to be staged**
	Complexity: degree of difficulty and interdependency of the operation of the works	**Flexibility:** adaptable to change/adjustment to suit future requirements	**Natural Environment:** impacts on areas of environmental significance such as native flora and fauna, CMAs	
	Maintenance: overall requirements and frequency of maintenance activities, degree of difficulty, impacts on system performance during maintenance etc.	**Constructability:** ease of construction, availability of local contractors, need for specialist equipment or techniques	**Community:** impact on community groups and local interests through construction and ongoing operation of new assets	
	Odour/Corrosion: septicity and odour generation, noxious gases, accelerated corrosion rates due to sulphide attack	**Opportunity/benefit:** provides additional benefits beyond the base requirements for the project	**Landowners/property:** impact on individual property owners during construction and ongoing operation	

The MCA process was undertaken within a workshop involving Watercare staff and MWH consultants. Through the MCA process:

- The workshop participants assessed each longlist option against each of the sub criteria. For each sub criteria a score of 1 - 5 was awarded based on the professional judgement of the collective workshop group. A score of 1 indicates a high risk associated with the criteria (i.e. the option will potentially fail to meet requirements), a score of 5 would indicate a low risk associated with the criteria (i.e. the option is considered reliable);
- Each criteria was weighted evenly; and
- Each longlist option was given a preliminary capital cost estimate. These cost estimates were developed using Watercare Unit Rate Cost Models and estimating data from the Central Interceptor and Associated Works project. The operating costs associated with

each option were considered to be quite similar and as such a NPV assessment was not undertaken at this stage.

The following table summarises the northern alignment longlist options, their relative MCA score and capital cost from which the four shortlisted options were identified. The full assessment, and comments on select criterion, is contained in Appendix A of this Report.

Table 5-3: Southern Alignment longlist Options

Route	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Rank	MCA Score	MCA Rank
Option 1 – Te Atatu Road	This option was developed as the most straightforward road based alignment from Concourse to Hobsonville outside of the motorway corridor.	$113M	6	$148	6	2.75	4
Option 2 – Te Atatu Road – avoiding difficult coastal areas	This option was developed as a variation to Option 1 with the route altered to avoid construction in the potentially difficult coastal areas.	$107M	4	$141	4	2.57	8
Option 3 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels	This option was developed as a variation to Option 2 with the aim of avoiding the need for a deep tunnelling shaft on Luckens Road.	$104M	2	$139	3	2.57	8
Option 4 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing	This option was also developed as a variation to Option 2 with the aim of avoiding the need for a deep tunnelling shaft on Luckens Road. This is achieved by altering the harbour crossing alignment with the tunnel connecting to Luckens Reserve then onto Marina View Drive.	$104M	2	$138	2	2.63	6
Option 5 – Matipo Road	This option was developed to be able to cross the harbour using HDD rather than micro-tunnelling as HDD is capable of much longer drives.	$132M	12	$176	12	2.69	5
Option 6 – Matipo Road – alternate pipeline alignment	This option was developed as a variation to Option 5, with an alternative pipeline alignment from the proposed pumping station to Hobsonville.	$114M	7	$150	7	2.82	2
Option 7 – Henderson Creek	This option was developed as an alternative gravity pipeline route from Concourse to a Te Atatu Peninsula Pumping Station (i.e. alternative for Options 5 and 6). The route follows Henderson Creek from Concourse to the proposed pumping station at the tip of Te Atatu Peninsula and the balance of the route is as per Options 5 or 6	$124M	10	$161	9	2.51	12

Route	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Rank	MCA Score	MCA Rank
Option 8 – North Western Motorway	This option follows the alignment of the North-Western Motorway. A pumping station at Concourse would pump flows into twin 2.5km long rising mains to a break pressure chamber located to the south of the Royal Road off-ramp. From here a gravity pipe would take flows to Hobsonville Pumping Station.	$116M	8	$152	8	3.2	1
Option 9 – Gloria Road	This option was developed as an alternative gravity pipeline route from Concourse to a Te Atatu Peninsula Pumping Station (i.e. alternative for Options 5 and 6). The route crosses Henderson Creek from Concourse then follows Gloria Road, Yeovill Road and Te Atatu Road to the proposed pumping station location. The balance of the route is as per Options 5 or 6.	$125M	11	$162	10	2.57	8
Option 10 – Direct to Te Atatu Road	This option was developed as an alternative gravity pipeline route from Concourse to a Te Atatu Peninsula Pumping Station (i.e. alternative for Options 5 and 6). The route crosses Henderson Creek from Concourse then takes the most direct route to Te Atatu Road and the proposed pumping station. The balance of the route is as per Options 5 or 6.	$111M	5	$147	5	2.57	8
Option 11 – Tunnel	This option was developed as a 3 metre bored tunnel to allow longer driver lengths and a more direct route from Concourse to Henderson.	$174M	13	$181	13	2.82	2
Option 12 – Gravity Micro-Tunnel	This option combines alignments from other options, based on the south (Concourse to end of Te Atatu Peninsula) and north (from Te Atatu Peninsula to Henderson) sections.	$102M	1	$108	1	2.19	13
Option 13 – Full Route Rising Main	This option was developed as a rising main for the majority of the route length.	$120M	9	$165	11	2.62	7

5.4 Identification of Shortlist Options

In comparing the MCA outcomes, capital costs and qualitative risk of each of the of the longlist options, the following table was developed for comparison:

Table 5-4: Summary of Outcomes, Southern Alignment (Stage 2)

Option	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Cost Rank	MCA Score	MCA Rank	Qualitative Risk
1	Te Atatu Road	$113M	6	$148	6	2.75	4	HIGH
2	Te Atatu Road – avoiding difficult coastal areas	$107M	4	$141	4	2.57	8	HIGH
3	Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels	$104M	2	$139	3	2.57	8	HIGH
4	Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing	$104M	2	$138	2	2.63	6	HIGH
5	Matipo Road	$132M	12	$176	12	2.69	5	VERY HIGH
6	Matipo Road – alternate pipeline alignment	$114M	7	$150	7	2.82	2	MEDIUM
7	Henderson Creek	$124M	10	$161	9	2.51	12	HIGH
8	North-Western Motorway	$116M	8	$152	8	3.2	1	MEDIUM
9	Gloria Road	$125M	11	$162	10	2.57	8	MEDIUM
10	Direct to Te Atatu Road	$111M	5	$147	5	2.57	8	MEDIUM
11	Tunnel	$174M	13	$181	13	2.82	2	HIGH
12	Gravity Micro Tunnel	$102M	1	$108	1	2.19	13	HIGH
13	Full Route Rising Main	$120M	9	$165	11	2.62	7	HIGH

Three shortlisted options were selected for consideration through the shortlist process. These are shown in Table 5-5. The full assessment, and comments on select criterion, is contained in Appendix A of this Report.

Table 5-5: Shortlisted Options

Option	Description	Capital Cost	Capital Cost Rank	NPV (50 year)	NPV Cost Rank	MCA Score	MCA Rank	Qualitative Risk
8	North-Western Motorway	$116M	8	$152	8	3.2	1	MEDIUM
1	Te Atatu Road	$113M	6	$148	6	2.75	4	HIGH
6	Matipo Road – alternate pipeline alignment	$114M	7	$150	7	2.82	2	MEDIUM

The shortlisted options were selected on the following basis:

- Option 8 was taken forward as it has the highest overall MCA score and comparable cost. This Option also has the capacity to service future development alongside and north of State Highway 16 and 18 and avoids a major crossing of the harbour and has a medium level of overall risk;
- Option 6 was taken forward as it was considered to be the better of the two route Options 5 and 6, having an equal MCA score but a 16% lower capital cost, and the equal second highest MCA score. Options 7, 9 and 10 were considered variants of Option 6 but all had lower MCA scores and approximately equivalent or higher capital costs;
- Option 1 was taken forward as it had comparable capital costs to the other options, and has the most direct alignment.

The remaining options were not shortlisted for the following reasons:

Table 5-6: Discarded Southern Alignment (Stage 2) Longlist Options

Option	Description	Reasons for Discarding the Option
2	Option 2 – Te Atatu Road – avoiding difficult coastal areas	Variant to Option 1 with similar MCA, similar capital cost and qualitative risk to Option 1. See comments below re: approach to Option 1 and potential re-evaluation of this Option.
3	Option 3 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels	Variant to Option 1 with similar MCA, similar capital cost and qualitative risk to Option 1. See comments below re: approach to Option 1 and potential re-evaluation of this Option.
4	Option 4 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing	Variant to Option 1 with similar MCA, similar capital cost and qualitative risk to Option 1. See comments below re: approach to Option 1 and potential re-evaluation of this Option.
5	Option 5 – Matipo Road	Higher capital cost and qualitative risk compared to Option 6 with the same MCA score.
7	Option 7 – Henderson Creek	Variant to Option 5 or 6, lower MCA score and higher capital cost and qualitative risk than the preferred Option 6.
9	Option 9 – Gloria Road	Variant to Option 5 or 6, lower MCA score and higher capital cost than the preferred Option 6.

Option	Description	Reasons for Discarding the Option
10	Option 10 – Direct to Te Atatu Road	Variant to Option 5 or 6, lower MCA score with only a marginally lower capital cost than the preferred Option 6.
11	Option 11 – Tunnel	Capital cost over 50% (approximately $60M) higher than the preferred Options 6 and 8 with a lower or equivalent MCA score
12	Option 12 – Gravity Micro-Tunnel	Lowest MCA score of all options.
13	Option 13 – Full Route Rising Main	Lower MCA score and higher capital cost than all three preferred options.

It should be noted that Options 2, 3 and 4 were originally developed as variants of Option 1 with different route alignments through the northern section of the alignment and have similar MCA scores, levels of risk and estimated capital costs. It was determined that should the further development of Option 1 indicate that the northern part of the proposed alignment was unsuitable, the alternative alignments proposed as Options 2, 3 and 4 would be reconsidered.

5.5 Shortlist Options

Once the preferred shortlist options were identified, further detailed analysis was undertaken to identify the preferred option. The following figure summarises the shortlist investigation process for Stage 2.

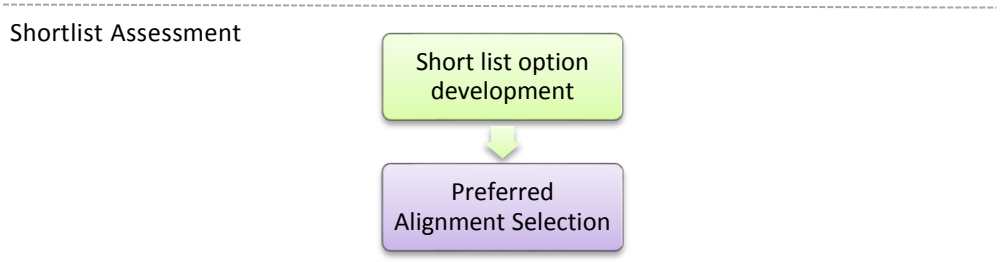


Figure 5-16: Shortlist Assessment Process

5.5.1 Shortlist Option Development

The shortlisted options identified through the longlist MCA process were further developed in order to select a preferred route. This development process included:

- A review of overall option sizing;
- Preliminary siting of main components;
- Review of alignments for access and constructability;
- Preparation of plans and longitudinal section drawings;
- Updating of cost estimates using pricing data obtained during the ECI process;
- Undertaking discussions with contractors to identify any significant issues.

During this process, an additional route alignment was identified. This alignment was developed as a combination of Options 1 and Option 6 and was called Option 1A – Te Atatu Road alternative and was included in the subsequent shortlisted options assessment process. This alternative alignment retains the same basic premise of Option 1 (of a pumping station at Concourse, rising main to a high point and a gravity sewer to Hobsonville) but utilises the general route alignment of Option 6. The alignment was identified as being more direct and avoided the construction around the West Harbour marina and the gravity micro-tunnel across Henderson Creek compared to Option 1 and the difficult micro-tunnelling along Matipo Road required for Options 6.

The following plan shows all 4 of the shortlist options.

Figure 5-17: Shortlist Options, Southern Alignment (Stage 2)

The further development work resulted in some modifications to the shortlist options and the identification of the advantages and disadvantages of each option. The modifications for Options 1, 6 and 8 were in relation to estimated depths of micro-tunnelling and pump stations and minor adjustments to the alignments to provide locations for micro-tunnelling shafts and HDD construction and to suit overall hydraulic requirements.

Table 5-7: Summary of Modifications, Advantages and Disadvantages of Southern Alignment (Stage 2) Shortlist Option

Shortlist Option	Finding of Further Investigations	Modifications to the Option	Advantages	Disadvantages
Option 1 – Te Atatu Road	• Ground conditions for the upper reaches of Hendersons Creek are good and would facilitate marine trenching or HDD • Existing (narrow) access road from Luckens Reserve down to foreshore • Shallow inlet into Waipareoira Bay immediately south of Westpark Marina is known to be poor ground with deep layer of soft muds • Restrictcted access to coastal forshore along Limeburners Bay • Long micro-tunnel drive across from Te Atatu to Luckens Reserve • New SHA at Scotts Point	• Allowance for HDD across Henderson Creek • 1800mm dia Micro-tunnel from Te Atatu to Luckens Reserve to enable longer drive length. Pit within marine section will be required. • Alignment through Scotts Point adjusted to suit proposed new road layouts.	• Shallow micro-tunnel shafts, which reduce costs and are safer to construct • Substantial length of gravity sewer, as there are lessissues with septicity and risks of odour. From an overall perspective, the reduced friction head would require less pumping, reducing the costs of energy	• Limited ability to pick up local flows from nearby areas of growth, which results in the need to provide additional infrastructure to be built in the future to service these areas. • Potential disruption to local residents and industry during construction activities • Potential significant adverse effects associated with: o removal of protected trees; o long length of coastal marine crossing; o construction activities in close proximity to sites and places of value to Mana Whenua • Break pressure chamber located in close to residents, which may impact local amenity values

Shortlist Option	Finding of Further Investigations	Modifications to the Option	Advantages	Disadvantages
				• Longer length of the gravity sewer requires additional maintenance.
Option 1A – Te Atatu Road alternative	• No suitable landing site on Matipou Road for HDD pipeline crossing of Henderson Creek • Long HDD crossing from Te Atatu point to Luckens Reserve • Shallow gully/inlet into Waipareira Bay immediately south of Westpark Marina is known to be poor ground with deep layer of soft muds • Several long micro-tunnel drives required for the gravity sewer section	• HDD crossing of Henderson's Creek with landing site moved east to open space adjacent to 22A Waione Avenue • HDD landing site in Luckens Reserve • Pipe bridge across small gully into Waipareira Bay • Allowance for additional micro-tunnel shafts for all micro tunnel drives over 400m	• Similar to Option 6, this is the shortest route from Concourse to Hobsonville • Lower capital cost than Option 1 • Avoids encroaching the CMA and construction around the West Harbour marina by using HDD technology, which would enable the pipeline to be constructed under the seabed • Utilises existing infrastructure and avoids the need to create a new discharge by utilising the existing Hobsonville PS as a discharge point	• Limited ability to pick up local flows from nearby areas of growth, which results in the need to provide additional infrastructure to be built in the future to service these areas. • Potentially significant disruption to local residents and industries from construction activities • Long length of rising main (approx. 4.1km) which increases the septicity and odour risks, particularly at discharge locations.
Option 6 – Matipo Road – alternate pipeline alignment	• Long micro-tunnel drive across Henderson Creek • Deep micro-tunnel shafts along Matipou Road	• Relatively longer micro-tunnel drive lengths proposed along Matipou Road to limit the number of shafts required	• Similar to Option 1A, this is the shortest route from Concourse to Hobsonville • Largely avoids impacting the CMA	• Limited ability to pick up local flows from nearby areas of growth, which results in the need to provide additional infrastructure to be built in the future to service these areas.

Shortlist Option	Finding of Further Investigations	Modifications to the Option	Advantages	Disadvantages
			• HDD crossing of Henderson Creek, which avoids disruption to the CMA at this location • As the gravity sewer will be shallow, there is the ability to utilise existing infrastructure and avoid the need to create a new discharge by utilising the existing Hobsonville PS as a discharge point	• Pump station would need to be located on the foreshore area at the end of Te Atatu peninsula, which would impact the coastal environment and coastal edges. • Potentially significant disruption to local residents, due to the need to construct numerous micro-tunnel shafts in narrow roads, and break pressure chamber in close proximity to residents
Option 8 – North-Western Motorway	• Ground conditions for the upper reaches of Henderson Creek are good and would facilitate marine trenching or HDD • Road widening proposed for North Western Motorway and future busway proposed for western side • Hydraulic assessment indicates that the change from rising main to gravity sewer will be required at around RL35-40m to provide grade to get to Hobsonville	• Allowance for HDD across Henderson Creek • Alignment shifted from western side of Motorway to eastern side with rising main through Radio NZ land, along Huruhuru Road and Cedar Heights Drive • Break pressure tank located on Cedar Heights Drive • Larger diameter (1500mm) micro-tunnel proposed to facilitate longer drive lengths (>400m)	• Has the ability to pick up a large amount of local flows from the surrounding area, which can potentially delay the need to build future infrastructure to service this area. • Unlike other options, this option offers opportunity to coordinate works and collaborate with other service providers, who have project earmarked for this area. This may include the future cycle way and bus route along	• Break pressure chamber located in close to residents, which may impact local amenity values • Very deep micro-tunnel and micro-tunnel shafts, which escalate cost and are a safety risk during construction. • Longest and most expensive route

Shortlist Option	Finding of Further Investigations	Modifications to the Option	Advantages	Disadvantages
	• Ridgelines along Royal Road and Hobsonville Road will require deep micro-tunnels • Deep gully alongside Manutewhau Walk to be avoided or will likely require pipe bridge • Rapid development of the Westgate commercial area		the motorway, and the future North Harbour 2 Watermain (“NH2”)	

5.6 Preferred Option Selection

The project specific MCA tool that was developed for the assessment of the Stage 1 shortlist options was also used for the evaluation of the Stage 2 shortlist options. The criteria and basis for the assessment are described in Table 4-9 above.

The MCA scores for each option are summarised in Table 5-8 below. In this MCA tool, lower scores represent the better outcome. Whilst the options have different impacts associated with each of the criteria, overall the total scores are relatively similar.

Table 5-8: MCA Score Summary (Southern Alignment, Stage 2)

MCA Criteria		Option 1	Option 1A	Option 6	Option 8
Functionality		2.8	2.6	2.6	1.6
O&M		2.7	2.7	2.7	2.7
Constructability		2.3	3.0	2.7	2.3
Assessment of Environmental Effects	Environmental	3.1	2.4	2.4	1.8
	Social	2.9	2.6	2.9	2.6
	Cultural	3.0	2.0	2.5	2.0
	Economic	3.0	2.8	2.8	2.8
	TOTAL	2.82	2.59	2.66	2.26

5.7 Comparative Costs

Preliminary capital cost estimates for the shortlist options were further developed from a range of sources including the Watercare Unit Cost database, escalated tender prices from the South West Interceptor and the Kohimarama Storage Tank and additional cost information provided by Fletchers and McConnell Dowell.

The median capital cost estimates are shown in the table below. In summary:

- Option 1A has the lowest estimated capital cost; and
- Option 8 has the highest estimated capital cost due to the overall longer length and larger sizing of the gravity sewer section alongside the upper harbour motorway.

Table 5-9: Comparative Cost Summary – Estimated Costs

Costs	Option 1	Option 1A	Option 6	Option 8
Capital Costs $M	$105.5	$92.7	$108.3	$118.6

It is anticipated that operating costs for the options will not be substantially different. The net present cost for 50 years operating costs for each option are shown in Table 13-4. These costs are based on Stage 2 being completed in the year 2035 and cover operation from 2035 to 2085. A discount rate of 6% per annum has been applied, starting from the year 2035.

Table 5-10: Operating Cost Comparison

Costs	Option 1	Option 1A	Option 6	Option 8
Operating Cost (50 yr NPC) $M	36.8	45.1	38.6	38.0

Chemical dosing will be required for all options as the rising main lengths are all between 2km and 4km. For the shorter rising main, a rate of $150/ML was adopted for chemical dosing costs and for the longer rising main (Option 1A), we have adopted $200/ML. Power costs have been determined based on a charge of $0.09/kWhr. Other O&M costs including attendance labour and maintenance activities have been based on a percentage of the overall capital cost.

5.8 Preferred Option

The shortlist options were compared and a preferred Stage 2 option agreed by the Project Team. To summarise the comparison and analysis:

- Option 8 has the best (lowest) MCA score, primarily due to the better environmental score;
- Option 8 has the highest capital cost but will provide a significant capital savings offset as the section along the Upper Harbour Motorway (State Highway 18) can double as the trunk sewer servicing the Massey North, Westgate, Trig Road, and Whenuapai areas of the Service Catchment;
- Option 1A had the second best MCA score;
- Option 1A has the lowest capital cost. It also has the lowest combined capital and operating cost;
- Overall the net capital costs for Option 1A and Option 8 quite comparable (allowing for the capital savings offset for Option 8) and when operating costs are also considered, Option 8 is more economic overall; and
- Option 6 has the second worst MCA score and allowing for the capital savings offset for Option 8, has the highest combined capital and operating cost. This option was not preferred.

Option 8 was selected as the preferred option as it had the highest non-price MCA score and also provides capacity to service the Redhills, Massey North, Westgate and Trig Road areas of the Service Catchment. It also provides the lowest overall combined capital and operating cost solution when factoring in the expected savings in infrastructure servicing costs.

5.9 Impacts on Private Land

Once Option 8 was identified as the preferred option for Stage 2, more detailed consideration was given to the alignment from Royal Road to St Margarets Park. As per Concept Design to date, it is anticipated that the pipeline will be relatively shallow in this location and as a result, the following potential issues arise:

- Potential adverse effects on private property. The alignment may need to pass directly under private property and properties may need to be acquired to enable a crossing of the Manutewhau Reserve;
- Potential need to cross the Manutewhau Reserve. The Manutewhau Reserve constitutes a steep stream and gully system that is identified as a Significant Ecological Area - Land (SEA:L) as a “stepping stone, migration pathway and buffer” in the PAUP, and a Managed Natural Area in the Auckland Council District Plan (Waitakere). This reserve also contains the Manutewhau Walkway; and

- A potential need to cross State Highway 16.

Given the identification of these potential issues, further consideration of the route alignment options from Royal Road to St Margarets Park was undertaken.

5.9.1 Development of Options

As noted above, the route alignment being considered constitutes the route from Royal Road to St Margarets Park (South to North). In terms of eastern and western boundaries to the catchment, the following boundaries were identified:

- Western – State Highway 16. It is considered undesirable to cross the State Highway due to accessibility and settlement issues as well as the need for additional pipeline length.
- Eastern – Moire Road. Due to topography a route alignment further east than Moire Road would result in micro-tunnel shafts deep in the ground escalating cost and safety risk during construction.

Within this catchment, the following route alignment options were identified:

- Option 1 - Generally follows local roads parallel to the alignment of the North-Western Motorway. After passing through Makora Reserve, Option 1 runs underneath Royal Road, under a public access way to Landsdale Place. Option 1 then follows Landsdale Place and turns left into Holmes Drive South. At the end of Holmes Drive South Option 1 passes underneath private property through to Ruze Vida Drive. Option 1 then follows Ruze Vida Drive to the intersection with Jadewynn Drive where it crosses under private property, across Manutewhau reserve and along Holmes Drive. At the intersection of Holmes Drive and Oreil Avenue Option 1 passes underneath private property an in to St Margaret's reserve.
- Option 2 – Option 2 generally follows the natural gully that is formed between the North-Western Motorway and Moire Road. Option 2 crosses under Royal Road and into reserve area, tracking along the green space created by the gully. Option 2 crosses Holmes Road South and into Holmes Reserve, then crosses Ruze Vida Drive in to Manutewhau Reserve. Across Manutewhau Reserve Option 2 crosses Oreil Avenue and in to St Margaret's Park.
- Option 3 – Option 3 is a hybrid between Options 1 and 2 to try and mitigate some of their constraints. Option 3 initially follows Option 2 along the gully parallel to Moire Rd. Option 3 then moves away from the gully and towards Option 1. Option 3 crosses Manutewhau Reserve at the same point as Option 1.

These alignment options are illustrated below.

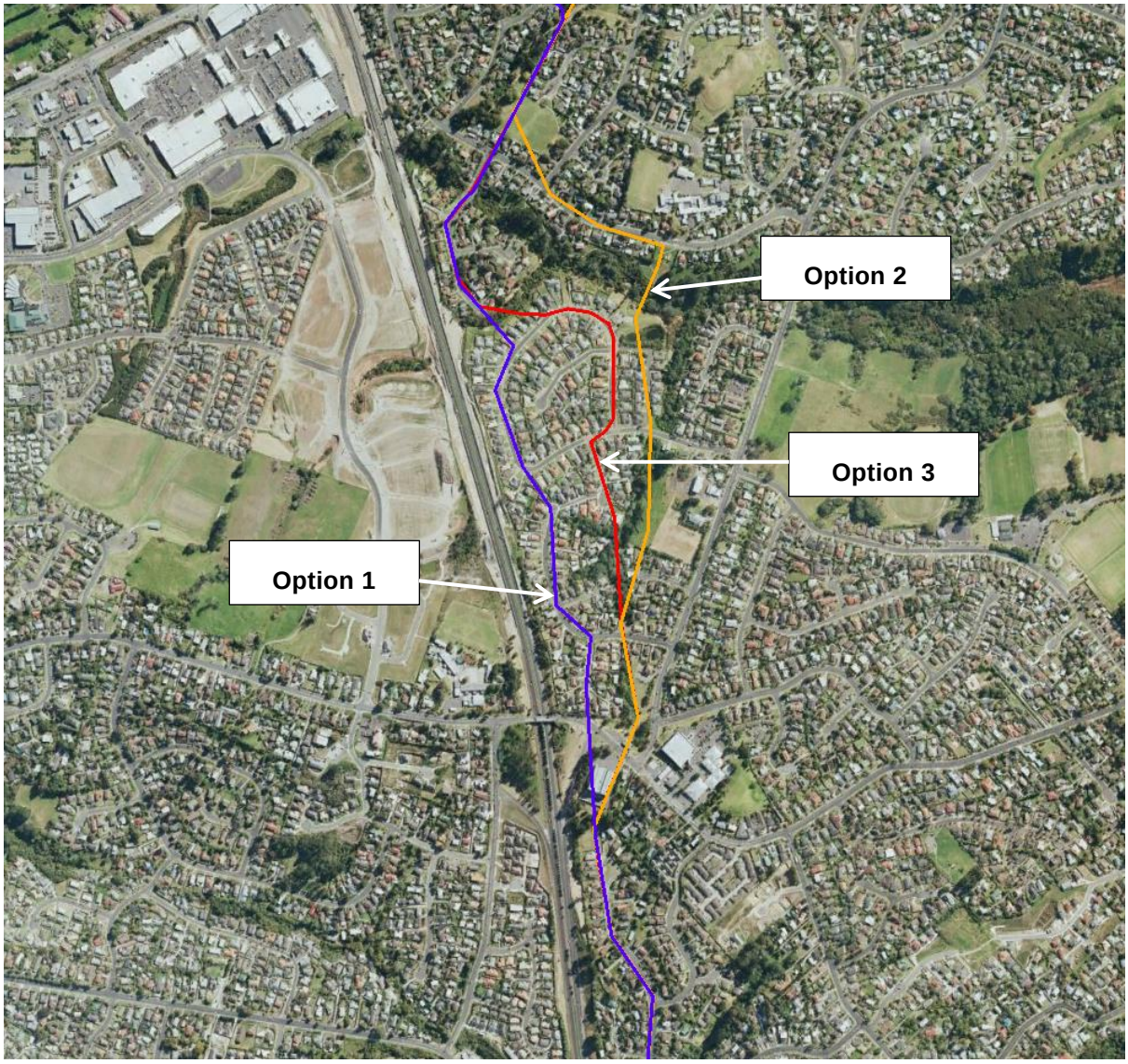


Figure 5-18: Alignment Options (Royal Road to St Margaret's Park)

A summary of the anticipated physical characteristics (as per concept design) of each option are outlined below:

Table 5-11: Physical Characteristics of Each Alternative

Parameter	Alignment 1	Alignment 2	Alignment 3
Indicative overall pipe length	2170m	2170m	2375m
Estimated No. of micro-tunnel shafts	16	14	16
Estimated total micro-tunnel shaft depth	163m	165m	164m
Average micro-tunnel shaft depth	10.2m	11.8m	10.3m
Estimated pipe bridge length	15m	45m	25m
Estimated No. of private properties that pipe will pass under	13	21	12
Estimated number of properties that will likely need to be acquired	2	0	2
Length in Private Property (approx.)	240m	640m	350m

As noted in the above table, a pipe bridge will be required to cross the Manutewhau Reserve. The reason why a pipe bridge is required at this location is because the pipeline will be operating under gravity at this location and it will need to continue on a steady gradient. For these reasons it cannot be installed by trenchless methods below the stream.

Through analysis of each of the alignment options, a number of advantages and disadvantages with each option were identified as follows:

Table 5-12: Advantages and Disadvantages of Options

Option	Construction		Operation	
	Advantage	Disadvantage	Advantage	Disadvantage
1	Anticipated to be shortest pipe length	• Virtually all construction within road corridors which impacts on traffic and residents in close proximity to work areas. • Difficulty constructing micro-tunnel shafts in narrow residential streets • Crossing Manutewhau Reserve will likely require the construction of a short pipe bridge. • Anticipated to pass under 13 different private properties. • Anticipated depth under private properties ranges between 7 – 15m. • Anticipated that 2 private properties will be temporarily required to enable construction works.	• Anticipated to be shortest pipe length for maintenance. • Minimal visual impact compared to other options • Good access to sewer manholes within road corridor	• Anticipated to pass under 13 different private properties. • Anticipated depth under private properties ranges between 7 – 15m.
2	• Anticipated to require the least number of micro-tunnel shafts. • Most use of open green space to facilitate construction and provide good access to micro-tunnel shafts	• Some construction within road corridors which impacts on traffic and residents in close proximity to work areas. • Loss of public use of open green space areas during construction • Crossing Manutewhau Reserve will require the construction of a 50m long pipe bridge through an area which is considered to have a very high amenity and environmental value. • Anticipated to pass under 21 different private properties.		• Ongoing aesthetic impact of the Manutewhau Reserve pipe bridge which would be up to 13m above ground level. • Maintenance requirements for the pipe bridge • Anticipated to pass under 21 different private properties • Anticipated depth under private properties

Option	Construction		Operation	
	Advantage	Disadvantage	Advantage	Disadvantage
		• Anticipated depth under private properties ranges between 3 – 18m. • Anticipated that 1 private property will be temporarily required to enable construction works		ranges between 3 – 18m.
3	• Easy to access micro-tunnel pits	• The majority of construction will be within road corridors which impacts on traffic and residents in close proximity to work areas. • Anticipated to pass under 12 different private properties. • It is likely that a section within the road corridor would need to be constructed by trenching because it is close to surface level. • Three micro-tunnel shafts are likely to be located on private property and Watercare would likely need to purchase three properties to provide suitable space for construction.	• Minimal visual impact • Good access to sewer manholes with road corridor	• Option 3 is longer than Options 1 and 2. • Anticipated to pass under 12 different private properties.

5.9.2 Cost Estimates

An estimate of the overall alignment costs are summarised below. The rates for micro-tunnelling are based on cost estimates received during early contractor engagement during the development of options.

	Option 1	Option 2	Option 3
Overall Cost	$23,300,000	$22,800,000	$25,600,000

5.9.3 Conclusions and Identification of Preferred Option

In the context of the above assessment and cost analysis, the following comments were made with respect to the alternative alignments:

- **Constructability** – Options 2 and 3 have the advantage of locating a number of micro-tunnel shaft sites in green space without size restrictions on construction areas. Option 1 has a number of microtunnel shafts that are located in tight road corridors, restricting the

area available for construction activities. The health and safety risk increases with confined construction sites and work in public roads which is a disadvantage of Option 1.

- **Social** – Due to the nature of construction in local roads versus green field sites, Option 1 is likely to create a greater disturbance to local residents, particularly around traffic flow. However, Option 2 will have a greater impact on recreational users of Manutewhau Reserve when compared to Option 1. Option 3 has construction in both roads and the reserves, but the reserve is less accessible in this location when compared to others, which limits the impact on recreational users.
- **Social** – Having a pipe bridge in a publicly accessed reserve will have a visual impact on users and neighbouring properties, which is a disadvantage of Option 2. Consultation with Auckland Council Parks, Sports and Recreation have indicated that the pipe bridge associated with Option 2 was not desirable.
- **Social** –Option 2 will require the most easements in private property, and the route through Housing New Zealand's site is considered undesirable.
- **Social** – Options 1 and 3 are likely to require more private property acquisition that Option 2.
- **Environmental** – While all options have construction works in reserve areas, Option 2 has a greater risk of effects to local waterways from construction, due to the number off micro-tunnel shafts in close proximity to watercourses.

Having regard to the above, Option 3 was identified as the preferred alignment.

6 Project Phasing

As a result of the processes described above, Option 9 (Northern) and Option 8 (Southern) were identified as the preferred alignment options for the Northern Interceptor Project to ultimately service the flows from the entire Service Catchment area, which is projected to reach approx. 350,000 by 2070. This growth is set to occur over a period of 50 years.

As noted above in Section 3.3, the ability to stage the project to adequately respond to actual population uptake was a key consideration in determining the preferred options. With this in mind, upon identification of the preferred options, further consideration was given to the potential staging of the Project, having regard to anticipated growth within the Service Catchment. Key factors that were taken into consideration during this process included:

- The rate and location of growth and development in Auckland and the need to service an ultimate population of 350,000;
- The ability to service new growth in the NWTA, which will likely be needed before the ultimate route is required;
- The need to divert flows from Mangere WWTP at some point in the future;
- The ability to size the pipeline according to the flows that are coming to them;
- Capability of the system to service low flows until the ultimate population is reached; and
- Ability to use existing new and used infrastructure and to potentially use some of the new infrastructure to defer the timing of new expenditure.

Subsequently, the following phases to the Project were identified:

Table 6-1: Project staging

Phase	Estimated construction timeframes	Description	Interrelationship with other Project phases
1[2]	2017-2020	**Hobsonville to Rosedale** This will serve the immediate population growth. Existing flows from the Hobsonville PS are transferred to the Rosedale WWTP, crossing the Upper Waitemata Harbour and through Greenhithe. Resource consents were granted in January 2016. Construction is expected to begin between 2016 and 2018.	The existing Hobsonville PS pumps up to 120L/s to the Whenuapai Branch Sewer. The Project will divert all of the Hobsonville PS flow away from this branch sewer and deal with immediate growth within the Service Catchment.
2	2022-2027	**Westgate to Hobsonville PS** This comprises the installation of a tunnel from near Westgate to the Hobsonville PS, along State Highway 18 (SH18), and	Primarily to convey flows to Hobsonville, but will also serve flows from newly developed and developing areas in the Service Catchment. These flows will then be diverted north to the Rosedale WWTP, via the Phase 1 pipeline.

[2] The works associated with Phase 1 was granted resource consent in January 2016 (reference LCO 2141617, LQ 2141618, LUC-2015-1326, LUC-2015- 1329, LUC-2015-1346, LUC-2015-1347 REG-2015-1332, REG-2015-1334, REG-2015-1336, REG 2141632, REG 2141623, REG 2141624, REG 2141625)

Phase	Estimated construction timeframes	Description	Interrelationship with other Project phases
		is mostly within the NZ Transport Agency's (the "Transport Agency") designation.	
3	2022-2027	**Wainoni Park (Booster PS)** This Phase is a new Booster PS that will increase the capacity of the Phase 1 pipeline from 275L/s to 520L/s.	This PS will double the flow transferred to the Rosedale WWTP and extend the capacity of the Phase 1, deferring large upgrades. This is considered necessary as it is anticipated that the Hobsonville PS will exceed capacity sometime around 2022 – 2027.
4	2032-2035	**Greenhithe to Rosedale and Wainoni Park (Intermediate PS)** This includes a new pipeline from the Hobsonville PS, across the Upper Waitemata Harbour, through Greenhithe to the Rosedale WWTP. This Phase follows a similar alignment to Phase 1, and will include an Intermediate PS in Wainoni Park North. Phase 4 will transfer flows from Red Hills, Kumeu, Huapai, Riverhead, Whenuapai and Hobsonville Ultimately, Phase 4 will also pick up the flows from the future Phase 5 pipeline.	Phase 4 will accommodate the flows coming from Phase 2 & 5 and will transfer up to 1,820L/s flow from the Concourse Storage Tank to the Rosedale WWTP.
5	2035+	**The Concourse to Hobsonville Road (Westgate)** The purpose of this connection is to divert flows away from the Western Interceptor (Swanson area) to free capacity at Mangere WWTP. The PS that will be installed at The Concourse will transfer flow northward, to the Rosedale WWTP.	Divert flows away from the Western Interceptor and the Concourse Storage Tank to free up capacity at Mangere WWTP
6	2035+	**Greenhithe to Rosedale** This Phase involves the duplication of the rising main sections of Phase 4 and increases the capacity of the Intermediate PS at Wainoni Park.	Phase 6 increases the capacity of Phase 4 from 1,850 L/s up to 3,600 L/s to accommodate growth.

7 Construction Methodologies

Throughout the development of the Project Concept Design, consideration of the preferred construction methodology has been undertaken. With regards to establishing the pipeline, there are broadly two construction methodologies available.

1) Trenched; or
2) Trenchless.

Open trenching is a cost efficient method of installing pipelines, however, open cut construction has several short comings, chief amongst which are; health and safety concerns for workers, surface disturbance, disruption to vehicular/pedestrian traffic and inability to cross certain sites.

Trenchless technologies comprise an array of different methods or techniques, with each method having certain capabilities and limitations. A number of factors are assessed to determine when trenchless technologies are suitable over open trenching:

- Ground conditions
- Site conditions (Rivers, creeks, railways, major roads)
- Impact to local stakeholders
- Access
- Depth of installation
- Pipe diameter
- Environmental impacts
- Traffic volumes
- Handling and treatment of contaminated soil
- Cost

As noted above, these factors have been considered throughout the development of Concept Design, and the preferred approach is reflected in the designation drawings.

8 Pump Station Location Development

Option 9 (Northern) and Option 8 (Southern) were identified as the preferred alignment options for the Project. Option 9 (Northern) requires two new pump stations, both located at a point midway along the alignment. Option 8 (Southern) requires a new pump station at the Concourse Storage Tank site, and one at the existing Hobsonville PS site. As such, four new pump stations are required for the Project.

Two of the pump station locations, being the Concourse site and the Hobsonville PS site, are required at 'fixed point' locations (refer Section 3). In addition, one of these, the new pump station at Concourse, is subject to existing Watercare designations.[3] The second, the new pump station at Hobsonville, is subject to NoR – NH2 (Waitakere, shared corridor). As these pump stations are proposed at fixed points (and are thus considered to be determined by the adoption of the preferred alignment, no further consideration of alternatives has been undertaken for these two pump stations

Subsequently, the following consideration of alternative pump station sites is thus limited to the Intermediate and Booster pump station locations.

8.1 Multi Criteria Assessment

A project specific MCA tool was used for the evaluation of the shortlisted options for both the Intermediate Pump Station ("IPS") and the Booster Pump Station ("BPS"). The criteria and basis for the assessment is shown in Table 8-1. Each assessment point was given a score from 1 to 5, with the lower scores representing better outcomes.

Table 8-1: MCA Criteria and Basis of Assessment

Assessment Framework	Basis for Assessment
Functionality	Operational and maintenance access to site for crane, truck, trailer, etc. Site location/space
	Operation and maintenance of gravity length versus rising main length
	Provide benefit or alignment with other utilities or public services. (Electricity supply (south east easier in Wainoni Park). Public space amenity as a park or cemetery
	Flow management in instance of failure
	Natural hazards affecting the PS (Flooding, liquefaction, fire, wind, SL-Mse, land stability)
	Provides for future operational flexibility (ex. How easy it will be to deal with a significant increase in flow or expand the pump station)
	Operational and maintenance Health & Safety
Constructability	Pump station Construction access and site establishment
	Pump station Potential for construction risks that may hold up, stop or adversely affect construction time and cost
	Pump station construction Health & Safety
	Site servicing
	Pipeline Construction access and site establishment
	Pipe line Potential for construction risks that may hold up, stop or adversely affect construction time and cost
	Pipeline construction Health & Safety
Environmental	Potential construction impacts on water quality

[3] Designation WSL8, Auckland Council District Plan (Waitakere Section) 2003, and Designation No. 9327 in the PAUP

Assessment Framework	Basis for Assessment
	Potential operational impacts on water quality
	Potential construction impacts on coastal ecosystems (e.g. Mangroves)
	Potential operational impacts on coastal ecosystems (e.g. Mangroves)
	Effects during construction on terrestrial ecosystems(habitats, flora, fauna)
	Effect during operation on terrestrial ecosystem (habitats, flora, fauna)
	Effects during construction on trees (protective)
	Effects during operation on trees
Social	Impact to neighbouring properties from construction activity includes (visual, dust, noise, odour, traffic) impact from construction activities
	Impact to neighbouring properties from operation and maintenance activity (includes visual, dust, noise, odour, traffic) and risk of operational failures
	Impact short term on use of recreational users, etc.
	Impact long term activity on use of recreational users, etc.
	Visual impact to neighbouring properties, park users, etc. during operation
	Impact on Amenity value, perception of effects by residential
	Impact on Amenity value, perception of effects by park users
Mana Whenua, Cultural, Archaeological and Heritage	Potential impacts waahi tapu sites identified in District Plan and impact on heritage and traditional sites for Mana Whenua
	Effects on mauri as a result of the pump station on land, water and air
	Archaeological/heritage

8.2 Booster Pump Station

The Phase 1 pipeline is designed to transfer flows from the Hobsonville PS to the Rosedale WWTP, to service immediate growth in the area. As growth continues, a new Pump Station will be required along the Phase 1 alignment to boost the ability of the pipeline to match the increase in population and carry additional flows to the Rosedale WWTP. This is referred to as the Booster Pump Station.

The location of the Booster Pump Station ("BPS") is governed by a number of considerations, namely:

- The need to be located along the Phase 1 pipeline,
- Hydraulics - the BPS is best located at or near to a high point along the pipeline for efficient operation and to limit the amount of emergency storage volume required;
- General configuration and layout requirements - the BPS will require a wet well for incoming wastewater, a dry well to house the pumps, a control building and site access, providing a minimum overall site footprint of 2,500m^2;
- Pumping systems - overall pumping heads are preferably limited to around 60 metres to match the capacity of standard wastewater pumps and pump station configurations
- Operational and emergency storage requirements –Watercare typically require sufficient operational and emergency storage such that pumping stations can be non-operational for a period of 4 hours

Based on the above, the following six locations were identified for the BPS. These can be seen in Figure 8-1:

- Option 1 – Wainoni Park (Southeast)
- Option 2 – Wainoni Park (Southwest)
- Option 3 – Collins Park
- Option 4 – Wainoni Park (North)
- Option 5 – Greenhithe Road
- Option 6 – Faith Grove

Figure 8-1: Booster Pump Station Locations

The following section provides a more detailed description of each of the options.

8.2.1 Option 1: Wainoni Park (Southeast)

This location at the North West of the intersection of Greenhithe Road and Orwell Road, in Wainoni Park was selected as it is the highest area of land along this part of the route of the Phase 1 pipeline at approximately RL35m. Access would be from Greenhithe and/or Orwell Road. The Phase 1 pipeline would need to follow the yellow dashed line in Figure 8-1: to accommodate this BPS site. The advantages of this location are that it equalises the pumping heads between the Hobsonville PS and the BPS, has the minimum possible operational and emergency storage volume, and is clear open space.

8.2.2 Option 2: Wainoni Park (Southwest)

This location in the Southwest corner of Wainoni Park adjacent to Greenhithe Road was selected as it was at a high point of RL 33m on the periphery of the park on the western side of the existing drainage gully. The advantages of this location are that it equalises the pumping heads between the Hobsonville PS and the BPS, has the minimum possible operational and emergency storage volume, is clear open space with excellent access off Greenhithe Road.

8.2.3 Option 3: Collins Park

This site is located at the top of Collins Park alongside Greenhithe Road. The site was selected as it is in open space at the northerly extreme of the localised high point on Greenhithe Road which is shaded red on Figure 8-1:. The site has a ground level of RL31m and is located on the periphery of the park. Access would be from Greenhithe Road. The preferred location within the park is in the south eastern corner behind the playground area as it has the least impact on the existing playing fields.

8.2.1 Option 4: Wainoni Park (North)

This site is located further north in Wainoni Park. This site is along the route of the Phase 1 pipeline but the land falls away as we move north from Greenhithe Road which means that this option requires a break pressure chamber to be installed at a high point along the route (Preferably near the site identified as option 1). The Phase 1 pipeline would be replaced with a section of gravity sewer between the break pressure chamber and the pump station. Access would most likely be through the sports complex car park off Churchouse Road. The BPS would also require additional emergency storage capacity compared to other options.

8.2.2 Option 5: Greenhithe Road

This site is located at 79 Greenhithe Road and was selected as an alternative to parkland within open space, part of which is currently used for a stormwater detention pond. Access would be from Greenhithe Road. The advantages of this location are that with a ground level of approximately RL35m it equalises the pumping heads between the Hobsonville PS and the BPS, has the minimum possible operational and emergency storage volume, is already being used for public purposes.

8.2.3 Option 6: Faith Grove

There is a possibility of locating the BPS in private property. For the purposes of assessing this option against the other five, a property in Faith Road was adopted due to proximity to the Phase 1 pipeline through Wainoni Park. The same method proposed for Option 4 would need to be applied to this option, utilising a break pressure chamber and gravity sewer. The pump station could be located in a practicable position coinciding with the location of the Phase 1 pipeline. The advantage of this option is that it does not use up any existing parkland but it will require the acquisition of one or more private properties.

8.2.4 Assessment

Using the above assessment criteria the six options for the BPS were assessed by the Project Team. The comparison is shown in Table 8-2

Table 8-2: Summary of MCA Assessment (BPS)

criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Functionality	1	2	2	5	2	4
Construction : Pump Station	1	2	3	5	5	5
Environmental	2	2	2	4	4	5
Construction : Social	3	2	5	4	5	5
Operation : Social	2	2	5	4	4	4
Cultural	2	2	2	3	3	3
Total	1.83	2.00	3.17	4.17	3.83	4.33

8.2.5 Booster Pump Station Preferred Option

On the basis of the above assessment, BPS Options 1 and 2 were identified as having the least overall impact. They also provide the greatest flexibility for siting of the pumping station and associated facilities.

From this point, further consultation with the Greenhithe Pony Club was undertaken to identify a preferred option of Options 1 and 2. Through this process it was agreed that Option 2 was preferred over Option 1.

8.3 Intermediate Pump Station

The Intermediate Pump Station ("IPS") will be up to seven time's greater capacity than the booster pump station. The IPS will have a significantly larger footprint and will require greater level of maintenance, labour and frequent deliveries to site.

Based on technical requirements the catchment considered for the IPS was limited to the area between Wainoni Park and the North Shore Golf Club ("NSGC"). Locations from Hobsonville PS to Wainoni Park were considered inappropriate as they would require the IPS to have a long rising main that would result in pumping pressures beyond the capacity of the pipeline and conventional manufacture pumping standards. Locations from NSGC to Rosedale WWTP were also considered inappropriate as they would require a very deep pump station well in excess of 30m due to the rising terrain elevation.

Within the catchment considered, specific options were selected based on technical site requirements, existing or future possible access and ground profile. Four possible options for the IPS site were identified, these being:

- Option 1 - Centre Wainoni Park
- Option 2 - North Wainoni Park
- Option 3 - North Shore Memorial Park ("NSMP")
- Option 4 - North Shore Golf Club ("NSGC")

The proposed IPS Options noted above are shown in Figure 8-2, and are described in more detail below.

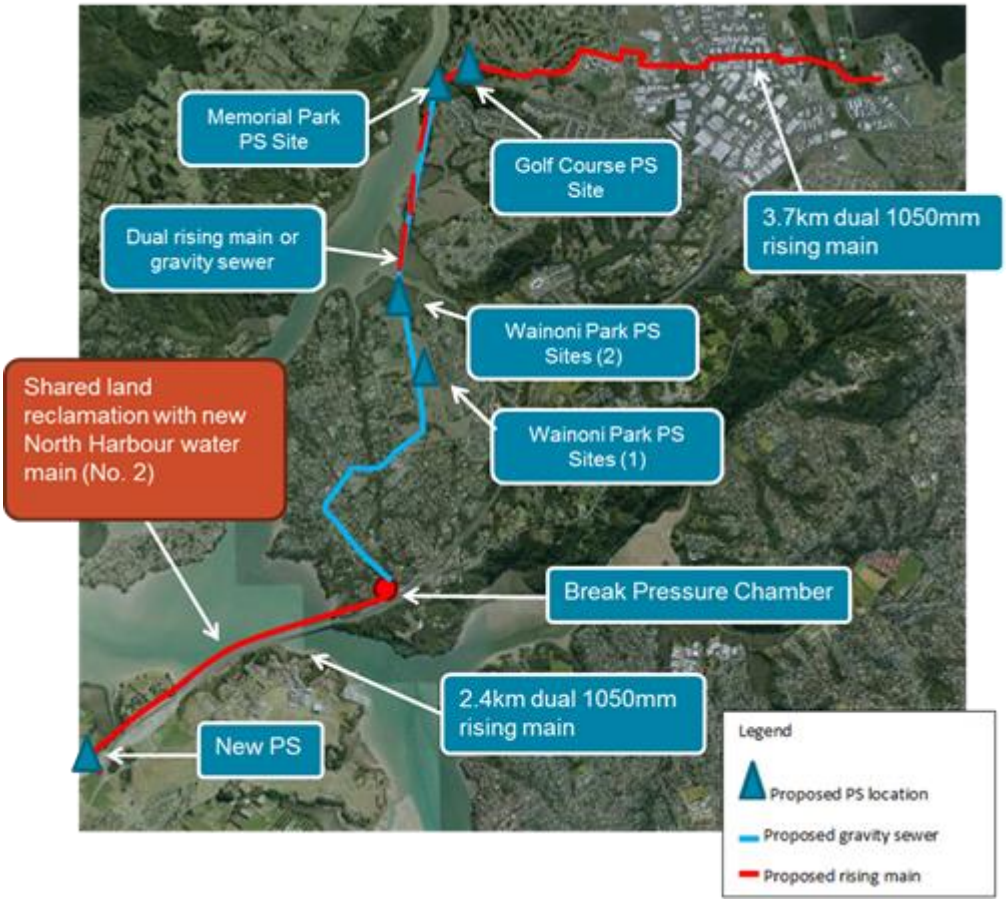


Figure 8-2: Alignment and PS Options

Geotechnical investigations have not been carried out for the four possible locations. At this stage it is assumed that proximity to the Te Wharau Creek will mean a high water level and possible alluvial soils at the pump station locations.

For Options 3 and 4, two construction methodologies for the pipe across Te Wharau Creek and Lucas Creek were considered in this MCA process; marine trenching and by pipe bridge.

8.3.1 Identification of Alternative Sites

8.3.1.1 Option 1: Wainoni Park (Central)

Option 1 is toward the centre of Wainoni Park. This location was considered due to the large working area available and the possible access to the site from an adjacent carpark. The following table outlines the advantages and disadvantages of Option 1:

Table 8-3: Advantages and Disadvantages of Options 1 ("IPS")

Advantages	Disadvantages
• Large working area allows site layout to be optimised and provides better future operational flexibility. • Good site access for construction and maintenance. • Expected that excavations would be above groundwater level. • Site is not located near any known sites and places of value to Mana Whenua. • Approximately 1,100 m length of gravity tunnel upstream for use as emergency storage. This will facilitate flow management in instance of failure and will reduce storage construction at the PS. • Relatively shallow IPS meaning comparatively less excavation required. • Longer rising main which require less maintenance than gravity sewer.	• Community lose access to a portion of existing reserve • Potential visual and amenity effects as the IPS will be located in the centre of the park • Site is located in close proximity to a Significant Ecological Area (Land) • Potential noise, vibration (construction) and odour (operation) effects on nearby residents as IPS will be in close proximity to homes located to the east of the proposed site • Long length of rising main. HDD pits require bigger space than micro-tunnelling shafts meaning comparatively more complex construction process • IPS is in eye line of local residents and park users thus potential visual effects.

8.3.1.2 Option 2: Wainoni Park (North)

Option 2 is situated further towards the northern end of Wainoni Park. This location was considered due to the large working area and the good site access for construction. The following table outlines the advantages and disadvantages of Option 2:

Table 8-4: Advantages and Disadvantages of Option 2 (IPS)

Advantages	Disadvantages
• Large working area allows the site layout to be optimised and provides better future operational flexibility. • Good site access for construction, operations and maintenance. • Out of the direct eye line of local residents and users of the main park area. • Longer rising main which require less maintenance than a gravity sewer.	• Community lose access to a portion of an existing reserve. • Site is located near a Significant Ecological Areas (Land) and within sites and places of value to Mana Whenua • Long length of rising main. HDD pits require bigger space than micro-tunnelling shafts meaning comparatively more complex construction process • Closer to the creek, resulting in potentially less favourable ground condition than other locations. • Higher cost and complexity relating to providing site services due to longer route to existing systems (water supply, stormwater, electricity, etc.). • No upstream gravity tunnel available as emergency storage.

8.3.1.3 Option 3: North Shore Memorial Park

Option 3 is adjacent to the northwest corner of Schnapper Rock Road, within the North Shore Memorial Park ("NSMP"). Preliminary discussions with the trustees have determined that this site is not part of the ongoing development plan, and is presently used for spoil and general stockpiling. It has been indicated that this site could potentially be available. For the purpose of concept design, marine trenching has been considered across Te Wharau Creek for Option 3.

The following table outlines the advantages and disadvantages of Option 3:

Table 8-5: Advantages and Disadvantages of Option 3 (IPS)

Advantages	Disadvantages
• Adequate site access for construction and permanent access. • Preliminary discussions with the NSMP representatives were positive. • Approximately 1,400 m length of gravity tunnel upstream of IPS for use as emergency storage. This will facilitate flow management in instance of failure and will reduce storage requirements at the pump station.	• Restricted working area limits operational flexibility and future opportunities. • Although this area is undeveloped at this time, it is still part of a cemetery, which has value to the park users and Mana Whenua. • Deep excavations are expected to be well below groundwater. • Site is close to consented development (residential properties). • IPS hydraulics will increase size of rising main to Rosedale WWTP. • High pumping costs. • Disturbance to users of the NSMP from construction activities. • Septicity and operational risks increased due to low velocity in the rising main. • Site in close proximity to Significant Ecological Areas (Marine 2 and land) and is within sites of value to Mana Whenua. • Construction impacts on coastal ecosystems due to potential marine trenching of the Te Wharau Creek for the construction of the gravity line. • Longer gravity sewer which require higher maintenance.

8.3.1.4 Option 4: North Shore Golf Club

Option 4 is within the southwest corner of the North Shore Golf Club proposed location for the pump station at this site is on land currently not used for playing purposes. The NSGC is in discussions with a developer for subdivision of the parcel of land along the southern boundary. Final layout details and arrangements for permanent access to the PS site area would depend on the final configuration for this subdivision, with the likely pumping station access road alignment following the new southern property boundary.

For the purpose of concept design, Marine Trenching has been considered across Te Wharau Creek in order to reduce the depth of the IPS.

The following table outlines the advantages and disadvantages of Option 4:

Table 8-6: Advantages and Disadvantages of Option 4

Advantages	Disadvantages
• Adequate site area for construction. • Preliminary discussions with the NSGC management concerning the use of the site have been positive. • Approximately 2,000m length of gravity tunnel upstream of the pump station for use as emergency storage. This will facilitate flow management in instance of failure and will reduce storage requirements at the PS.	• Deep excavations are expected to be below groundwater. • Complicated connections to water supply, stormwater, electricity, etc. • Disturbance to users of the NSGC from construction activities. • Isolated site which would require a new access road. • IPS hydraulics will increase size of rising main to Rosedale WWTP. • High pumping costs. • Septicity and operational risks increased due to low velocity in the rising main. • Higher potential construction and operational impacts on coastal ecosystems especially mangroves due to potential marine trenching of the Te Wharau Creek for the construction of the gravity line. • Longer length gravity sewer which require higher maintenance.

8.3.2 MCA Results

The results of the MCA assessment for the four different IPS options are summarised in Table 8-7 below. Lower scores represent a better outcome.

Table 8-7: Summary of MCA Assessment (IPS)

criteria	Option 1	Option 2	Option 3	Option 4
Functionality	3	3	2	2
Construction : Pump Station	2	2	4	5
Construction : Pipeline	2	2	4	5
Environmental	3	3	3	3
Construction : Social	5	4	3	3
Operation : Social	4	3	4	3
Cultural	2	2	3	2
Total	3	2.71	3.29	3.29

8.3.3 Estimated Costs

A comparison of costs was undertaken for each IPS option. This cost comparison considered only the section between the Greenhithe culvert to the Location 5 NSGC as shown in Figure 8-3

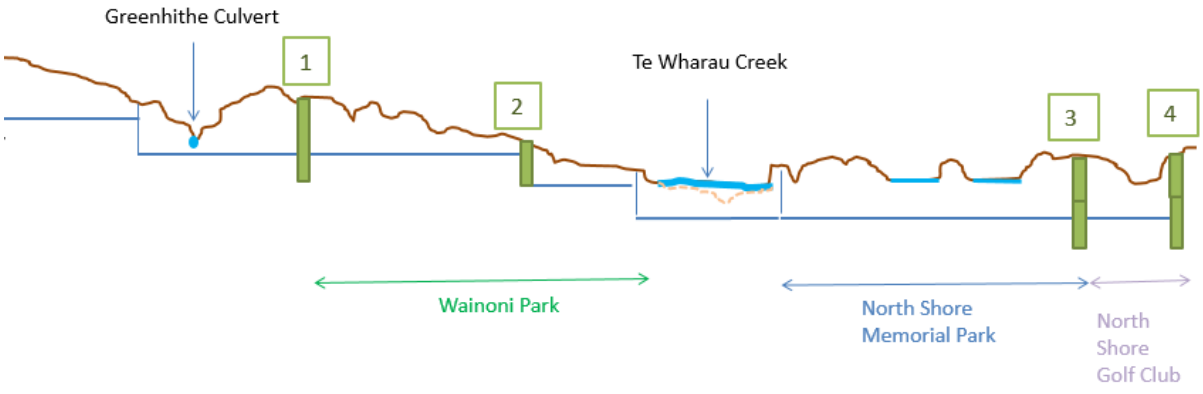


Figure 8-3: Cost Comparison Area for IPS

Pricing has used costs provided from previous Early Contractor Involvement engagements, Watercare Unit Rates, and other project sources.

The estimated costs for the works based on the pump station Options are summarised in Table 8-4**.** Cost estimation allows for 17.5% Preliminary and General Overheads, and 17.5% Design Development and Minor Works.

Land cost has been included in the cost estimation. For the purpose of this consideration of alternatives, it has been assumed that the land required to construct the IPS is 0.6 ha, therefore the cost has been calculated as the actual cost per m^2 for the 6000 m^2 required for the IPS.

For Option 4, it has been assumed that the four required private properties will be purchased.

NPV analysis comparison has been calculated for Capital Cost and operational energy costs between the period 2043 to 2035.

Table 8-8: Cost Estimates

	Option 1 (Centre Wainoni Park Site)	Option 2 (North Wainoni Park Site)	Option 3 (NSMP)	Option 4 (NSGC)
CAPEX	$88,419,154	$90,114,098	$104,436,049	$103,124,923

8.3.4 Intermediate Pump Station Preferred Option

IPS Option 2 has the best MCA score and the second lowest capital cost. As such Option 2 was identified as the preferred option.

9 Alternative Statutory methods

As discussed in more detail in Sections 3 and 6 of this Report, the Northern Interceptor Project is proposed to be implemented in 6 phases over a period of 20 years. As part of the consideration of alternative methods, the Project Team gave consideration to the preferred methods of statutory implementation. The following alternative options were identified:

1. Seek a private plan change to the relevant District Plans to provide for the Project;
2. Seek a suite of District and Regional resource consents to authorise the Project; or
3. Utilise Watercare's Requiring Authority status to seek designations through a Notice of Requirement Process;

With regards to Option 1, a Plan Change process was dismissed as a potential option as it is considered that the timeframes associated with such a process would retain the risk of the Project becoming compromised (potentially completely) as a result of loss of optimum network locations (e.g. for the crossing of watercourses) through development. In addition, this option is not considered to provide any advantages over either a resource consent or designation process.

As such, Options 2 and 3 were shortlisted for further consideration. Each Phase of the Project was considered against Options 2 and 3 in the context of the following criteria:

- Criteria 1 – implementation timeframe: The timeframe for which the phase is anticipated to be required to be implemented to allow for growth and the potential for significant changes in the environment over that timeframe. Where there is no to low risk of significant changes to the environment prior (anticipated implementation to begin between within 5 years) to the anticipated phase of the Project being implemented, a resource consent process is generally preferred. Where there is a medium to high risk of significant changes to the environment (anticipated implementation to begin 5+ years) prior to the anticipated phase of the Project being implemented, a designation process is generally preferred.
    - Long Term – implementation anticipated to begin 10 years+
    - Medium Term – implementation anticipated to begin between 5 and 10 years.
    - Short Term – implementation anticipated to begin within 5 years.
- Criteria 2 - The need to protect the route: Where there is a need for the route alignment and pump station sites to be protected from potential conflicting development (including the provision of other utilities). Where there is no to low need for route protection, a resource consent process is generally preferred. With the obligations of Section 178(2) of the RMA in mind, where there is medium to high need for route protection, a designation process is generally preferred.
    - High – the phase faces significant pressure from conflicting urban development (e.g. is within an identified growth area).
    - Medium – the phase faces some pressure from conflicting urban development (e.g. is within an area identified for intensification).
    - Low – the phase is within an area unlikely to face pressure from conflicting urban development.
- Criteria 3 – the need for flexibility: The need for flexibility with respect to construction methodology and route alignment. In many cases, this criteria is influenced by the anticipated implementation timeframe and subsequently the degree of certainty in times of detail of design. Where there is no to low need for flexibility, a resource consent process

is generally preferred. Where there is a medium to high need for flexibility, a designation process is generally preferred.

- High – there is a high need for route and/or construction flexibility (e.g. phase is at concept design);
- Medium – there is a medium need for route and/or construction flexibility (e.g. phase is preliminary design);
- Low– there is a low need for route and/or construction flexibility (e.g. phase is at detailed design).

Table 9-1: Overview of Phases 1-6 of the Northern Interceptor

Phase	Description	Anticipated Construction Timeframe[4]	Criteria 1	Criteria 2	Criteria 3	Preferred Statutory Method of Implementation
1	This phase transfers existing flows from the Hobsonville flows to the Rosedale WWTP, crossing the Upper Waitemata Harbour and through Greenhithe.	2018-2020	Short term	Low	Medium	Given the short term anticipated implementation timeframe a Resource Consent process is the preferred method of implementation.
2	This phase of the project comprises the installation of a tunnel from near Westgate to the Hobsonville PS, along the State Highway ("SH18"), and is mostly within the NZ Transport Agency's designation.	2022-2027	Medium Term	High	Medium	Given the medium term anticipated implementation timeframe and the high need for route protection, a designation processes is the preferred methods of implementation.
3	This phase is a new BPS that will increase the capacity of the Phase 1 pipeline from 275L/s to 520L/s	2022 - 2027	Medium Term	Low	High	Given the medium term anticipated implementation timeframe and high need for construction and/or route flexibility, a designation process is the preferred method of implementation.
4	This phase includes a new pipeline from the eastern abutment of the Greenhithe Bridge to the Rosedale WWTP and an	2032 - 2034	Long Term	Medium	High	Given the long term anticipated implementation timeframe, medium need for route protection and high need for construction and/or

[4] Dependant on the rate of growth of the catchment area

Phase	Description	Anticipated Construction Timeframe[4]	Criteria 1	Criteria 2	Criteria 3	Preferred Statutory Method of Implementation
	Intermediate PS in Wainoni Park					route flexibility, a designation process is the preferred method of implementation.
5	This includes the installation of a pipeline from the Concourse Storage tank to Hobsonville Road, where it will connect with the Phase 2 pipeline.	2035+	Long Term	Medium	High	Given the long term anticipated implementation timeframe and high need for construction and/or route flexibility, a designation process is the preferred method of implementation.
6	This phase involves the duplication of the rising main sections of Phase 4.	2035+	Long Term	Low	High	Given the long term anticipated implementation timeframe and high need for construction and/or route flexibility, a designation process is the preferred method of implementation.

10 Conclusion

Watercare has evaluated a wide range of alternatives for addressing the wastewater network needs for the Service Catchment. That evaluation process confirmed the delivery of wastewater to Rosedale WWTP for treatment and discharge is the preferred option. Northern Interceptor was confirmed as the preferred integrated network upgrading solution. A subsequent detailed consideration of alignment options and design and construction configurations confirmed the alignment. The Northern Interceptor project represents the outcome of that process and is considered to be the option that best provides for future wastewater network needs and best meets Watercare's Strategic Intent. The work lays the foundations for the wastewater network in this part of Auckland for the next 50 years and represents a cost effective solution to provide for future growth, asset risk management and an appropriate level of overflow mitigation.

Appendix A

Longlist criteria and basis for assessment for Northern and Southern Alignment

Criteria	Operational	Technical	Environmental	Staging
Sub-Criteria	**Safety:** ability for Watercare staff to operate and maintain the works in a safe manner, includes issues such as confined spaces, working at heights, gas accumulation, accessibility etc.	**Reliability:** whether the option provides for a reliable technology with prior application and proof of performance in NZ	**Cultural/heritage:** impacts on areas of cultural or heritage significance	**Ability to be staged**
	Complexity: degree of difficulty and interdependency of the operation of the works	**Flexibility:** adaptable to change/adjustment to suit future requirements	**Environment:** impacts on areas of environmental significance such as native flora and fauna, CMAs	
	Maintenance: overall requirements and frequency of maintenance activities, degree of difficulty, impacts on system performance during maintenance etc.	**Constructability:** ease of construction, availability of local contractors, need for specialist equipment or techniques	**Community:** impact on community groups and local interests through construction and ongoing operation of new assets	
	Odour/Corrosion: septicity and odour generation, noxious gases, accelerated corrosion rates due to sulphide attack	**Opportunity/benefit:** provides additional benefits beyond the base requirements for the project	**Landowners/property:** impact on individual property owners during construction and ongoing operation	

Shortlist criteria and basis for assessment for Northern and Southern Alignment

Assessment Framework		Basis for Assessment
Functionality	Baseline requirements	Options consistent with the Three Waters Strategy, particularly the future utilisation of treatment capacity Rosedale vs Mangere, providing for increasing network capacity to **service** growth the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas
		Capacity to **support** growth and development in the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas
	Additional requirements	Ability to intercept catchments and allow the decommissioning of local pump stations
		Ability to delay or replace local and wastewater network upgrades
		Provide benefit or alignment with other utilities or public services
Operational & Maintenance		Site location and space available for on-going operational and maintenance access requirements (e.g. at shaft sites)
		Site appropriately buffered from surrounding community
		Provides for future operational flexibility (e.g. how easy will it be to deal with a significant increase in flow)
Constructability		Potential for construction risks that may hold up, stop or adversely affect construction time
		Ability for construction techniques to be delivered by a number of Contractors allowing competitive tenders to be obtained
		Potential for construction risks that result in significant cost overruns
Assessment of Environmental Effects	Environmental	Potential construction impacts on coastal and freshwater quality
		Potential construction effects on terrestrial ecosystems. Sites located in close proximity to SEA-Land and/or riparian margins will have a greater impact on habitats, flora fauna
		Potential effects on protected trees during construction
		Potential construction effects on landscape/neutral character values, and their ability to be mitigated
		Potential construction on coastal ecosystems. Construction activities that are near to the CMA and/or are within the CMA (e.g. marine trenching) will have a greater impact on coastal ecosystems
		Sensitivity of ecosystems from operational overflow discharges. Assume dilution and dispersion is better at the head of creeks in the CMA

Assessment Framework		Basis for Assessment
	Social	Distance from site to arterial road for operational and maintenance purposes
		Likelihood of adverse effects on local roads resulting from construction activities
		Operational effects on residential properties with line of sight of permanent structures e.g. pump stations). This includes effects relating to visual amenity, noise, and odour
		Impact to neighbouring properties within 200m of construction sites resulting from construction activity (visual, dust noise, odour, traffic)
		Short-term impact on community facilities resulting from construction activities (e.g. reduced access to community facilities (e.g. Beach, sports club, community hall, playground, etc.)
		Proximity of construction activities to sensitive community facilities (e.g. School, play centre, medical facility) located on likely construction traffic route
		Extent to which construction works will reduce access to parks and reserves when considering the ability to operate parks/reserves 'as usual' during construction, and the amount of reserve required for construction activities. This considers the sensitivity of the users of the reserve (e.g. North Shore Memorial Park and mourners)
		Effects arising from potential operational odour discharges (e.g. at break pressure chamber sites and pump station sties)
		Impact to neighbouring properties from operation and maintenance activity (includes visual, dust, noise, odour, traffic) and risk of operational failures
		Number of properties above the centreline of the pipeline
	Cultural	Potential impacts waahi tapu sites identified in District Plan and impact on heritage and traditional sites for Mana Whenua
		Effects on mauri of waterbodies through wastewater overflows
		Impact on cemetery (as an urupā)
	Economic	Excavations in alluvium with risk of settlement of sensitive structures
		Number of private property purchases required to facilitate the construction of the pipeline
		Potential for short-term business disruption during construction
		Disruption to existing services and utility providers
		Energy use required for operating the facility (pump stations sties)

Longlist Options Assessment – Hobsonville to Rosedale

MCA scoring and comments on scoring

- The workshop participants assessed each longlist option against each of the sub criteria. For each sub criteria a score of 1 - 5 was awarded based on the professional judgement of the collective workshop group. A score of 1 indicates a high risk associated with the criteria (i.e. the option will potentially fail to meet requirements), a score of 5 would indicate a low risk associated with the criteria (i.e. the option is considered reliable);
- Each criteria was weighted evenly (0.25%)

Option	Criteria	Operational Criteria						Technical Criteria						Environmental Criteria						Staging		Overall MCA SCORE (sum of weighted scores)	Rank
	Sub-criteria	Safety	Complexity	Maintenance	Odour/ Corrosion	Score Average (Operational)	Score Weighted (Operational)	Reliability	Flexibility	Constructability	Opportunity/ Benefit	Score Average (Technical)	Score Weighted (Technical)	Cultural/ Heritage	Environment	Community	Landowner/ Property	Score Average (Environmental)	Score Weighted (Environmental)	Ability to Stage	Score Weighted (Staging)		
1	Upper Harbour Drive	2	3	2	3	**2.5**	**0.63**	3	2	1	2	**2.0**	**0.5**	3	4	3	4	**3.5**	**0.87**	2	**0.5**	2.5	9
2	Beach Haven Road	3	3	3	4	**3.25**	**0.81**	2	2	1	3	**2.0**	**0.5**	3	4	2	3	**3.0**	**0.75**	2	**0.5**	2.56	7
3	Upper Harbour Highway	2	3	1	3	**2.25**	**0.56**	3	2	1	2	**2.0**	**0.5**	3	4	3	2	**3.0**	**0.75**	2	**0.5**	2.31	11
4	Kyle Road	4	2	3	2	**2.75**	**0.69**	3	2	2	3	**2.50**	**0.63**	3	3	2	3	**2.75**	**0.69**	2	**0.5**	2.51	8
5	Lucas Creek (rising main and gravity sewer)	4	3	2	2	**2.75**	**0.69**	3	2	2	2	**2.25**	**0.56**	2	2	3	3	**2.5**	**0.63**	2	**0.5**	2.38	10
6	Lucas Creek (rising main only)	4	3	2	2	**2.75**	**0.69**	3	2	2	2	**2.25**	**0.56**	2	2	3	3	**2.5**	**0.63**	4	**1**	2.88	6
7	Deep Tunnel (western alignment)	4	4	4	4	**4.0**	**1.0**	4	5	4	3	**4.0**	**1.0**	4	5	4	4	**4.25**	**1.06**	2	**0.5**	3.56	2
8	Deep Tunnel (eastern alignment)	4	4	4	4	**4.0**	**1.0**	4	5	4	5	**4.5**	**1.13**	4	5	4	4	**4.25**	**1.06**	3	**0.75**	3.94	1
9	Tauhinu Road, Greenhithe	4	3	3	2	**3.0**	**0.75**	3	2	3	3	**2.75**	**0.69**	3	3	3	3	**3.0**	**0.75**	3	**0.75**	2.94	4
10	Beach Haven (coastal and tunnel)	4	3	2	3	**3.0**	**0.75**	3	3	2	3	**2.75**	**0.69**	2	2	4	4	**3.0**	**0.75**	3	**0.75**	2.94	4
11	Shallow Tunnel (eastern alignment)	4	4	3	2	**3.25**	**0.81**	4	2	2	3	**2.75**	**0.69**	4	4	2	3	**3.25**	**0.81**	3	**0.75**	3.06	3

Comments on select individual scores

Option 1 - Upper Harbour Drive

This option is based on the broad concept of maximising the use of roads and urban environments. From a construction perspective, the need for a crossing of the CMA at the Upper Waitemata Harbour was considered to be the most challenging aspect of this option.

For the purpose of longlist development it is assumed that the crossing of the Harbour would be constructed by HDD into the flatter coastal area north of the existing bridge as this would reduce HDD length to around 600m but would increase the overall rising main route by approximately 200m. However, early analysis also determined that a crossing to the north of the bridge would also be a preferred option for marine trenching if this technique is preferred. Construction along Upper Harbour Drive would be by micro-tunnelling. As this road runs up along the main ridgeline the micro-tunnelling needs to be very deep under this option.

This option would require new pump stations to be constructed at the Rosedale WWTP and the Concourse Storage Tank.

Criteria	*Score*	*Comment*
Safety	2	Difficulty associated with deep micro-tunnelling operations, traffic and public safety.
Maintenance	2	Long rising mains, high head pumping station and very deep gravity sewer.
Flexibility	2	System has no surplus design capacity for additional flows and requires flows to be delivered to the Hobsonville PS by rising main or shallow sewer due to the very high pump heads required to transfer flows onward.
Constructability	1	Difficulties of a marine crossing or long HDD shot and the deep micro-tunnelling along upper harbour drive.
Opportunity benefits	2	A pumping station at Rosedale inlet would provide some operational benefit to the existing network by removing existing siphons.
Staging	2	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Predominant length of gravity sewer and inlet PS at Rosedale need to be sized for ultimate capacity from day 1 thereby limiting overall staging capability.

Option 2 - Beach Haven Road

This option is based on the broad concept of maximising the use of roads and urban environments. This option was developed as a predominantly gravity sewer alignment on an easterly approach to Rosedale from Hobsonville. Preliminary investigations suggest that the main challenge with this alignment is likely to be the harbour crossing which is anticipated to require deep micro-tunnelling and thus increase the overall gravity sewer depth and pumping head requirements compared to other options.

For the purpose of longlist development it was assumed that the crossing of the Harbour would be constructed by marine trenching, and micro-tunnelling would be utilised along Beach Haven Road and Glenfield Road. This option would require new pump stations to be constructed near Glenfield Road and at the existing Hobsonville PS site.

Criteria	*Score*	*Comment*
Odour Corrosion	4	Odour/corrosion risk was scored at 4 due to the predominantly gravity alignment.
Flexibility	2	System has no surplus design capacity for additional flows and the very high pump heads required to lift flows at Glenfield College.
Constructability	1	Difficulties of a shallow gravity marine crossing the deep micro-tunnelling along Glenfield Road and through the residential streets in Totaravale.
Opportunity benefits	3	Some potential to replace existing assets in the North Shore if the gravity sewer and pumping station and rising mains were upsized.
Staging	2	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Predominant length of gravity sewer and PS at Glenfield College need to be sized for ultimate capacity from day 1 thereby limiting overall staging capability.

Option 3 - Upper Harbour Highway

This option is based on the broad concept of maximising the use of roads and urban environments, and is the most direct road based alignment. From a construction perspective, the need for a crossing of the CMA and the deep gravity section along Upper Harbour Highway, were considered to be the most challenge aspects of this option.

For the purpose of longlist development it is assumed that the crossing of the Harbour would be constructed by HDD into the flatter coastal area north of the existing bridge as this would reduce HDD length to around 400m but would increase the overall rising main route by approximately 200m. However, early analysis also determined that a crossing to the north of the bridge would also be a preferred option for marine trenching if this technique is preferred.

With respect to the gravity main, it is assumed that this would be constructed by micro-tunnelling from a break pressure chamber north of the Upper Harbour Bridge to the Rosedale WWTP. This tunnel would be very deep in places (over 50m in parts), and would require micro-tunnel shafts every 250m due to the depth and jacking forces required.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and the Rosedale WWTP.

Criteria	*Score*	*Comment*
Safety	2	Difficulty associated with deep micro-tunnelling operations, traffic and public safety.
Maintenance	1	Deep section of rising main and accessibility to the deep gravity sewer within the highway corridor.
Flexibility	2	System has no surplus design capacity for additional flows and requires flows to be delivered to the Hobsonville PS by rising main or shallow sewer due to the very high pump heads required to transfer flows onward.
Constructability	1	Difficulties of a marine crossing or long HDD shot and the deep micro-tunnelling along upper harbour highway.
Opportunity benefits	2	A pumping station at Rosedale inlet would provide some operational benefit to the existing network by removing existing siphons.
Landowner/ property	2	Due to the work within the highway corridor.
Staging	2	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Predominant length of gravity sewer and inlet PS at Rosedale need to be sized for ultimate capacity from day 1 thereby limiting overall staging capability.

Option 4 - Kyle Road

This option is based on the broad concept of maximising the use of roads and urban environments. This option is a predominantly gravity sewer alignment on a westerly approach. From a construction perspective, the need for two crossings of the CMA, the potential need to reclaim land, and the need to micro-tunnel along the existing North Harbour Water Main were considered to be the most challenging aspects of this option.

For the purpose of longlist development it is assumed that the crossing of the Harbour would be constructed by HDD. Early analysis of marine crossing options noted that a crossing in the shallow area of the harbour (across to Herald Island) may be viable to construct by marine trenching, but the channel between Herald Island and the North Shore is deep, making trenching in this area less viable.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

Criteria	*Score*	*Comment*
Safety	4	Shallower gravity sewer and construction away from highly trafficked roads.
Complexity	2	There are two or even potentially 3 pump stations depending on Rosedale inlet arrangements and multiple air treatment facilities.
Odour and Corrosion	2	Two separate sections of rising main.
Flexibility	2	No surplus design capacity for additional flows.
Constructability	2	Perceived difficulties of the marine crossing between Herald Island and Rahui Road and micro-tunnelling through the residential streets in Greenhithe and the industrial area at Rosedale.
Opportunity benefits	3	Some potential to replace existing assets in the North Shore if the gravity sewer and pumping station and rising mains were upsized.
Community	2	Construction impacts on Herald Island, and in the Greenhithe area.
Staging	2	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Predominant length of gravity sewer and PS at Kyle Road need to be sized for ultimate capacity from day 1 thereby limiting overall staging capability.

Option 5 - Lucas Creek (rising main and gravity sewer)

This option is based on the broad concept of avoiding the use of roads and urban environments. This option was developed to avoid the higher ridgelines to the south and east of Rosedale by cutting across to Lucas Creek and approach Rosedale from the west. From a construction perspective, the depth of micro-tunnelling through Rosedale's industrial area, the large extent of pipeline within the CMA (including Coastal Protection and Significant Ecological Areas) were considered to be the most challenging aspects of this option.

For the purpose of longlist development, it was assumed that a combination of marine trenching and HDD would be used to construct the rising main components of the pipeline within the marine areas from the north side of Herald Island up to Lucas Creek, and that micro-tunnelling would be used to install the gravity section of the pipeline to the Rosedale WWTP due to the construction depths required (over 50m) in some locations.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and the Rosedale WWTP.

Criteria	*Score*	*Comment*
Safety	4	Majority of construction away from roads and residential areas.
Maintenance	2	Inaccessibility of rising mains and the risk of low/high points in rising mains without ability to scour or air relief.
Odour and Corrosion	2	The long (4.9km) section of rising main.
Flexibility	2	The system has no surplus design capacity for additional flows.
Constructability	2	Perceived difficulties of marine pipeline construction and the deep micro-tunnelling section.
Opportunity benefits	2	Potential to divert Kyle Road PS into the new gravity sewer. Using Rosedale inlet PS to remove existing gravity sewer siphons coming into the plant would increase pumping station size and pumping costs significantly and is not considered practical. However, the use of the pump well for regular sewer siphon scouring might be practical.
Cultural/Heritage	2	Impacts of the extensive marine pipeline works.
Staging	2	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. The long gravity sewer would need to be sized for ultimate capacity from day 1 and the Rosedale PS structure would be sized for ultimate capacity but pumps could be staged.

Option 6 - Lucas Creek (rising main only)

This option is based on the broad concept of avoiding the use of roads and urban environments. This option is a variation on the route above (Lucas Creek) and has been developed as entirely rising mains with no gravity sewer to minimise pipeline construction depths. From a construction perspective, the large extent of pipeline within the CMA (including Coastal Protection and Significant Ecological Areas), the odour risks due to significant retention time, and the potential impact on sites of significance along the route were identified as the most challenging aspects of this option.

For the purpose of longlist development, it was assumed that the pipeline would be constructed by open trenching techniques for both the land-based and marine crossing components. Early analysis indicated that HDD was a viable option for the marine crossing as an alternative.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

Criteria	*Score*	*Comment*
Safety	4	Majority of construction away from roads and residential areas
Maintenance	2	Inaccessibility of rising mains and the risk of low/high points in rising mains without ability to scour or air relief
Odour and Corrosion	2	Long sections of rising main
Flexibility	2	The system has no surplus design capacity for additional flows
Constructability	2	Perceived difficulties of marine pipeline construction and the deep micro-tunnelling section.
Opportunity benefits	3	No real potential to connect existing catchments
Cultural/Heritage	2	Impacts of the extensive marine pipeline works.
Staging	4	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. For the new pumping station at the Golf Course, the structure would be sized for ultimate capacity but pumps could be staged.

Option 7 - Deep Tunnel (western alignment)

This option is based on the broad concept of maximising the use of deep tunnels and constitutes the use of a deep gravity tunnel direct from Hobsonville to Rosedale WWTP across the Greenhithe peninsula. From a construction perspective, the depth of the tunnel was considered to be the most challenging aspect of this option.

The western alignment was selected to maintain clearance from the Upper Harbour Highway bridge and to provide a number of suitable open space options for the location of tunnel shafts.

For the purpose of longlist development, it was assumed that the pipeline would be installed by a Tunnel Boring Machine ("TBM"). However, uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require a new pump station to be constructed at the Rosedale WWTP.

Criteria	*Score*	*Comment*
Safety	4	Controlled discreet working sites and a segmental lining TBM tunnelling operation.
Complexity	4	It is a gravity sewer, the existing Hobsonville PS is removed and only a single PS is required at Rosedale.
Maintenance	4	Large diameter gravity sewer with good accessibility.
Odour and Corrosion	4	No rising mains.
Reliability	4	Only a single PS at Rosedale and there is storage capacity in the system for managing PS failure.
Flexibility	5	The system has surplus design capacity for additional flows, provides storage capacity at Rosedale and could accommodate any connection option for the Concourse to Rosedale works.
Constructability	4	TBM construction is well proven and tunnel is below all existing services and construction will have little impact on the community
Opportunity benefits	4	The storage afforded by a tunnel would provide operational security at Rosedale. Existing network assets such as the Kyle Road PS could be abandoned
Assessment of Effects	4 and 5	Shafts can be located to minimise any impacts on Cultural, Heritage, Environment, Community or Landowners.
Staging	2	Any staging would require additional works that are not part of the ultimate scheme. An example would be to only construct part of the tunnel from Rosedale through to Greenhithe Road and to use a 600mm diameter rising main from an augmented Hobsonville PS for start-up.

Option 8 - Deep Tunnel (eastern alignment)

This option is based on the broad concept of maximising the use of deep tunnel and was developed as a deep gravity tunnel direct from Hobsonville to Rosedale WWTP through Beach Haven and then north up to Rosedale. From a construction perspective the depth of the tunnel, which would require tunnel shafts of between 30 to 100m, was considered to be the most challenging aspect of this option.

The eastern alignment was selected to maintain clearance from the Upper Harbour Highway bridge and to provide a number of suitable open space options for the location of tunnel shafts. It also passes adjacent to the main wastewater pumping station at Kahika providing the opportunity to incorporate a large proportion of the lower North Shore into the scheme.

As with the option above, for the purpose of longlist development, it was assumed that the pipeline would be installed by a TBM. However, uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require a new pump station to be constructed at the Rosedale WWTP.

Criteria	*Score*	*Comment*
Safety	4	Controlled discreet working sites and a segmental lining TBM tunnelling operation.
Complexity	4	It is a gravity sewer, the existing Hobsonville PS is removed and only a single PS is required at Rosedale.
Maintenance	4	Large diameter gravity sewer with good accessibility.
Odour and Corrosion	4	No rising mains.
Reliability	4	Only a single PS at Rosedale and there is storage capacity in the system for managing PS failure.
Flexibility	5	The system has surplus design capacity for additional flows, provides storage the Concourse to Hobsonville works.
Constructability	4	TBM construction is well proven and tunnel is below all existing services and construction will have little impact on the community.
Opportunity benefits	5	The storage afforded by a tunnel would provide operational security at Rosedale. Existing network assets such as the Kahika PS could be abandoned.
Assessment of Effects	4 and 5	Shafts can be located to minimise any impacts on Cultural, Heritage, Environment, Community or Landowners.
Staging	2	Any staging would require additional works that are not part of the ultimate scheme. An example would be to only construct part of the tunnel from Rosedale through to Kahika and to use a 600mm diameter rising main from an augmented Hobsonville PS for start-up. This alternative is discussed further as Option 11.

Option 9 - Tauhinu Road, Greenhithe

This option is based on the broad concept of maximising the use of roads and urban environments, and combines sections from other routes. This option was developed to avoid the higher ridgelines to the south and east of Rosedale by cutting across to the upper section of Lucas Creek and approach Rosedale from the west.

From a construction perspective, the need for a crossing of the CMA was considered to be the most challenging aspect of this option. As with Option 1, for the purpose of longlist development it is assumed that the crossing of the Upper Waitemata Harbour would be constructed by HDD into the flatter coastal area north of the existing bridge.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and midway along the route.

Criteria	*Score*	*Comment*
Safety	4	Shallower gravity sewer and construction away from highly trafficked roads
Complexity	3	Only one additional pumping station (plus Hobsonville) at the golf course
Odour and Corrosion	2	Two separate sections of rising main
Flexibility	2	The system has no surplus design capacity for additional flows
Constructability	3	The marine crossing and connection through to Tauhinu Road is difficult but the balance of the alignment being pipe jack and rising main is more straightforward. Opportunity benefits were scored at 3. There is the potential to abandon Kyle Road Pumping station if the gravity sewer and pumping station and rising mains were upsized
Assessment of Effects	3	Limited marine work, impact on parks and private property. There are potential cultural/heritage locations in this area as identified in the Unitary Plan
Staging	3	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Predominant length of gravity sewer would need to be sized for ultimate capacity from day one. The new Golf Course pump station structure would be sized for ultimate but pump installation and emergency storage capacity may be staged.

Option 10 - Beach Haven (coastal and tunnel)

This option is based on the broad concept of avoiding the use of roads and urban environments. This option was developed to maximise marine pipeline construction along an easterly approach to Rosedale WWTP. This option was abandoned due to the difficulties associated with traversing the high ridge line (approximately RL 105m) along the Albany Highway and the associated pumping head requirements.

This option would require a new pump station at the existing Hobsonville PS site.

Criteria	*Score*	*Comment*
Safety	4	Working well away from public areas, deep gravity section would be 3 to 3.5m diameter and constructed by TBM
Complexity	3	Only one additional pumping station (plus Hobsonville) at Rosedale inlet and the availability of storage within the tunnel section
Odour and Corrosion	3	Long rising main
Flexibility	3	The long rising main sections have no surplus design capacity for additional flows.
Constructability	2	The marine pipeline being seen as difficult with ability to maintain grades and stability of shallow trenched large diameter rising mains in the long term.
Opportunity/ Benefit	3	Opportunity benefits were scored at 3. Some existing North Shore assets could be redirected into the gravity tunnel through new link sewers. The Rosedale inlet PS would enable existing siphons to be removed but being very deep would mean significant additional pumping costs unless a double lift configuration was adopted.
Cultural/Heritage and Environment	2	Extent of the marine work
Community and Landowner	4	Limited impact due to marine route and tunnel
Staging	3	Options available for staging include using smaller diameter rising main on start-up to defer construction of the major works. Tunnelled section of gravity sewer and Rosedale inlet pumping station (civils) would need to be sized for ultimate capacity from day 1.

Option 11 - Shallow Tunnel (eastern alignment)

This option is based on the broad concept of maximising the use of deep tunnels, and also on the broad concept of avoiding the use of roads and urban environments. This option was developed as a shallow tunnel option to Rosedale following an easterly alignment. The alignment provides for a new pumping station at Hobsonville with rising main to Kahika, connecting to a 3m diameter tunnel section from Kahika to Rosedale and a new pump station at Rosedale to lift flows into the WWTP.

From a construction perspective, the need to avoid existing deep gullies where the pipeline is shallow as well as the need for a crossing of the CMA, were identified as the most challenging aspects of this option.

For the purpose of longlist development it was assumed that the pipeline would be installed by a TBM. However, uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require new pump stations to be constructed at the existing Hobsonville PS site and Rosedale WWTP.

Criteria	*Score*	*Comment*
Safety	4	Controlled discreet working sites and a segmental lining TBM tunnelling operation and small diameter rising main construction
Complexity	4	Whilst there is a pump station at Hobsonville and at Rosedale, the overall operation at Rosedale WWTP would be simplified through the single pump station arrangement and the storage afforded by the section of oversized tunnel.
Maintenance	3	The long rising mains are predominantly within road reserves and the large diameter gravity sewer has good accessibility
Odour and Corrosion	2	The very long rising mains and discharge to the tunnel at a Park close to residential properties.
Reliability	4	There is storage capacity in the system for managing PS failure and Hobsonville would be designed to also maintain the ability to pump to Whenuapai for the initial stage. The new Hobsonville pump station would require a full backup power supply and substantial emergency storage.
Flexibility	2	The tunnel is too shallow at Kaipatiki Park to be extended further towards Hobsonville or enable the Kahika Road PS to be abandoned. The rising mains are only sized for design flows
Constructability	2	Marine works and construction through Hobsonville and Beach Haven. TBM construction is well proven and tunnel is below all existing services and construction of this section will have little impact on the community
Opportunity benefits	3	The storage afforded by a tunnel would provide operational security at Rosedale. Existing network assets such as the Kahika Road PS rising main and some sections of the North Shore gravity network could be redirected into the tunnel if these assets were under capacity or in poor condition.

Assessment of Effects	Various	Shafts can be located to minimise any impacts on Cultural, Heritage, Environment, Community or Landowners. Marine crossing will impact slightly on Cultural Heritage and Environment and both were scored at 4. Works through Hobsonville and Beach Haven Road will affect Community and Landowners and were scored at 2 and 3 respectively
Staging	3	The tunnel is sized for ultimate capacity but the initial rising main will provide interim capacity until growth requires additional capacity (the length of time that the interim rising main will be adequate will depend upon the actual rate of growth experienced by the catchment, the design should be sized to ensure that at a minimum that 10 years of capital deferral

Shortlist Options Assessment – Hobsonville to Rosedale

MCA scoring

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Upper Harbour Highway	Tauhinu Road, Greenhithe
Functionality	Baseline requirements	Options consistent with the Three Waters Strategy, particularly the future utilisation of treatment capacity Rosedale vs Mangere, providing for increasing network capacity to service growth the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas	1 = entirely consistent; 2 = closely aligned; 3 = aligned on key aspects on; 4 = little alignment; 5 = no alignment	1	1
		Capacity to support growth and development in the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas.	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	1	1
	Additional requirements	Ability to intercept catchments and allow the decommissioning of local pump stations	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4	2
		Ability to delay or replace local and wastewater network upgrades	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4.5	4
		Provide benefit or alignment with other utilities or public services	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4	4
Functionality Average Score				**2.9**	**2.4**
Operational & Maintenance		Site location and space available for on-going operational and maintenance access requirements (e.g. at shaft sites)	1 = neutral or positive; 2 = minor construction risks; delay < 4wks; 3 =moderate risk, delay 4 - 12wks; 4 = high level of risk, delay >12wks; 5 = high risk, construction held up indefinitely.	3	2
		Site appropriately buffered from surrounding community	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Unlikely (only 1or 2 Contractors); 5 = Impossible (1 or none Contractors).	2	2
		Provides for future operational flexibility (e.g. how easy will it be to deal with a significant increase in flow)	1 <5%; 2 = 5-10%; 3 = 10%-15%; 4 = 20-25%; 5 = >25%	4	2

Operational & Maintenance Average Score				**3.0**	**2.0**
Constructability		Potential for construction risks that may hold up, stop or adversely affect construction time	1 = neutral or positive; 2 = minor construction risks; delay < 4wks; 3 =moderate risk, delay 4 - 12wks; 4 = high level of risk, delay >12wks; 5 = high risk, construction held up indefinitely.	4	3
		Ability for construction techniques to be delivered by a number of Contractors allowing competitive tenders to be obtained	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Unlikely (only 1or 2 Contractors); 5 = Impossible (1 or none Contractors).	2	2
		Potential for construction risks that result in significant cost overruns	1 <5%; 2 = 5-10%; 3 = 10%-15%; 4 = 20-25%; 5 = >25%	3.5	3
Constructability Average Score				**3.2**	**2.7**
Assessment of Effects on the Environment	Environmental	Potential construction impacts on coastal and freshwater quality	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread impacts; 5 = very significant – widespread impacts on sensitive environments (e.g. CPA 1, beaches).	2	3
		Potential construction effects on terrestrial ecosystems. Sites located in close proximity to SEA-Land and/or riparian margins will have a greater impact on habitats, flora fauna.	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread impacts loss of ecologically valuable habitats; 5 = very significant – widespread impacts, loss of ecologically habitats, rare/threatened species.	2	2
		Potential effects on protected trees during construction	1 = neutral or positive; 2 = slight impact – removal or trimming of a couple of non-protected trees; 3 = moderate impact, removal of a couple of protected trees; 4 = high impact – removal of a scheduled or notated tree; 5 = very significant – removal of several scheduled or notated trees.	2	2
		Potential construction effects on landscape/neutral character values, and their ability to be mitigated	1 = neutral or positive; 2 = slight impact – temporary minor reduction in visual quality; 3 = moderate impact, slightly more than localised effect, temporary effect that can be mitigated; 4 = high impact – significant visual or natural character impacts, permanent effect; 5 = very significant – significant impact in regionally significant landscape, permanent effect.	3	4
		Potential construction on coastal ecosystems. Construction activities that are near to the CMA and/or are within the CMA (e.g. marine trenching) will have a greater impact on coastal ecosystems.	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread, permanent loss of CMA; 5 = very significant – widespread impacts on sensitive environments (e.g. CPA 1, beaches).	2	3
		Sensitivity of ecosystems from operational overflow discharges. Assume dilution and dispersion is better at the head of creeks in the CMA.	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect, visual; 4 = high impact – wide spread impacts loss of ecologically valuable habitats; 5 = very significant – widespread pollution.	2	3

	Environmental Average Score			**2.2**	**2.8**
	Social	Distance from site to arterial road for operational and maintenance purposes.	1 = site on arterial; 2 = <200; 3 = <1 km; 4 = 1.3 km 5 = => 3 km	1	4
		Likelihood of adverse effects on local roads resulting from construction activities.	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major effect.	3	4
		Operational effects on residential properties with line of sight of permanent structures e.g. pump stations). This includes effects relating to visual amenity, noise, and odour.	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major visual impact.	2	4
		Impact to neighbouring properties within 200m of construction sites resulting from construction activity (visual, dust noise, odour, traffic)	1 = neutral or positive; 2 = minor effect; 3 = moderate effect, limited amount of complaints; 4 = significant effect that is difficult to mitigate, large number of complaints; 5 = major effect.	4	4
		Short-term impact on community facilities resulting from construction activities (e.g. reduced access to community facilities (e.g. Beach, sports club, community hall, playground, etc.)	1 = neutral or positive; 2 = minor disturbance, facilities can continue to operate with minor restrictions; 3 = moderate disturbances, facilities can be continue to operate but with temporary loss of access to part of site; 4 = high level of restrictions on facilities, only limited operability; 5 = facilities no longer able to operate.	2	3
		Proximity of construction activities to sensitive community facilities (e.g. School, play centre, medical facility) located on likely construction traffic route	1 = no facilities on route; 2 = park or similar on route; 3 = sports complex on route; 4 = schools, play centres in vicinity of route; 5 = schools, play centres on route.	2	4
		Extent to which construction works will reduce access to parks and reserves when considering the ability to operate parks/reserves 'as usual' during construction, and the amount of reserve required for construction activities. This considers the sensitivity of the users of the reserve (e.g. North Shore Memorial Park and mourners)	1 = neutral or positive; 2 = minor disturbance, facilities can continue to operate with minor restrictions; 3 = moderate disturbances, facilities can be continue to operate but with temporary loss of access to part of site; 4 = high level of restrictions on facilities, only limited operability; 5 = facilities no longer able to operate.	1	3
		Effects arising from potential operational odour discharges (e.g. at break pressure chamber sites and pump station sties)	1 = neutral or positive; 2 = low potential for odour effects; 3 = moderate potential for odour effects; 4 = odour effects almost certain over local area; 5 = adverse effects over widespread area.	2	3
		Impact to neighbouring properties from operation and maintenance activity (includes visual, dust, noise, odour, traffic) and risk of operational failures	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major effect.	2	3
		Number of properties above the centreline of the pipeline	1 = <5; 2 = <20; 3 = <50; 4 = <100; 5 = >100	2	1

	Social Average Score			**2.1**	**3.3**
	Cultural	Potential impacts waahi tapu sites identified in District Plan and impact on heritage and traditional sites for Mana Whenua	1 = neutral or positive; 2 = minor disturbance of site; 3 = moderate disturbance of lower value site; 4 = destruction of significant site; 5 = destruction of very significant site.	2	3
		Effects on mauri of waterbodies through wastewater overflows	1 = neutral or positive; 2 = emergency overflow only; 3 = if overflow, it is not direct to waterbody, and little potential for adverse effect on Mauri; 5 = If overflow, it is direct to special environment (stream, beach) and mauri reduced.	3	3
		Impact on cemetery (as an urupā)	1 = neutral or positive; 2 = minor disturbance of site; 3 = moderate disturbance; 4 = destruction of significant site; 5 = destruction of very significant site.	1	3
	Cultural Average Score			**2.0**	**3.0**
	Economic	Excavations in alluvium with risk of settlement of sensitive structures	1 = no settlement expected; 2 = settlement but with negligible effect; 3 = excavation in alluvium with localised settlement – no damage; 4 = excavation in alluvium, widespread settlement, moderate non-structural damage; 5 = excavation in alluvium with widespread settlement and significant structural damage.	3	4
		Number of private property purchases required to facilitate the construction of the pipeline	1 = <2; 2 = <5; 3 = <10; 4 = <20; 5 = >20	2	2
		Potential for short-term business disruption during construction	1 = neutral, site not in commercial area; 2 = site in commercial area, or commercial area in proximity, minor disruption possible; 3 = site in commercial area, or commercial are in proximity, with likely disruption to commercial activities; 4 = site in commercial area or commercial are in proximity, significant disruption to commercial activity; 5 = site in commercial area or commercial area in proximity, major disruption to commercial activity.	2	3
		Disruption to existing services and utility providers	1 = neutral or positive; 2 = slight impact - localised, minor disturbance; 3 = moderate impact, minor services relocation required; 4 = high impact - major services require relocation, limited disruption to services operation and moderate cost; 5 = very significant - major services require relocation, major disruption to services operation, significant cost.	2	3
		Energy use required for operating the facility (pump stations sties)	1 = neutral or positive; 2 =low energy use; 3 = moderate energy use 4 = high energy use; 5 = very significant energy use.	5	5
	Economic Average Score			**2.8**	**3.4**
Overall MCA Score				**2.6**	**2.8**

Longlist Options Assessment – Concourse to Hobsonville

MCA scoring and comments on scoring

- The workshop participants assessed each longlist option against each of the sub criteria. For each sub criteria a score of 1 - 5 was awarded based on the professional judgement of the collective workshop group. A score of 1 indicates a high risk associated with the criteria (i.e. the option will potentially fail to meet requirements), a score of 5 would indicate a low risk associated with the criteria (i.e. the option is considered reliable)
- Each criteria was weighted evenly (0.25)

Option	Criteria	Operational Criteria						Technical Criteria						Environmental Criteria						Staging			
	Sub-criteria	Safety	Complexity	Maintenance	Odour/ Corrosion	**Average Score (Operational)**	**Weighted Score (Operational)**	Reliability	Flexibility	Constructability	Opportunity/ Benefit	**Average Score (Technical)**	**Weighted Score (Technical)**	Cultural/ Heritage	Environment	Community	Landowner/ Property	**Average Score (Environmental)**	**Weighted Score (Environmental)**	Ability to Stage	**Weighted Score (Staging)**	**Overall MCA SCORE (sum of weighted scores)**	**Rank**
1	Te Atatu Road	3	3	3	3	**3.0**	**0.75**	3	4	2	2	**2.75**	**0.69**	3	2	2	2	**2.25**	**0.56**	3	**0.75**	2.75	4
2	Te Atatu Road – Avoiding Difficult Coastal Areas	3	3	3	3	**3.0**	**0.75**	3	4	1	2	**2.5**	**0.63**	1	2	2	2	**1.75**	**0.44**	3	**0.75**	2.57	8
3	Te Atatu Road – Avoiding Difficult Coastal Areas and the Use of Deep Tunnels	3	3	3	3	**3.0**	**0.75**	3	4	1	2	**2.5**	**0.63**	1	2	2	2	**1.75**	**0.44**	3	**0.75**	2.57	8
4	Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing	3	3	3	3	**3.0**	**0.75**	3	4	2	2	**2.75**	**0.69**	1	2	2	2	**1.75**	**0.44**	3	**0.75**	2.63	6
5	Matipo Road	3	3	3	3	**3.0**	**0.75**	3	4	2	2	**2.75**	**0.69**	2	2	2	2	**2.0**	**0.5**	3	**0.75**	2.69	5
6	Matipo Road – alternate pipeline alignment	3	3	3	3	**3.0**	**0.75**	3	4	2	2	**2.75**	**0.69**	2	2	2	4	**2.5**	**0.63**	3	**0.75**	2.82	2
7	Henderson Creek	3	3	2	3	**2.75**	**0.69**	3	4	2	2	**2.75**	**0.69**	2	1	1	2	**1.5**	**0.38**	3	**0.75**	2.51	12

Option	Criteria	Operational Criteria						Technical Criteria						Environmental Criteria						Staging		**Overall MCA SCORE (sum of weighted scores)**	**Rank**
	Sub-criteria	Safety	Complexity	Maintenance	Odour/ Corrosion	**Average Score (Operational)**	**Weighted Score (Operational)**	Reliability	Flexibility	Constructability	Opportunity/ Benefit	**Average Score (Technical)**	**Weighted Score (Technical)**	Cultural/ Heritage	Environment	Community	Landowner/ Property	**Average Score (Environmental)**	**Weighted Score (Environmental)**	Ability to Stage	**Weighted Score (Staging)**		
8	North Western Motorway	3	3	3	2	**2.75**	**0.69**	3	4	3	4	**3.5**	**0.88**	4	4	4	2	**3.5**	**0.88**	3	**0.75**	3.2	1
9	Gloria Road	3	3	2	3	**2.75**	**0.69**	3	4	2	2	**2.75**	**0.69**	2	2	1	2	**1.75**	**0.44**	3	**0.75**	2.57	8
10	Direct to Te Atatu	3	3	2	3	**2.75**	**0.69**	3	4	2	2	**2.75**	**0.69**	2	2	1	2	**1.75**	**0.44**	3	**0.75**	2.57	8
11	Tunnel	2	4	2	4	**3.0**	**0.75**	3	4	4	3	**3.5**	**0.88**	4	4	4	3	**3.75**	**0.94**	1	**0.25**	2.82	2
12	Gravity Microtunnel	3	3	3	4	**3.25**	**0.81**	4	3	1	3	**2.75**	**0.69**	1	1	2	3	**1.75**	**0.44**	1	**0.25**	2.19	13
13	Full Route rising main	3	3	2	1	**2.25**	**0.56**	2	3	2	2	**2.25**	**0.56**	2	1	2	3	**2.0**	**0.5**	4	**1**	2.62	7

Comments on select individual scores

Option 1 - Te Atatu Road

This option is based on the broad concepts of maximising the use of roads and urban environments for the first component of works (to Luckens Point), an on the broad concept of avoiding urban environments for the second component, from Luckens Point to Limeburners Bay. This option is considered to be the most straightforward alignment for the Concourse to Hobsonville section of the project.

From a construction perspective, the need for a crossing of the CMA over long distances, the potential impacts on the coastal environment, and the poor ground conditions near the existing marina were considered to be the most challenging aspects of this option.

For the purposes of this option it is assumed that the rising main from Concourse will cross Henderson Creek using HDD through to KunWoo Park/Rutherford College, and then be trenched along Toru Street and Te Atatu Road. The crossing of the harbour and the alignment through to Hobsonville PS will be micro-tunnelled. At 500m long the crossing of the harbour is seen as the greatest challenge and may require some additional micro-tunnel shafts to be constructed within the marine environment. This option would require a new pump station to be constructed at the existing Concourse Storage Tank site.

Criteria	*Score*	*Comment*
Constructability	2	Difficulties of a marine crossing by long micro-tunnelling shot and difficult access to shoreline sections.
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Environment	2	Work on shoreline and potential (although unlikely) for a failure during harbour crossing
Community	2	Disruption to marina and reserves.
Landowner property	2	Works would be quite disruptive for Westharbour Marina and other private properties.

Option 2 - Te Atatu Road – avoiding difficult coastal areas

This option is based on the broad concept of maximising the use of roads and urban environments, and was developed as a variation to Option 1. In this option, the route has been altered to minimise the overall length of the harbour crossing section and to avoid construction in the potentially difficult coastal areas.

The overall construction techniques are the same as for Option 1, however, from a construction perspective, the deep sections of micro-tunnelling around Lukens Road and Marina View Drive and the need to set up construction activities on the reef off Orukuwai Point, were considered to be the most challenging aspects of this option.

Criteria	*Score*	*Comment*
Constructability	1	Microtunnelling at depths over 50m is not practicable
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	1	Orukuwai Point reef is of cultural importance
Environment	2	Significant works in the harbour
Community	2	Disruption to reserves.
Landowner/ Property	2	Works would be quite disruptive for private properties.

Option 3 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels

This option is based on the broad concept of maximising the use of roads and urban environments, and maximising the use of deep tunnels. This option was developed as a variation to Option 2, and uses the same overall construction approach as Options 1 and 2 but seeks to avoid the need for the deepest micro-tunnelling shaft (on Luckens Road) by tunnelling under private property from the West Harbour esplanade reserve to Luckens Road.

This option would also require a new pump station to be constructed at the existing Concourse Storage Tank site.

Criteria	*Score*	*Comment*
Constructability	1	Microtunnelling at depths over 50m is not practicable
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	1	Orukuwai Point reef is of cultural importance
Environment	2	Significant works in the harbour
Community	2	Disruption to reserves.
Landowner/ Property	2	Works would be quite disruptive for private properties.

Option 4 - Te Atatu Road – avoiding difficult coastal areas and the use of deep tunnels with alternate harbour crossing

Similar to Option 3, this option is based on the broad concept of maximising the use of roads and urban environments, and maximising the use of deep tunnels. This option was also developed as a variation to Option 2, and seeks to avoid the need for a deep tunnelling shaft (on Luckens Road) by tunnelling under private property from the West Harbour esplanade reserve to Luckens Road, and altering the location of the marine crossing. This alignment is more direct than Options 2 and 3 but passes under a larger number of private properties.

This option would also require a new pump station to be constructed at the existing Concourse Storage Tank site.

Criteria	*Score*	*Comment*
Constructability	2	Deep microtunnel and long drives required
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	1	Orukuwai Point reef is of cultural importance
Environment	2	Significant works in the harbour
Community	2	Disruption to reserves.
Landowner/ Property	2	Works would be quite disruptive for private properties.

Option 5 - Matipo Road

This option is based on the broad concepts of maximising the use of roads and urban environments for the first component of works (to Te Atatu Road), an on the broad concept of avoiding urban environments for the second component (to the esplanade reserve near Scott Road). For the purposes of longlist development it is assumed that the initial gravity section from Concourse under Henderson Creek and through the Te Atatu peninsula will be constructed by micro-tunnelling. The rising main across the harbour through to Scott Road will be constructed using a combination of marine trenching and HDD and the remaining gravity section from Scott Road to Hobsonville PS will be constructed by micro-tunnelling.

From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- Finding a satisfactory site to locate the new pump station at the top of the Te Atatu peninsula;
- The limited area available to set up a HDD landing site on the northern end of the crossing (near Scott Road);
- The need to construct the pipe under private properties;
- The construction and environmental risks associated with long HDD drives; and
- The need to set up construction activities on the reef off Orukuwai Point.

For the purpose of longlist development it is assumed that the marine crossing would be constructed by HDD. This option would require a new pump station to be constructed at the Te Atatu peninsula rather than at Concourse.

Criteria	*Score*	*Comment*
Constructability	2	Long HDD drives, potentially constrained work sites
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	2	Orukuwai Point reef is of cultural importance
Environment	2	Significant works in the harbour
Community	2	Disruption to reserves.
Landowner/ Property	2	Works would be quite disruptive for private properties.

Option 6 - Matipo Road – Alternate pipeline alignment

This option is based on the broad concept of maximising the use of roads and urban environments. It has a similar configuration as Option 5 with a gravity section from Concourse to new pumping station to be located Te Atatu point; a rising main section under the harbour through to a break pressure tank, and a second gravity section through to Hobsonville PS.

The alignment and construction approach for Option 6 is the same as for Option 5 through to Te Atatu point. The rising main across the harbour through to Luckens Reserve will be constructed using HDD and then by open trenching through to a break pressure chamber to be located in Wiseley Road. The remaining gravity section to Hobsonville PS will be constructed by micro-tunnelling.

This option comprises of a shorter marine crossing, with a landing point at Luckens Point. From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- Finding a satisfactory site to locate the new pump station at the top of the Te Atatu peninsula;
- The limited area available to set up a HDD landing site on the northern end of the crossing (at the coastal end of Luckens Reserve); and
- The construction and environmental risks associated with long HDD drives;

Criteria	*Score*	*Comment*
Constructability	2	Long HDD drives, potentially constrained work sites
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	2	Orukuwai Point reef is of cultural importance
Environment	2	Significant works in the harbour
Community	2	Disruption to reserves.

Option 7 - Henderson Creek

Option 7 considers an alternate route from the Concourse Storage Tank, to a new pumping station at Te Atatu point. From here the route alignment could follow either route Option 5 or 6 to Hobsonville PS and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of avoiding urban environments for the first component of the route from Concourse to Te Atatu point and maximising the use of roads and urban environments for the second component.

The section of gravity pipeline along Hendersons Creek would be constructed by micro-tunnelling but will require a number of shafts to be constructed within the coastal reserve.

From a construction perspective, the need for multiple crossings of Henderson Creek, the associated environmental and cultural impacts, and the potentially long drive lengths, were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

Criteria	*Score*	*Comment*
Constructability	2	Long microtunnelling drives, potentially constrained access to route
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	2	Significant impact to the banks of Henderson Creek
Environment	1	Significant works in the harbour
Community	1	Significant disruption to reserves.
Land owner/ property	2	Significant works close to private property

Option 8 - North Western Motorway

This option is based on the broad concept of maximising the use of roads and urban environments, and follows the alignment of the North Western Motorway.

For the purposes of this option it was assumed that the rising main from Concourse will cross Henderson Creek using HDD and run alongside the motorway (but not in the motorway corridor) to a break pressure chamber at around RL35m where it will change to gravity sewer constructed by micro-tunnelling.

From a construction perspective, the need to build the pipeline in or alongside the motorway corridor, the need for a marine crossing, the relatively deep micro-tunnel and shafts (35m+ in some locations to cross under ridgelines at Royal Road, Fred Taylor Drive and Trig Road) and the high static pumping head, were considered to be the most challenging aspects of this option.

This option would require a new pump station to be constructed at the existing Concourse Storage Tank site.

Criteria	*Score*	*Comment*
Odour and Corrosion	2	Long rising mains discharge into a residential area so odour will need to be controlled
Land owner/property	2	Significant works close to private property

Option 9 - Gloria Road

This option combines two broad concepts: that of maximising the use of roads and urban environments, and avoiding urban environments. Option 9 considers an alternate route from the Concourse Storage Tank, to a new pumping station at Te Atatu point. From here the route alignment either follows route Option 5 or 6 to Hobsonville PS, and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of maximising the use of roads and urban environments.

The section of gravity pipeline from Concourse to Te-Atatu point would be constructed by micro-tunnelling. A tunnel drive of 400m is proposed under Henderson Creek through to Gloria Park.

From a construction perspective, the long micro-tunnel drive lengths, the limited area available for construction activities, and the need to micro-tunnel under private property immediately to the north of the Concourse storage tank were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

Criteria	*Score*	*Comment*
Maintenance	2	Difficult ongoing access
Constructability	2	Long microtunnelling drives, potentially constrained access to route
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	2	Significant impact to the banks of Henderson Creek
Environment	2	Significant works in the harbour
Community	1	Significant disruption to reserves.
Land owner/ property	2	Significant works close to private property

Option 10 - Direct to Te Atatu

This option combines two broad concepts: that of maximising the use of roads and urban environments, and avoiding urban environments. Option 10 considers an alternate route from the Concourse Storage Tank, to the Te Atatu peninsula. From here the route alignment either follows route 5 or 6 to Hobsonville PS70, and for the purposes of this longlist assessment route Option 6 has been adopted. This option is based on the broad concept of maximising the use of roads and urban environments.

The section of gravity pipeline from Concourse to Te-Atatu point would be constructed by micro-tunnelling. A tunnel drive of 500m is proposed under Henderson Creek through to the coastal area at the southern end of Edgerton Road.

From a construction perspective, the long micro-tunnel drive lengths, the limited area available for construction activities, and the need to micro-tunnel under private property immediately to the north of the Concourse Storage Tank, and a number of residential properties were considered to be the most challenging aspects of this option.

This option would also require a new pump station to be constructed at the Te Atatu Peninsula.

Criteria	*Score*	*Comment*
Maintenance	2	Difficult ongoing access
Constructability	2	Long microtunnelling drives, potentially constrained access to route
Opportunity benefits	2	Little or no opportunity to pick up other catchments
Cultural and Heritage	2	Significant impact to the banks of Henderson Creek
Environment	2	Significant works in the harbour
Community	1	Significant disruption to reserves.
Land owner/property	2	Significant works close to private property

Option 11 – Tunnel

This option is based on the broad concept of maximising the use of deep tunnels, and is considered to be a more direct route from Concourse to Henderson. From a construction perspective, the need to construct the pipeline under private property, the grade requirements for the tunnel, and construction safety were considered to be the most challenging aspects of this option.

For the purpose of longlist development, it is assumed that the tunnel would comprise of a 3m bored tunnel to allow for longer driver lengths, and would require a shaft in Moire Park and Picasso Reserve. Uncertainty with respect to changes in Health and Safety Legislation and the future requirements for additional access shafts was identified as potential risk.

This option would require a new pump station at the existing Hobsonville Pump Station site.

Criteria	*Score*	*Comment*
Safety	2	Although access is not often required personnel entry presents significant safety issues
Maintenance	2	Difficult access
Ability to Stage	1	Full capacity would need to be constructed at day one.

Option 12 - Gravity Microtunnel

This option is based on the broad concept of maximising the use of roads and urban environments, and combines alignments from other options (Option 6 for the southern component, and Option 3 for the northern component). From a construction perspective, the following elements of this option were considered to be the most challenging aspects:

- The limited area available to set up a HDD landing site on the northern end of the crossing (near Scott Road);
- The need for long micro-tunnel drives;
- The need to set up construction activities on the reef off Orukuwai Point;
- Difficult/constrained access to multiple deep shafts; and
- Very deep pipe sections of 55m+

For the purpose of longlist development, it is assumed that the entire pipeline would be installed by micro-tunnelling.

Criteria	*Score*	*Comment*
Constructability	1	Long microtunnelling drives, potentially constrained access to route and too deep
Cultural and Heritage	1	Significant impact to the reef opposite Orukuwai Point
Environment	1	Significant works in the harbour
Community	2	Significant disruption to reserves.

Option 13 - Full Route Rising Main

This option has been developed to maximise the overall length of rising main in order to minimise pipeline construction depths. This option is based on the broad concept of avoiding urban environments, with the pipeline constructed primarily within the CMA.

The rising main would be constructed from a new pumping station at Concourse along Henderson Creek, Waipareira Bay and Limeburners Bay to a break pressure chamber at Scott Road. The pipeline would then be gravity from Scott Road to Hobsonville PS.

For the purpose of longlist development, it was assumed that the pipeline would be constructed by a combination of HDD and open trenching techniques.

From a construction perspective, the large extent of pipeline within coastal strip, long HDD drives required for marine pipeline construction, the difficulty in accessing HDD setup points, septicity and odour issues and friction loss were considered to be the most challenging aspects of this option.

Criteria	*Score*	*Comment*
Odour and Corrosion	1	The very long rising mains and discharge to the tunnel at a Park close to residential properties.
Reliability	2	Long rising main with difficult access added to likely corrosion issues
Environment	1	Harbour works andf potential odour issues from septicity.
Community	2	As environment

Shortlist Options Assessment – Concourse to Hobsonville

MCA scoring

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
Functionality	Baseline requirements	Options consistent with the Three Waters Strategy, particularly the future utilisation of treatment capacity Rosedale vs Mangere, providing for increasing network capacity to service growth the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas	1 = entirely consistent; 2 = closely aligned; 3 = aligned on key aspects on; 4 = little alignment; 5 = no alignment	1	1	1	1
		Capacity to support growth and development in the North West Transformation Area ("NWTA"), Kumeu, Huapai, Riverhead ("KHR"), Northern Waitakere catchments and South Rodney areas	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	1	1	1	1
	Additional requirements	Ability to intercept catchments and allow the decommissioning of local pump stations	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4	4	3	2
		Ability to delay or replace local and wastewater network upgrades	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4	4	4	2
		Provide benefit or alignment with other utilities or public services	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Barely Adequate; 5 = Inadequate	4	3	4	2
Functionality Average Score				**2.8**	**2.6**	**2.6**	**1.6**
Operational & Maintenance		Site location and space available for on-going operational and maintenance access requirements (e.g. at shaft sites)	1 = neutral or positive; 2 = minor construction risks; delay < 4wks; 3 =moderate risk, delay 4 - 12wks; 4 = high level of risk, delay >12wks; 5 = high risk, construction held up indefinitely.	2	2	2	2
		Site appropriately buffered from surrounding community	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Unlikely (only 1or 2 Contractors); 5 = Impossible (1 or none Contractors).	2	2	2	2

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
		Provides for future operational flexibility (e.g. how easy will it be to deal with a significant increase in flow)	1 <5%; 2 = 5-10%; 3 = 10%-15%; 4 = 20-25%; 5 = >25%	4	4	4	4
Operational & Maintenance Average Score				**2.7**	**2.7**	**2.7**	**2.7**
Constructability		Potential for construction risks that may hold up, stop or adversely affect construction time	1 = neutral or positive; 2 = minor construction risks; delay < 4wks; 3 =moderate risk, delay 4 - 12wks; 4 = high level of risk, delay >12wks; 5 = high risk, construction held up indefinitely.	3	4	3	3
		Ability for construction techniques to be delivered by a number of Contractors allowing competitive tenders to be obtained	1 = Very Good; 2 = Good; 3 = Adequate; 4 = Unlikely (only 1or 2 Contractors); 5 = Impossible (1 or none Contractors).	2	2	2	2
		Potential for construction risks that result in significant cost overruns	1 <5%; 2 = 5-10%; 3 = 10%-15%; 4 = 20-25%; 5 = >25%	2	3	3	2
Constructability Average Score				**2.3**	**3.0**	**2.7**	**2.3**
Assessment of Effects on the Environment	Environmental	Potential construction impacts on coastal and freshwater quality	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread impacts; 5 = very significant – widespread impacts on sensitive environments (e.g. CPA 1, beaches).	3	2.5	2.5	2
		Potential construction effects on terrestrial ecosystems. Sites located in close proximity to SEA-Land and/or riparian margins will have a greater impact on habitats, flora fauna	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread impacts loss of ecologically valuable habitats; 5 = very significant – widespread impacts, loss of ecologically habitats, rare/threatened species.	4	3	3	2
		Potential effects on protected trees during construction	1 = neutral or positive; 2 = slight impact – removal or trimming of a couple of non-protected trees; 3 = moderate impact, removal of a couple of protected trees; 4 = high impact – removal of a scheduled or notated tree; 5 = very significant – removal of several scheduled or notated trees.	3	2	2	2

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
		Potential construction effects on landscape/neutral character values, and their ability to be mitigated	1 = neutral or positive; 2 = slight impact – temporary minor reduction in visual quality; 3 = moderate impact, slightly more than localised effect, temporary effect that can be mitigated; 4 = high impact – significant visual or natural character impacts, permanent effect; 5 = very significant – significant impact in regionally significant landscape, permanent effect.	3	2	2	1.5
		Potential construction on coastal ecosystems. Construction activities that are near to the CMA and/or are within the CMA (e.g. marine trenching) will have a greater impact on coastal ecosystems	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect; 4 = high impact – wide spread, permanent loss of CMA; 5 = very significant – widespread impacts on sensitive environments (e.g. CPA 1, beaches).	3.5	3	3	1.5
		Sensitivity of ecosystems from operational overflow discharges. Assume dilution and dispersion is better at the head of creeks in the CMA	1 = neutral or positive; 2 = slight impact – localised & minor; 3 = moderate impact, slightly more than localised effect, visual; 4 = high impact – wide spread impacts loss of ecologically valuable habitats; 5 = very significant – widespread pollution.	2	2	2	2
	Environmental Average Score			**3.1**	**2.4**	**2.4**	**1.8**
	Social	Distance from site to arterial road for operational and maintenance purposes	1 = site on arterial; 2 = <200; 3 = <1 km; 4 = 1.3 km 5 = => 3 km	3	1	2	2
		Likelihood of adverse effects on local roads resulting from construction activities	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major effect.	3	3	3	2
		Operational effects on residential properties with line of sight of permanent structures e.g. pump stations). This includes effects relating to visual amenity, noise, and odour	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major visual impact.	2	2	3	2
		Impact to neighbouring properties within 200m of construction sites resulting from construction activity (visual, dust noise, odour, traffic)	1 = neutral or positive; 2 = minor effect; 3 = moderate effect, limited amount of complaints; 4 = significant effect that is difficult to mitigate, large number of complaints; 5 = major effect.	5	5	5	5

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
		Short-term impact on community facilities resulting from construction activities (e.g. reduced access to community facilities (e.g. Beach, sports club, community hall, playground, etc.)	1 = neutral or positive; 2 = minor disturbance, facilities can continue to operate with minor restrictions; 3 = moderate disturbances, facilities can be continue to operate but with temporary loss of access to part of site; 4 = high level of restrictions on facilities, only limited operability; 5 = facilities no longer able to operate.	3	3	3	2
		Proximity of construction activities to sensitive community facilities (e.g. School, play centre, medical facility) located on likely construction traffic route	1 = no facilities on route; 2 = park or similar on route; 3 = sports complex on route; 4 = schools, play centres in vicinity of route; 5 = schools, play centres on route.	4	3.5	3.5	2
		Extent to which construction works will reduce access to parks and reserves when considering the ability to operate parks/reserves 'as usual' during construction, and the amount of reserve required for construction activities. This considers the sensitivity of the users of the reserve (e.g. North Shore Memorial Park and mourners)	1 = neutral or positive; 2 = minor disturbance, facilities can continue to operate with minor restrictions; 3 = moderate disturbances, facilities can be continue to operate but with temporary loss of access to part of site; 4 = high level of restrictions on facilities, only limited operability; 5 = facilities no longer able to operate.	4	4	4	2
		Effects arising from potential operational odour discharges (e.g. at break pressure chamber sites and pump station sties)	1 = neutral or positive; 2 = low potential for odour effects; 3 = moderate potential for odour effects; 4 = odour effects almost certain over local area; 5 = adverse effects over widespread area.	2	2	2	2
		Impact to neighbouring properties from operation and maintenance activity (includes visual, dust, noise, odour, traffic) and risk of operational failures	1 = neutral or positive; 2 = minor effect; 3 = moderate effect; 4 = significant effect that is difficult to mitigate; 5 = major effect.	2	1	2	2
		Number of properties above the centreline of the pipeline	1 = <5; 2 = <20; 3 = <50; 4 = <100; 5 = >100	1	1	1	5
	Social Average Score			**2.9**	**2.6**	**2.9**	**2.6**
	Cultural	Potential impacts waahi tapu sites identified in District Plan and impact on heritage and traditional sites for Mana Whenua	1 = neutral or positive; 2 = minor disturbance of site; 3 = moderate disturbance of lower value site; 4 = destruction of significant site; 5 = destruction of very significant site.	3	1	2	1

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
		Effects on mauri of waterbodies through wastewater overflows	1 = neutral or positive; 2 = emergency overflow only; 3 = if overflow, it is not direct to waterbody, and little potential for adverse effect on Mauri; 5 = If overflow, it is direct to special environment (stream, beach) and mauri reduced.	3	3	3	3
		Impact on cemetery (as an urupā)	1 = neutral or positive; 2 = minor disturbance of site; 3 = moderate disturbance; 4 = destruction of significant site; 5 = destruction of very significant site.	n/a	n/a	n/a	n/a
	Cultural Average Score			**3.0**	**2.0**	**2.5**	**2.0**
	Economic	Excavations in alluvium with risk of settlement of sensitive structures	1 = no settlement expected; 2 = settlement but with negligible effect; 3 = excavation in alluvium with localised settlement – no damage; 4 = excavation in alluvium, widespread settlement, moderate non-structural damage; 5 = excavation in alluvium with widespread settlement and significant structural damage.	4	4	4	4
		Number of private property purchases required to facilitate the construction of the pipeline	1 = <2; 2 = <5; 3 = <10; 4 = <20; 5 = >20	1	1	1	1
		Potential for short-term business disruption during construction	1 = neutral, site not in commercial area; 2 = site in commercial area, or commercial area in proximity, minor disruption possible; 3 = site in commercial area, or commercial are in proximity, with likely disruption to commercial activities; 4 = site in commercial area or commercial are in proximity, significant disruption to commercial activity; 5 = site in commercial area or commercial area in proximity, major disruption to commercial activity.	4	3	3	3
		Disruption to existing services and utility providers	1 = neutral or positive; 2 = slight impact - localised, minor disturbance; 3 = moderate impact, minor services relocation required; 4 = high impact - major services require relocation, limited disruption to services operation and moderate cost; 5 = very significant - major services require relocation, major disruption to services operation, significant cost.	3	3	3	2

Criteria	Sub-criteria	Basis for Assessment	Basis for scoring	Te Atatu	Te Atatu (alternative)	Matipo Road – alternate pipeline	North Western Motorway
		Energy use required for operating the facility (pump stations sties)	1 = neutral or positive; 2 =low energy use; 3 = moderate energy use 4 = high energy use; 5 = very significant energy use.	3	3	3	4
	Economic Average Score			**3.0**	**2.8**	**2.8**	**2.8**
Overall MCA Score				**2.82**	**2.59**	**2.66**	**2.26**