

Greenhithe Bridge Watermain Duplication and Causeway

ASSESSMENT OF EFFECTS ON THE ENVIRONMENT

July 2015



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Abbreviations

Abbreviation	Description
ACDP:NS	Auckland Council District Plan: North Shore Section
ACDP:WS	Auckland Council District Plan: Waitakere Section
ACRP:ALW	Auckland Council Regional Plan: Air Land Water
ACRP:C	Auckland Council Regional Plan: Coastal
ACRP:SC	Auckland Council Regional Plan: Sediment Control
ANZECC	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
AMA	Auckland Motorway Alliance
AVD	Auckland Vertical Datum
CE	Construction Elements
CFU	Colony forming units
CMA	Coastal Marine Area
CMP	Construction Management Plan
CNVMP	Construction Noise and Vibration Management Plan
CCO	Council Controlled Organisation
CoPTTM	Code of Practice for Temporary Traffic Management
CPA	Coastal Protection Area
Db	Decibels
DIN	German Institute for Standardisation
ERC	Environmental Response Criteria
ESCMs	Erosion and Sediment Control Measures
ESCP	Erosion and Sediment Control Plan
FSC	Floating Silt Curtain
GBWD	Greenhithe Bridge Watermain Duplication
HAIL	Hazardous Activities Industries List
HAT	Highest Astronomic Tide
HNZPT	Heritage New Zealand Pouhere Taonga Act
HSEP	Health Safety and Environment Plan
ISQG	Interim Sediment Quality Guidelines
kph	Kilometre per hour
LCM	Lime Cement Mixing
LCP	Landscape Concept Plan
LOD	Levels of Detection
L/s	Litres per second
L_{Aeq}	Equivalent Sound Level
mBGL	Metre below ground level
MfE	New Zealand Ministry for the Environment
MHWS	Mean High Water Springs
mRL	Maximum Recorded Level
NZTA	New Zealand Transport Agency
NH1	North Harbour No.1 Watermain

Abbreviation	Description
NH2	North Harbour No.2 Watermain
NI	Northern Interceptor
NorSGA	Northern Strategic Growth Area
HSEP	Health, Safety and Environmental Plan
PA	Permitted Activity
PAUP	Proposed Auckland Unitary Plan
PPV	Peak Particle Velocities
RMA	Resource Management Act 1991
SGVs	Soil Guideline Values
SH18	State Highway 18
SNA	Significant Natural Area
ST	Sedimentation Tank
TMPs	Traffic Management Plans
TPH	Total Petrol Hydrocarbons
UCL	Upper Confidence Limit
USLE	Universal Soil Loss Equation
UHH	Upper Harbour Highway
UWH	Upper Waitemata Harbour
Watercare	Watercare Services Limited

Executive Summary

This project is the Greenhithe Bridge Watermain Duplication and Causeway project (GBWD and Causeway). The project will provide a new watermain, sections of three new wastewater mains, and the widening of the existing State Highway 18 (SH18) Causeway approaching the Greenhithe Bridge to accommodate these pipelines. The project will be implemented by Watercare Services Limited (Watercare) as the organisation responsible for the provision of potable (drinking) water and wastewater services in Auckland.

Background

An existing watermain, North Harbour No.1 (NH1), is located on the Greenhithe Bridge and provides the primary water supply to northern parts of the North Shore and Rodney. The proposed watermain will provide a second water supply pipeline across the Greenhithe Bridge. The new watermain will support NH1 in this location as it will allow essential maintenance to be undertaken on NH1 and increase the resilience of water supply to a regional population in areas of the North Shore and Rodney.

A section of Watercare's Northern Interceptor project (NI) will be located in the GBWD and Causeway project area. The NI project allows wastewater flows to be diverted from the growing areas of north-western Auckland to the Rosedale Wastewater Treatment Plant; providing for growth in other parts of the Auckland Region. The GBWD and Causeway project will provide opportunity for the construction of sections of three NI wastewater pipelines in the widened SH18 causeway to reduce potential duplication of construction effects in the project area.

Watercare require resource consents for the GBWD and Causeway project from Auckland Council. An assessment of environmental effects (AEE) has been prepared to support the resource consent applications.

Proposed works

The GBWD and Causeway project involves construction, operation and maintenance of a new watermain and construction of portions of three new wastewater mains. In summary, the physical features of the project include:

- Widening and extension of the existing SH18 causeway on the western approach to the Greenhithe Bridge in order to install new pipes for the GBWD and NI.
- Installation of the new watermain within the widened causeway and attachment of the watermain across Greenhithe Bridge, including associated landward connections to NH1 at the western and eastern ends.
- Installation of three NI wastewater pipes within the widened causeway.
- End use of the reclaimed area following installation of the new watermain and NI wastewater pipes – including operations and maintenance access for water and wastewater pipes, and provision of open space for passive recreation.

Construction of the GBWD and Causeway project is currently planned to begin in 2016.

Consents sought

A number of resource consents are sought for the project under sections 9, 12, 14 and 15 of the Resource Management Act 1991 (RMA), including for:

- Reclamation, occupation, disturbance of the foreshore and seabed, and erection of temporary and permanent structures in the coastal marine area;
- Land use activities, including earthworks and disturbance and removal of vegetation;
- Damming and diversion of water; and
- Discharge of contaminants and stormwater.

Considerations of alternatives

Alternative routes for both the GBWD watermain and the NI wastewater mains were considered as part of the development of these projects. In particular, a range of options were considered for pipeline crossings of the Upper Waitemata Harbour and the location of the pipelines to the west of the Greenhithe Bridge.

The outcome of the assessment of alternatives was the selection of a route across the Greenhithe Bridge for the new watermain and routes under the seabed for the NI wastewater mains. To the west of the Greenhithe Bridge the pipelines will be located in a widened and extended SH18 causeway. The proposed alignments are considered by Watercare to achieve the optimal overall outcome having regard to construction, operation, social, economic, environmental and cultural considerations.

Consultation

The development of the GBWD and Causeway project has involved consultation with a wide range of parties. These have included Auckland Council and other agencies, network utility operators, transport authorities, mana whenua, directly affected land owners and the wider community via Local Boards and public information days.

The consultation process has assisted with finalisation of the proposed route and identification of measures to minimise potential adverse effects. Consultation will continue through the design development and construction phases of the project and will be important for successful project delivery.

Assessment of effects

The GBWD and Causeway project will have positive effects for the social, cultural and economic well-being of Auckland. Significantly, the provision of a duplicated watermain across the Greenhithe Bridge will improve the resilience of water supply to areas of the North Shore and Rodney. Most importantly, timely provision of such infrastructure will support the future development of North Harbour Watermain No.2 which enables planned development and growth of the Auckland; helping Auckland Council to fulfil its strategic growth aspirations.

A range of effects have been considered for the construction and operational phases of the GBWD and Causeway project, including (but not limited to) those key issues related to:

- Coastal processes;
- Ecology;
- Landscape and visual effects;
- Earthworks and sedimentation;
- Traffic impacts; and
- Culture and heritage.

A number of actual or potential effects have been identified in the AEE. None of these effects have been identified as significant and it considered that effects can be managed and mitigated to an acceptable level.

Planning and Statutory Assessment

The statutory assessment and AEE has had regard to the provisions of the RMA and other relevant planning documents. The project is generally consistent with the relevant provisions in these documents.

The resource consent application for the GBWD and Causeway widening is a non-complying activity in the Auckland Council Regional Plan: Coastal, and found to pass both of the threshold tests in section 104D of the RMA.

Under the other relevant plans, the consent requirements for the GBWD and Causeway are of a discretionary, or lesser status.

The project has given regard to those matters in section 104 as follows:

- The actual and potential adverse effects associated with construction of the project overall will be minor and, with mitigation, post-construction adverse effects will be minor;
- The project is generally consistent with, and not repugnant to, the intentions and requirements of the relevant planning documents; and
- The project achieves the purpose of the RMA through the provision of water and wastewater infrastructure that provides for the health, safety and wellbeing of the community, while avoiding remedying or mitigating the effects on the environment.

The assessment demonstrates that the GBWD and Causeway responds appropriately to the matters raised in sections 5, 6, 7, and 8 of the RMA.

Conclusion

The GBWD and Causeway Project will form an important part of Auckland's water supply network and will improve the resilience of supply to areas of the North Shore and Rodney. The project will also assist in providing for future growth in the north-west of metropolitan Auckland through construction of sections of the NI pipelines.

The project achieves the purpose of the RMA and is consistent with the provisions of relevant planning documents. Construction effects associated with the GBWD and Causeway can be adequately managed to ensure that, overall, the effects on the environment are minor/moderate. Post-construction, the project will have positive effects and, overall, any adverse effects will be minor (taking proposed mitigation into account).

1. Introduction and Project Overview

1.1 Introduction

Watercare Services Limited (Watercare) is responsible for the provision of potable (drinking) water and wastewater services in Auckland. Watercare is a Council-Controlled Organisation of the Auckland Council. The company's vision is for "outstanding and affordable water services for all the people of Auckland". Watercare is continually reviewing its activities and identifying maintenance, replacement, upgrading and new infrastructure projects to ensure it meets customer's needs, business objectives, design standards and statutory requirements.

Areas of the North Shore and Rodney are currently supplied with potable water by the existing North Harbour No.1 Watermain (NH1). This supply can also be supplemented for as a contingency measure by the water supply that crosses the Auckland Harbour Bridge.

NH1 crosses the Upper Waitemata Harbour between Hobsonville Point and Greenhithe and is located within the original (southern) Greenhithe Bridge. Significant risks have been identified in relation to the section of NH1 within the Greenhithe Bridge. A combination of highly restricted access for inspection, repairs and maintenance, damage to the pipe caused by movements of the bridge structure, external corrosion of the pipe, and the potential for seismic damage presents a major supply risk for Watercare.

Shutdown of NH1 for major repairs would result in severe water restrictions and service disruption being imposed on the North Shore and parts of Rodney. The existing section of NH1 within the Greenhithe Bridge cannot be isolated for a sufficient timeframe to undertake anything more than remedial works of very short duration (24-36 hours). This can only be considered as a contingency as it cannot be sustained without service disruption.

In this context, Watercare proposes to construct a new watermain to supplement the existing NH1 where it crosses the Greenhithe Bridge. This new watermain is known as the Greenhithe Bridge Watermain Duplication (GBWD). Construction of the GBWD will allow Watercare to shut down and undertake essential maintenance on the existing section of NH1 within the Greenhithe Bridge. The new watermain will also be designed to current seismic standards, allow for bridge movement and be provided with sustainable corrosion protection measures to meet its design life.

Watercare is currently planning other major infrastructure projects in the north and north-west of Auckland, being the North Harbour No. 2 Watermain (NH2) and Northern Interceptor (NI) projects. The proposed GBWD and Causeway will form part of these projects where they cross the Upper Waitemata Harbour in the vicinity of Greenhithe Bridge. These other projects have therefore influenced the manner in which it is proposed to undertake the GBWD project.

The NH2 project involves installation of a new watermain that will convey drinking water from Auckland's western water sources in the Waitakere Ranges to west Auckland, North Shore and Rodney. The new watermain will run from a proposed new storage reservoir adjoining Watercare's Huia Water Treatment Plant to the Albany Reservoirs (a length of approximately 33kms). The new watermain proposed to be installed as part of the GBWD project will ultimately connect to and form part of NH2.

NI is a new wastewater project that will convey wastewater from north-western parts of Auckland to the Rosedale Wastewater Treatment Plant at Albany. NI will allow wastewater flows to be diverted from the Northern Strategic Growth Area (NORSGA), or the Hobsonville Wastewater Pump Station to Rosedale Wastewater Treatment Plant (WWTP), instead of being conveyed to the Mangere Wastewater Treatment Plant.

This project, the GBWD and Causeway project, includes the new watermain, elements of the NI project, and the reclamation required to accommodate the GBWD and NI pipelines. The GBWD and Causeway project requires resource consent under the Resource Management Act 1991 (RMA). This Assessment of Effects on the Environment (AEE) supports the resource consent applications and describes the site, the proposed works, and

the potential effects on the environment arising from the activities for which consent is required. The AEE also summarises the consultation undertaken and assesses the project against the relevant statutory documents. Technical reports to support the AEE are contained in Volume 2. Drawings to support the AEE are contained in Volume 3.

1.2 The Greenhithe Bridge Watermain Duplication and Causeway

The works required to construct the GBWD and Causeway project include:

- Widening and extension of the existing SH18 causeway on the western (Hobsonville) side of the Greenhithe Bridge in order to install new pipes for the GBWD and NI.
- Installation of the new watermain within the widened causeway and attachment of the watermain across Greenhithe Bridge, including associated landward connections to NH1 at the western and eastern ends.
- Installation of three NI wastewater pipes within the widened causeway, as shown on Drawing 2010673.006 (Volume 3).
- End use of the reclaimed area following installation of the new watermain and NI wastewater pipes – including operations and maintenance access for water and wastewater pipes, and provision of open space for passive recreation.
- Based on the preliminary design to date, the proposed nominal pipeline diameters and materials are:
 - Water: A single 1200mm diameter concrete lined steel pipeline within the causeway and 800 mm diameter pipeline fixed to the underside of the Greenhithe Bridge;
 - Wastewater: One 710mm diameter polyethelene (PE) pipeline and two 1200mm diameter PE pipelines, installed within the causeway as shown on Drawing 2010673.006.

In addition, the necessary infrastructure to support the new watermain will be installed as part of the project. This includes scour valves, air valves, cross connection valves, chambers and support structures where the new watermain transfers to the Greenhithe Bridge structure.

The width of the proposed SH18 causeway reclamation allows for the GBWD and has sufficient width for other planned Watercare infrastructure – notably the NI.

The current programme is to begin construction in 2016.

1.3 Purpose and structure of this report

1.3.1 Purpose

Watercare seeks resource consent for the GBWD and Causeway works under sections 9, 12, 14 and 15 of the RMA. This includes:

Section 9 Land use activities including:

- Land disturbance and earthworks
- Installation, operation and maintenance of network utilities
- Creation of impervious surfaces
- Vegetation alteration, removal and works in the dripline of protected trees

Section 12 Coastal activities

- Reclamation of the foreshore and seabed
- Occupation of the coastal marine area (CMA) by temporary and permanent structures
- Erection of temporary and permanent structures

- Disturbance of the foreshore and seabed

Section 14 Water permit

- Damming or diversion of coastal water
- Diversion and taking of groundwater during construction
- Diversion of an overland flow path

Section 15 Discharges

- Discharge of contaminants to the CMA
- Discharge of stormwater from new impervious surfaces

The purpose of this AEE is to describe the proposed works, the alternatives considered, the consultation undertaken and the potential effects arising from the construction works and ongoing operation and maintenance of the new watermain and construction of the wastewater mains. The AEE addresses the statutory requirements and provides an assessment of the project against the relevant statutory documents.

The AEE has been prepared in accordance with section 88 and the Fourth Schedule of the RMA and provides information in support of the resource consent applications. The scope of the resource consents is set out in Section 4 of this AEE.

1.3.2 Structure

This AEE comprises three volumes which form part of the resource consent applications. The three volumes of the AEE are as follows:

Volume 1 Assessment of Effects on the Environment Report

- | | |
|------------|--------------------------------|
| Appendix A | Certificates of Title |
| Appendix B | Alternatives Assessment Report |

Volume 2 Technical Reports

- | | |
|--------------------|--|
| Technical Report A | Earthworks, Erosion and Sediment Generation |
| Technical Report B | Soil, Sediment and Groundwater Contamination |
| Technical Report C | Groundwater |
| Technical Report D | Ecological Assessment |
| Technical Report E | Arboriculture |
| Technical Report F | Traffic Assessment Report |
| Technical Report G | Construction Noise and Vibration |
| Technical Report H | Coastal Processes Report |
| Technical Report I | Landscape and Visual Assessment |
| Technical Report J | Heritage Impact Assessment |

Volume 3 Drawings

2. Project Background and Proposed Works

2.1 Watercare Responsibilities and Corporate Objectives

Watercare supplies potable water and collects, treats and disposes of wastewater in Auckland. Watercare has supplied wholesale water supply and wastewater services since 1991. On 1 November 2010, Watercare took over ownership and management of all the water and wastewater assets within the Auckland Council area and became responsible for the fully integrated water and wastewater services.

Watercare is wholly owned by Auckland Council and became a Council Controlled Organisation (CCO) on 1 July 2012. The Company's obligations to deliver water and wastewater services for Auckland are established under s57 (1) of the Local Government (Auckland Council) Act 2009.

Watercare's vision and key goals are set out in its Statement of Intent for the period 2014 - 2017. The vision is "outstanding and affordable water services for all the people of Auckland." "Outstanding" means Watercare will provide safe drinking water, promote efficient water use, and protect waterways and the environment through the effective transport and treatment of wastewater. "Affordable" water services means that Watercare will run an efficient business and keep the overall costs of services to customers (collectively) at minimum levels.

2.2 Existing Infrastructure

Watercare's existing NH1 watermain supplies water to the northern parts of the North Shore and to Whangaparaoa and Orewa. The only other supply to the North Shore is via existing watermain crossing the Auckland Harbour Bridge. These latter watermain supply Devonport, Takapuna, Northcote, Birkenhead and East Coast Bays. The areas supplied by NH1 can be supplemented from the Auckland Harbour Bridge watermain. However, this only occurs in the case of emergency repairs or planned shut down for remedial works, and can only be sustained for one to two days at winter low demand period before reservoir storage is depleted and security of supply is threatened.

2.3 Greenhithe Bridge Watermain Duplication and Causeway Overview

In summary, the GBWD and Causeway project involves duplication of a section of the existing NH1 watermain, construction of a section of the NI wastewater project, and widening of the State Highway 18 (SH18) Causeway in order to accommodate these pipelines.

NH1 is located within the southern side of the Greenhithe Bridge. Duplicating this section of the watermain will enable the existing NH1 within the bridge to be shut down for essential maintenance work whilst maintaining water supply to the North Shore. The proposed new watermain will be attached under the north side of the Greenhithe Bridge.

NI is a new wastewater project that will convey wastewater from north-western parts of Auckland to the Rosedale WWTP in Albany. A section of the NI pipeline route, to the west of the Greenhithe Bridge, shares a common corridor with the proposed new watermain. Consequently, Watercare proposes to integrate the development of these projects in this locality.

In order to provide the necessary space for the GBWD and NI projects to the west of the Greenhithe Bridge, Watercare proposes to widen and extend the existing SH18 Causeway.

Key elements of the project include:

- The new watermain and NI Phase 1 pipelines;
- Structures to connect the new watermain to the Greenhithe Bridge and to transition to and from land at either end of the bridge;
- Connections between NH1 and the new watermain to the east and west of Greenhithe Bridge; and

- Provision for future wastewater pipelines, which may be installed as part of the causeway widening or at a later date.

All dimensions, areas and volumes provided in this AEE are approximate and it is possible that some details may change as the design and construction methods are finalised. Any refinements that may occur during this process are not expected to alter the assessment of effects set out in Section 6 of this AEE.

2.3.1 New Watermain Route

The watermain duplication project comprises a section of new watermain across and to the west of the Greenhithe Bridge with a connection from NH1, and a connection pipeline linking the new watermain to NH1 east of the Greenhithe Bridge. A layout plan, showing the alignment of the proposed new watermain, is included on Drawing 2010674.001 in Volume 3. The route is summarised, going from west to east, in the following paragraphs.

The western-most extent of the watermain duplication project will be south of SH18 adjoining the NH1 watermain adjacent to Station Street at Hobsonville Point (refer Drawing 2010673.006 in Volume 3). From this point a connection pipe will link from NH1, under SH18 for a distance of approximately 192m to meet the GBWD watermain to the north of SH18. The connection pipe will have a nominal diameter of 800mm.

The GBWD watermain is located to the north of SH18, starting approximately 200m east of the roundabout at the head of the Squadron Drive on-ramp (refer Drawing 2010673.006 in Volume 3). The pipe extends east, linking to the connection pipe near the beginning of the existing SH18 Causeway and down the cut slope into the coastal marine area (CMA).

The new watermain will run parallel to SH18 in a widened causeway within the CMA for a distance of approximately 860m. At the western abutment of Greenhithe Bridge the proposed watermain will transition upwards to connect to the underside of the Greenhithe Bridge structure on the northern side of the bridge (refer Figure 2-4 in Section 2.3.1.3 of this AEE and Drawing 2010673.006 in Volume 3). When the bridge was constructed allowance was made for the additional loading of a new watermain on the structure. The pipe will run east along the full length of the bridge, a distance of approximately 470m. At the eastern end of the bridge, the new watermain will transition into the road reserve on the northern side of SH18 and continue east for approximately 32m, where the pipe will meet and reconnect to the existing NH1. The connection to NH1 on the eastern side of the bridge forms the eastern extent of the watermain duplication project (refer Drawing 2010674.006).

The alignment as described above is variously located within the motorway reserve, the CMA, an esplanade reserve and on private property as detailed in Table 2 1. Relevant certificates of title are included in Appendix A.

Table 2-1 GBWD Property Information

Property	Owner	Appellation
State Highway 18	Crown – Managed by the NZ Transport Agency	Road Reserve
2 Squadron Drive, Hobsonville Point	Ann and Michael Evans	Lot 1 DP 475066
Local purpose reserve	Auckland Council	Lot 3 DP 475066
Coastal Marine Area	-	-

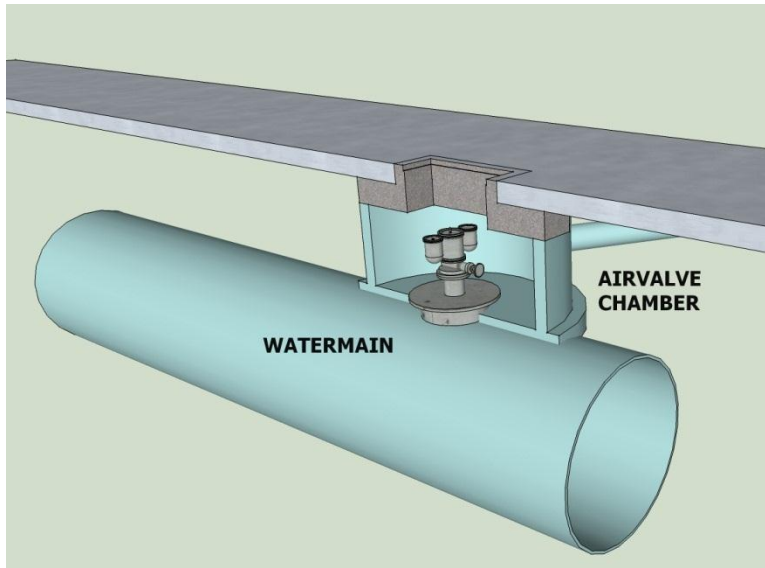
2.3.2 New Watermain

The new watermain will be a concrete-lined steel pipe and will be designed to withstand a 1 in 2500 year return period seismic event. The new watermain will have a nominal diameter of 1200mm west of the Greenhithe Bridge, which will be reduced to 800mm across the bridge. The connection pipe between NH1 and the new watermain on the western side of the bridge will also have a nominal diameter of 800mm. Connections

between NH1 and the new watermain will be established on both the eastern and western sides of the Greenhithe Bridge, controlled by a series of valves located within buried reinforced concrete chambers.

Air valves will be located at a number of high points on the new watermain to let air in and out of the pipeline when it is being filled and emptied. An example of a typical air valve is shown below in Figure 2-1 below.

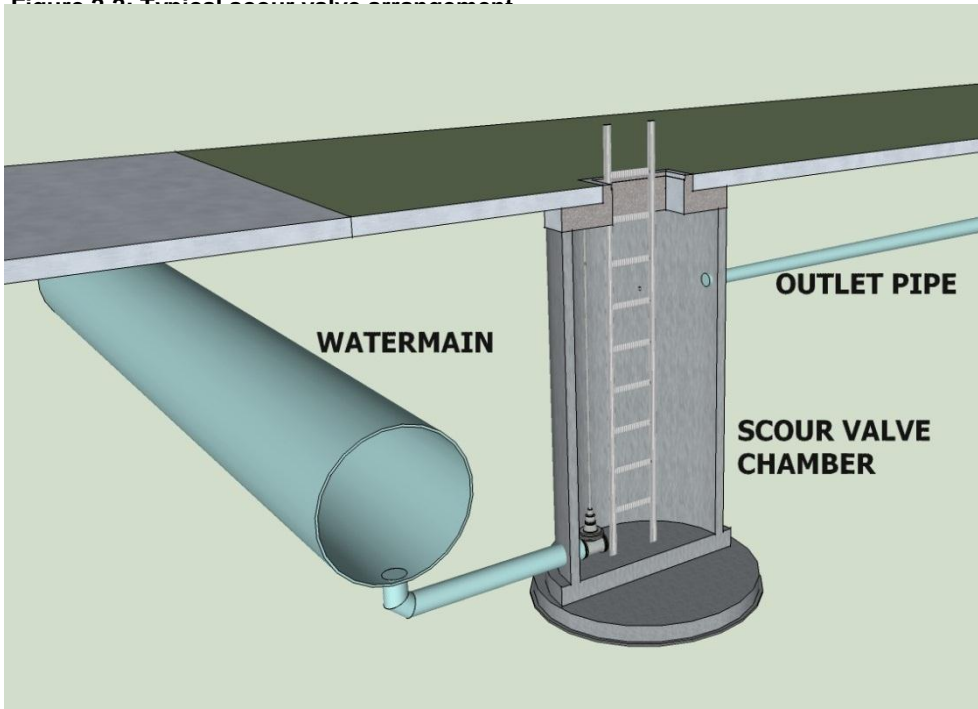
Figure 2-1: Indicative air valve arrangement



The air valves will be able to be isolated so that maintenance can be carried out on the valves without shutting down the watermain. Each air valve will be housed in a manhole with a diameter of 1650mm. Ground levels on the causeway may be raised around the air valves to provide the required coverage depth. Any localised ground level raising will be integrated into the surrounding ground levels so that access along the causeway is maintained.

A scour valve will be fitted to the new watermain in the widened causeway, within the same chamber that houses the valve connection between the GBWD and NH1 (in the location shown on Drawing 2010674.002 in Volume 3). This scour valve will enable water from both NH1 and the new watermain to be drained for maintenance, commissioning or operational reasons. An example of a typical scour valve is shown in Figure 2-2 below.

Figure 2-2: Typical scour valve arrangement



The scour valve allows the watermain to discharge to a stilling chamber for energy dissipation and de-chlorination before being discharged to the CMA. Discharges from the scour valve will be released through an outlet structure with a reinforced concrete headwall located at the toe of the causeway widening. A photo of a typical scour outlet is shown in Figure 2-3 below.

Figure 2-3: Example of outfall and rip-rap erosion protection below the Mangere Bridge



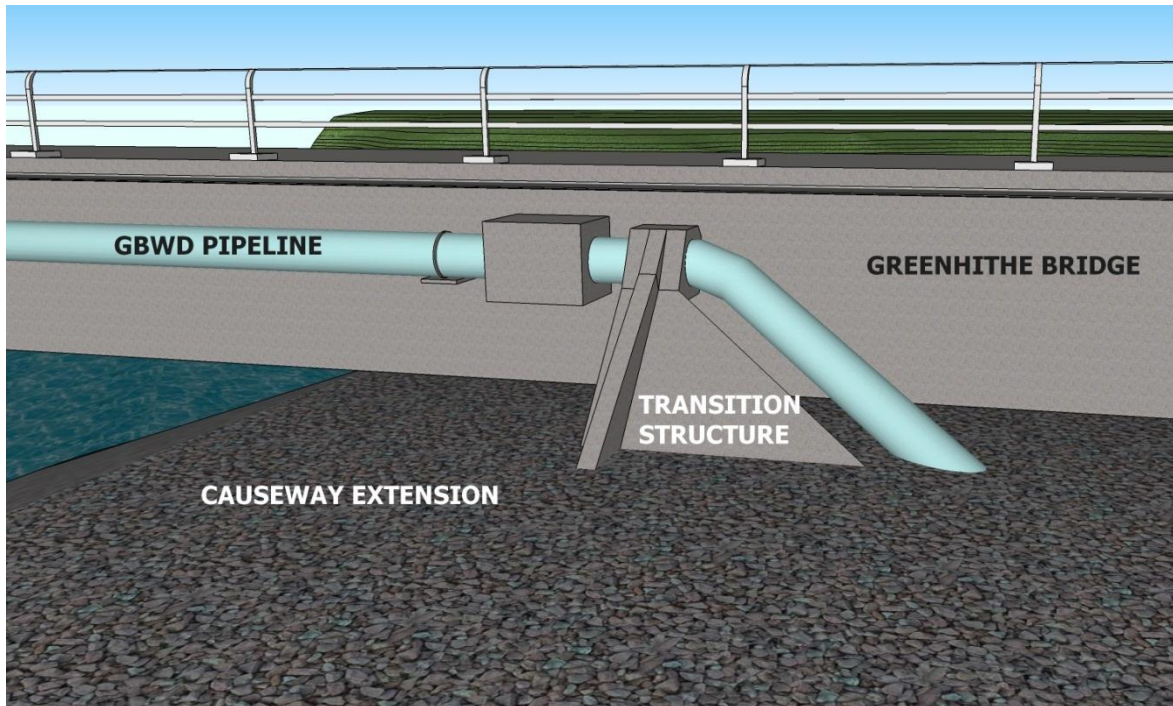
2.3.3 New Watermain on the underside of Greenhithe Bridge

On the Greenhithe Bridge, the new watermain will be connected beneath the northern side of the bridge superstructure. The pipeline will be supported by steel brackets. The brackets will be provided at approximately 8m intervals, although the spacing will vary to avoid clashes with existing structural features on

the bridge. Examples of potential bracket designs are shown in Drawing 2010675.003, in Volume 3. The pipeline profile will not extend below the soffit of the bridge structure thereby maintaining the bridge profile as a dominant feature. During operation, access to the proposed watermain will be gained from the bridge.

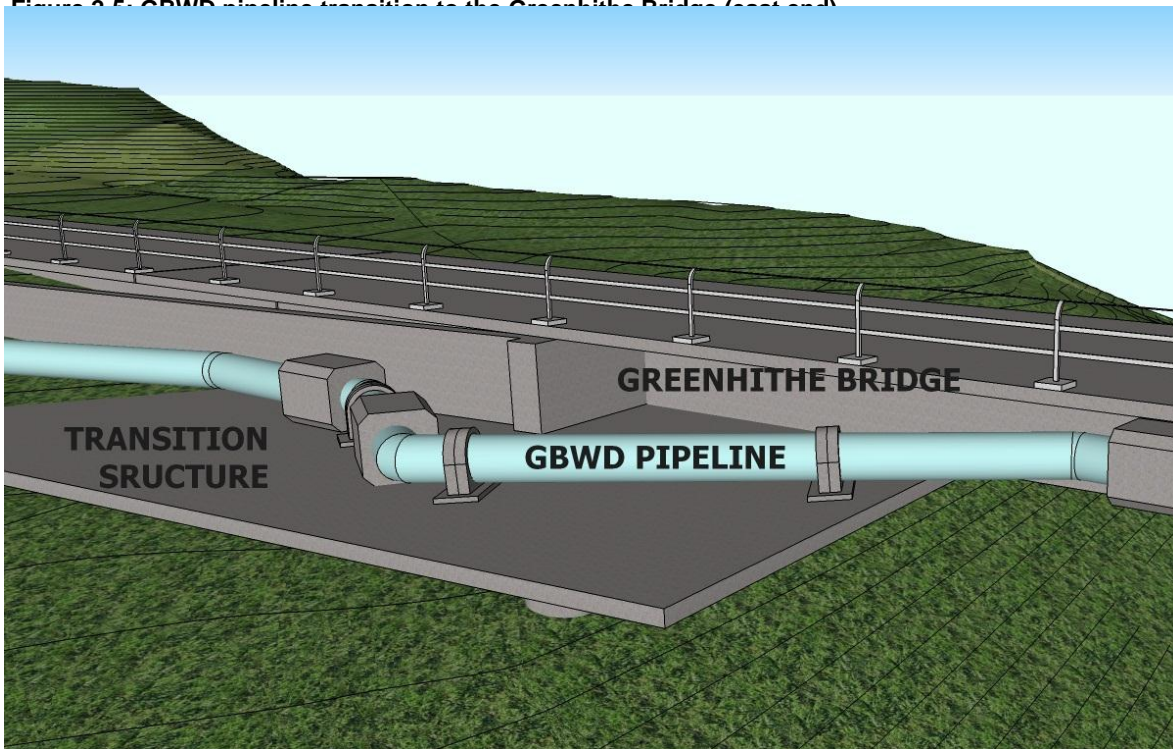
Transition structures will be constructed at the western and eastern ends of the Greenhithe Bridge to support the new watermain in transitioning to and from the bridge. At the western end of the bridge, the watermain will transition from the causeway to the bridge above. This transition is shown in Figure 2-4 below. At this location, the inclining pipe will be supported by a reinforced concrete or structural steel structure and piles constructed on the causeway extension.

Figure 2-4: GBWD pipeline transition to the Greenhithe Bridge (west end)



At the eastern abutment of the Greenhithe Bridge the new watermain transitions off the bridge and will be supported on piles and a reinforced concrete slab. This pipe transition is shown in Figure 2-5 below.

Figure 2-5: GBWD pipeline transition to the Greenhithe Bridge (east end)



2.3.4 Northern Interceptor

The existing SH18 causeway will be widened and extended to accommodate the new watermain and pipes required for the NI project. The NI pipelines proposed to be installed within the widened causeway comprise a 710mm diameter wastewater main and two 1200mm diameter wastewater mains. The 710mm diameter main relates to Phase 1 of the NI project and this pipeline will be installed at the time of causeway widening. The two 1200mm diameter mains relate to future phases of the NI project and beyond the installation of the pipes do not form part of this consent application.

From the western end of the causeway, the new watermain and the three NI pipelines will run in parallel for approximately 500m (refer Drawing 2010673.006 in Volume 3 and section 2.3.6 below). Provision for installation of the three NI pipelines along this length of the widened causeway forms part of the GBWD and Causeway project and is addressed in this AEE. The NI pipelines will be continued beyond this point in the future, and this is addressed by way of a separate AEE and resource consent applications for the NI project. In particular, the 710mm diameter wastewater main (NI Phase 1) will turn northward within the proposed NI construction platform on the widened causeway and will cross the harbour as two 550mm diameter pipelines. The two 1200mm diameter wastewater mains will continue eastward as part of a future phase of the NI project, being directionally drilled under the harbour towards Greenhithe. The proposed alignments for the NI pipelines are shown on Drawing 2010674.001, and in more detail on Drawings 2010674.002, 003 and 004 in Volume 3.

2.3.5 The Causeway

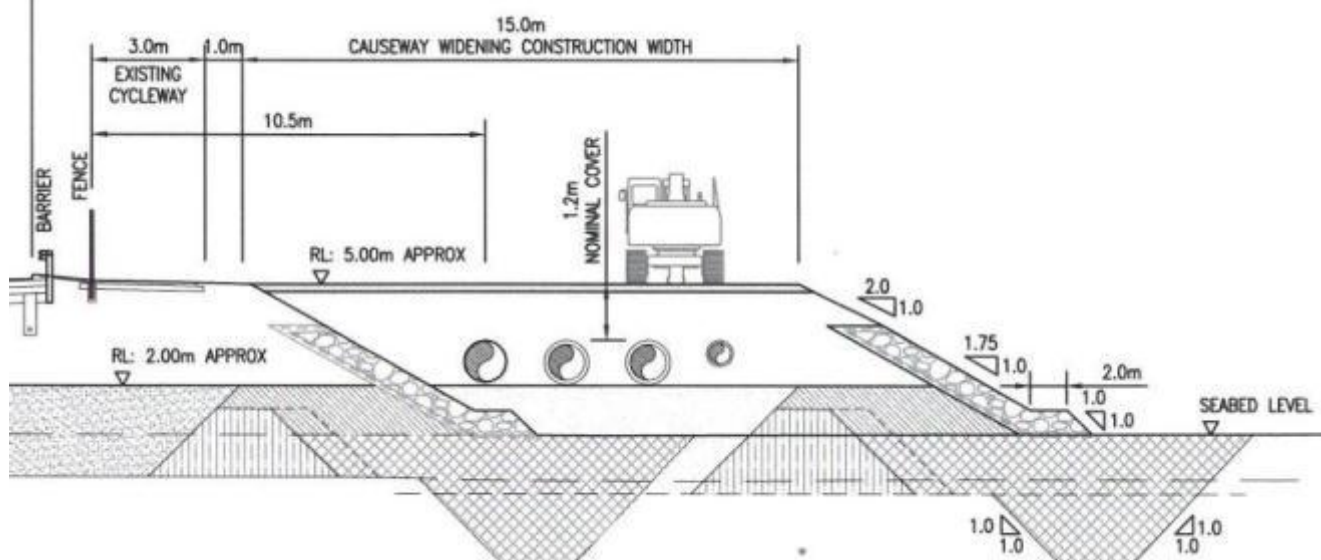
The shape and dimensions of the proposed causeway widening (including the construction platform for the NI project) and length extension are shown on Drawing 2010673.007 in Volume 3.

In order to accommodate the proposed watermain and NI pipelines, the existing SH18 causeway will be widened along the northern side by approximately 15m from the edge of the existing shared path (top of the embankment) for a length of approximately 860m. A typical cross-section of the causeway widening is shown in Figure 2-6 below.

The widening proposed is the minimum necessary for the installation of the pipelines and associated construction activity, while avoiding the utility services corridor in the existing section of causeway. In the first instance it is proposed that the causeway widening will largely follow the top level of the existing cycleway at

approximately 4.5m – 5.5m RL. It may, however, be possible to lower the level of the widened section of causeway, or parts of it, while still accommodating the existing stormwater culverts, the proposed new watermain and NI wastewater pipes as well as making adequate provision for storm surge effects and sea level rise. The feasibility of varying the height of the causeway will be confirmed as detailed design of the GBWD and Causeway project progresses. The causeway embankment will be constructed at a gradient of approximately 1.75:1, reaching a height of up to 5m above the existing seabed level. Drawing 2010673.007 in Volume 3 shows both the top and toe of the embankment.

Figure 2-6: Causeway widening - typical cross section of completed causeway



At its western end, the causeway will integrate with a small peninsula of land over a distance of approximately 40m; this is referred to as the 'western embayment'. This is shown on Drawing 2010673.007 in Volume 3 and will allow for a construction access area to be established to the west of the causeway.

As part of the causeway widening, a construction platform will be established approximately 600m from the western end of the causeway (refer Drawing 2010673.007). This platform will provide an additional area of approximately 150m long by 53m wide (to the top of the embankment). The platform will enable construction of sections of the NI pipelines which, in Phases 1 and Future Phases of the NI project, are expected to extend north and east respectively under the harbour from this point. The platform is also necessary to provide adequate cover for the NI pipelines as they transition downwards from the causeway to below seabed.

At its eastern end, the causeway will be extended to the point at which the new watermain is able to transition up onto the Greenhithe Bridge. The length of the causeway extension has been designed to accommodate the new watermain, the pipe transition structure, and allow access to the causeway-to-bridge watermain transition during construction and operation. The requirement for the pipe transition structure under the bridge means that the width of the extension will be approximately 24m (top surface). As the extension will be constructed in deeper water compared to the majority of the causeway widening, more significant embankments are required. The embankments will be constructed at a gradient of approximately 3:1, reaching a height of approximately 9m above seabed level. Drawing 2010673.007 in Volume 3 shows both the top and toe of the embankment. The top level of the extended causeway will be approximately 1.3 to 2.3metres lower than the widened causeway and have a finished level of 3.2m RL.

The materials and makeup of the widened and extended causeway will largely replicate that of the existing causeway construction. In total, the additions to the causeway will cover an area of approximately 17,000m² (at surface level) and 25,000m² (at sea bed level). The volume of materials used will be approximately 97,000m³; comprising approximately 5,500m³ landward of the current CMA and approximately 91,000m³ in the CMA. As the causeway widening will be located on an area of weak marine sediments, the area under the causeway

widening will be stabilised. Stabilisation is likely to be carried out by constructing shear keys, or by way of in-situ stabilisation.

To service the watermain at the bridge abutment, an all weather accessway is proposed which will be constructed in concrete. Once constructed, the causeway will be used on an ongoing basis to access, operate and maintain the GBWD and NI water and wastewater assets. In addition, opportunities for enhancement of the causeway (as public open space, providing additional coastal access and amenity) have been identified in Section 6 of this AEE. The final form of causeway enhancements is yet to be confirmed. The proposed enhancements and a number of opportunities for future improvements are shown on the Indicative Landscape Coastal Plan (Volume 2, Technical Report I Landscape and Visual Assessment) as contained in Volume 3 Drawings. The future ownership of the causeway will be confirmed through a process set out in the Marine and Coastal Area (Takutai Moana) Act 2011. This process will include discussions between Watercare and the Crown, mana whenua and Auckland Council and NZTA to determine future interests in, and management of, the widened and extended causeway.

2.3.5.1 Stormwater Outfall Extensions

The existing causeway incorporates two stormwater drainage systems that are owned and operated by the NZ Transport Agency, and which drain SH18 and the low-lying tidal area between SH18 and Hobsonville Point. These drainage systems comprise several stormwater pipes and will need to be modified when the causeway is widened. The existing stormwater pipelines and the proposed extensions are shown on Drawings 2010674.002 – 004 and Drawings 2010674.030 – 032 in Volume 3.

The first drainage system consists of four single pipe culverts (375mm to 525mm nominal diameter) which drain stormwater from the SH18 road surface. To accommodate the widened causeway and the new watermain/NI pipelines, the level of these culverts will be lowered, and extended to new outfalls on the causeway embankment.

The second stormwater system in the existing causeway comprises low level box culverts which discharge to the CMA at sea level. These culverts will be extended below the widened causeway and new outlet structures will be constructed in the toe of the causeway embankment. These will replicate and replace the existing outlets.

The pipeline extensions will maintain the capacity of the existing stormwater systems. Erosion protection will be installed around the outlets as required using rip-rap aprons, an example of which is shown in Figure 2-3.

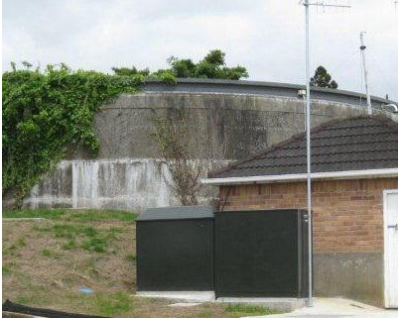
2.3.5.2 Corrosion Protection (Cathodic Protection)

The short section of watermain in the causeway will require to be protected from corrosion by a combination of pipe wrapping with plastic tape and the use of cathodic protection (CP). Cathodic protection is achieved by placing a magnesium (or similar metal) “anode” in a trench underground, and connecting the anode electrically to the watermain. The anode corrodes in preference to the steel watermain, thus protecting the main. The NH1 watermain already has cathodic protection but the NH2 will require to be isolated from the NH1 watermain and may have its own separate, temporary CP protection until the remainder of the NH2 watermain has been constructed. The temporary anode bed is below ground and will be placed within the causeway as shown on the sketch below. There may be a small box (no more than 1 m high) mounted above ground level to allow for the testing of the anodes. The box will be located to be unobtrusive and be combined with the control cabinets for the valve chamber where possible.

2.3.5.3 Equipment Control Cabinets

The valve chambers contain electrical equipment to control the valves. The equipment needs to be monitored through a radio control system and therefore require a surface mounted control box at each valve chamber. The box is approximately 1.5m long and 0.5 m deep and up to 1.5 m high. It is typically painted green as exemplified by the two boxes shown in Figure 2.7

Figure 2-7: Example of control cabinet – (NB two shown in this photo, only one required at each site for NH2)

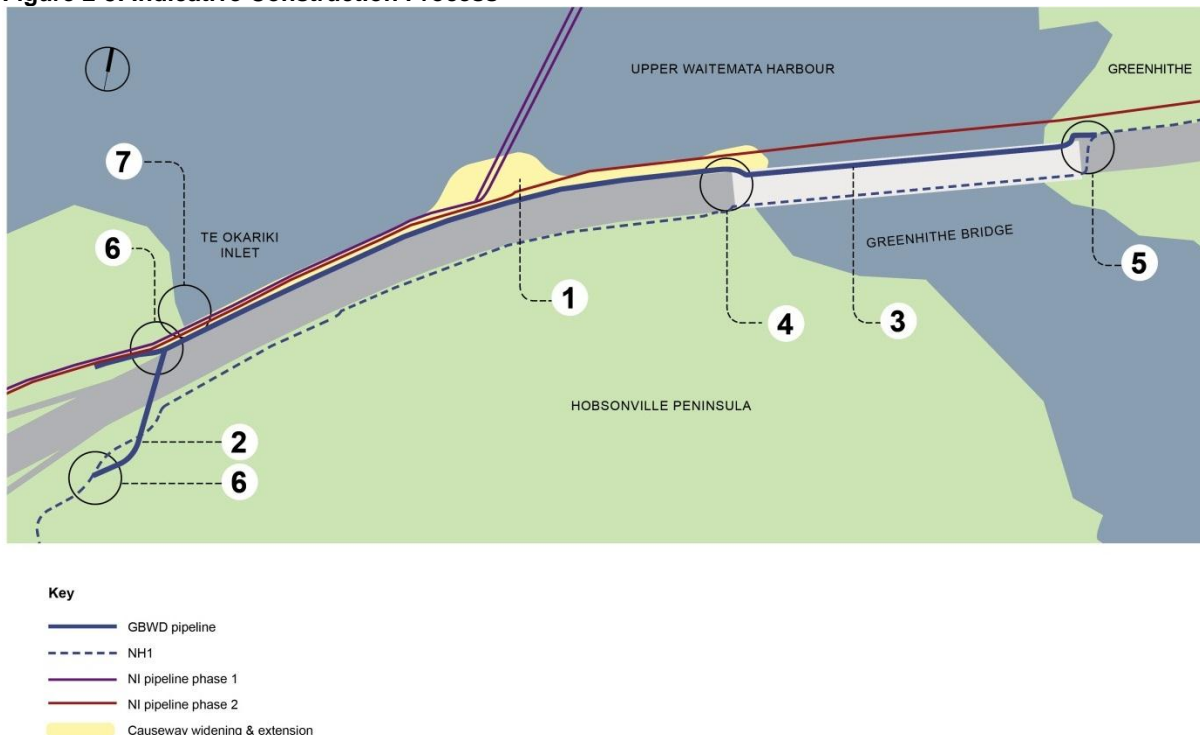


2.3.6 Construction of causeway including pipe installation

The proposed methodology for construction of the new watermain and causeway is summarised in the following sections, split into the seven key elements of the project as shown in Figure 2-8 and based on the possible construction sequence summarised below. Some activities may be able to be conducted in parallel (such as items 3 and 6):

- 1) Causeway widening and extension and installation of new pipes within the causeway;
- 2) Connection pipe between NH1 and the new watermain – west end;
- 3) New watermain placement on the Greenhithe Bridge;
- 4) Watermain transition structure at the west end of the Greenhithe Bridge;
- 5) Connection between NH1 and the new watermain – east end;
- 6) West end valve chambers; and
- 7) Scour chamber.

Figure 2-8: Indicative Construction Process



A number of components of the project have multiple methodologies available for construction. Where this is the case, potential options are described below. The proposed methodology will be finalised once a contractor has been appointed. At that time, a detailed Construction Management Plan (CMP) will be prepared which confirms the detail of the proposed works and management controls. The CMP will be submitted to Council

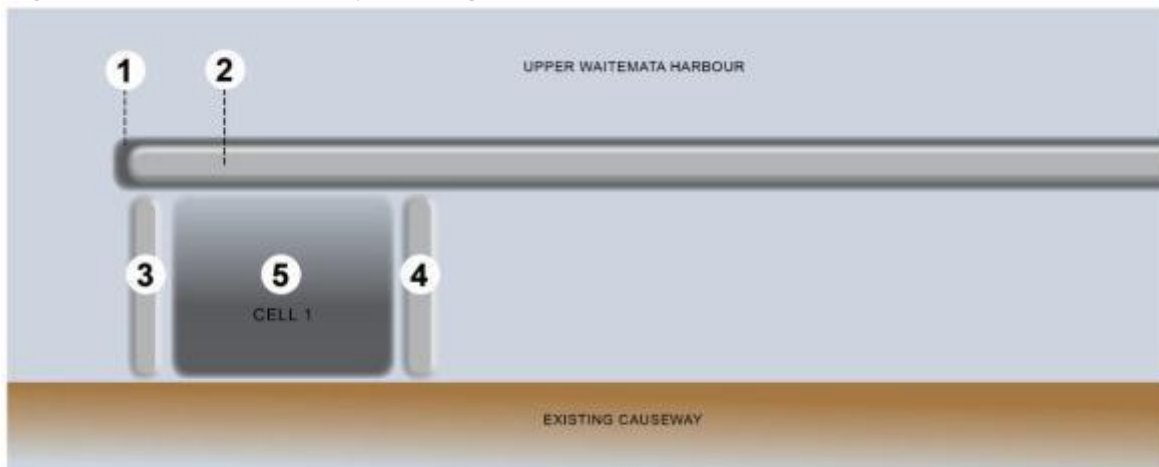
prior to construction. The assessment of potential effects in Section 6 of this AEE is sufficiently broad to address effects from different construction methodologies.

2.3.6.1 Causeway widening and extension and pipeline installation

The existing causeway will be widened and extended as described below. Drawings 2010673.852 – 855 (Volume 3), show typical cross-sections for the causeway widening and extension. This design is largely a replication of the previous causeway extension undertaken in 2005.

The causeway widening will be constructed in cells, which create areas that are separated from coastal waters, with construction activities being undertaken within a single cell at any given time. The majority of cells will be constructed in a series of steps that are marked by numbers in Figure 2-9 and set out below.

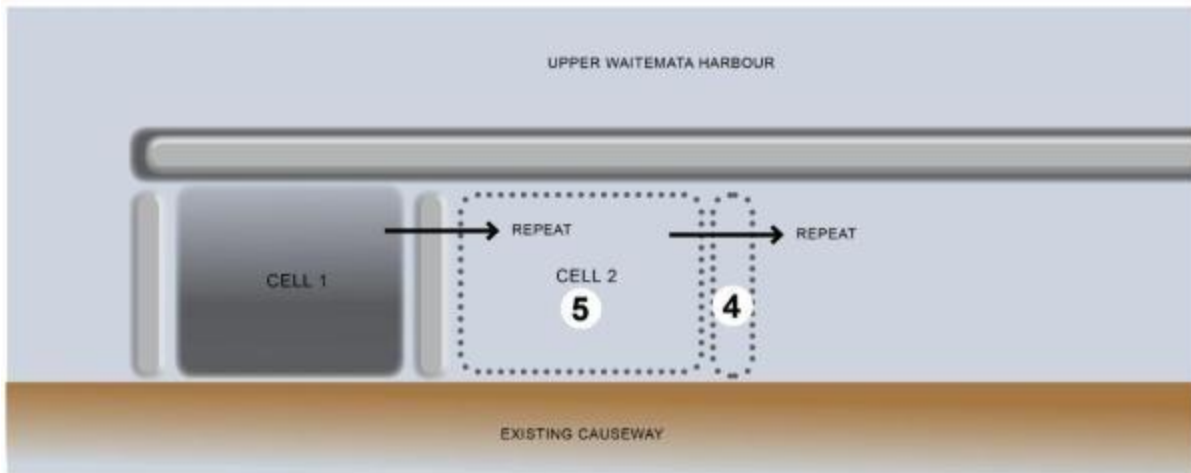
Figure 2-9: Indicative causeway widening construction process (construction of a cell)



- 1) Silt curtains will be installed around the proposed causeway widening to retain sediment within the works area (refer Drawing 2010674.040). During low tides, an amphibious excavator will work to dig a trench parallel to the coast in the location of the proposed toe of the batter for the length of the causeway (this work may be completed in sections). A cross-section of the trench will be trapezoidal (as shown on Drawings 2010673.852-855) with a width of approximately 2-3m at the base and 6m at the top. A trench shield will support the weak marine muds, and the trench will be immediately filled with rock, mudcrete, or lime cement mixing (LCM) - injection of lime cement powder into the coastal floor to strengthen sediments.
- 2) During subsequent low tides, the area above the trench will be built up with rocks to causeway level creating a bund parallel to the coast. The top surface of the bund will be of a sufficient width for construction vehicle access.
- 3) To enclose each cell, piers will be constructed perpendicular to the causeway, connecting the bund to the coast. Formation of the piers may require some excavation/stabilisation of soft sediments so that the causeway has a suitable base, or the piers may be constructed directly on the sea bed. These piers will be formed using the same method as the parallel bund (building trapezoidal bunds up above the sea bed using rock and engineered fill). Once complete, the parallel and perpendicular bunds will create a series of cells.
- 4) Once each cell is formed, soft sediments in the interior of the cells may be excavated/stabilised so that the causeway has a suitable base, or the causeway may be built directly on the seabed. Engineered fill will then be imported, placed in layers and compacted to form the causeway. Until complete, the water level in the interior of the cells will be controlled by pumping as required to prevent inundation from sea water and stormwater outfalls. On completion of each cell, rock armouring will be applied to the batter slope and the silt curtain will be removed.

The process described above will be replicated along the causeway widening as shown in Figure 2-10 in a sequence to be determined by the contractor.

Figure 2-10: Indicative causeway widening construction process



The causeway widening construction methodology described above is similar to that which is currently being employed on the State Highway 16 Causeway extension project between Waterview and Te Atatu. Figure 2-11 and Figure 2-12 below show the causeway extension under construction.

Figure 2-11: State Highway 16 causeway extension, showing causeway cells in construction to the right of the highway

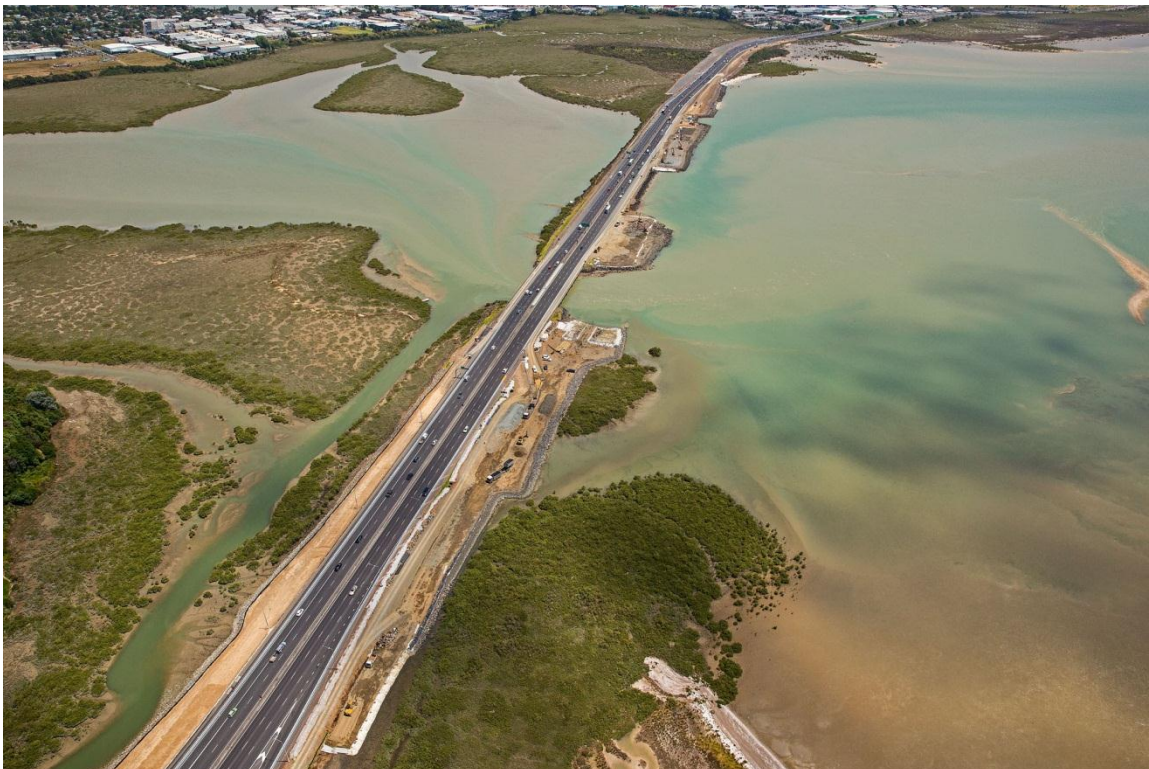
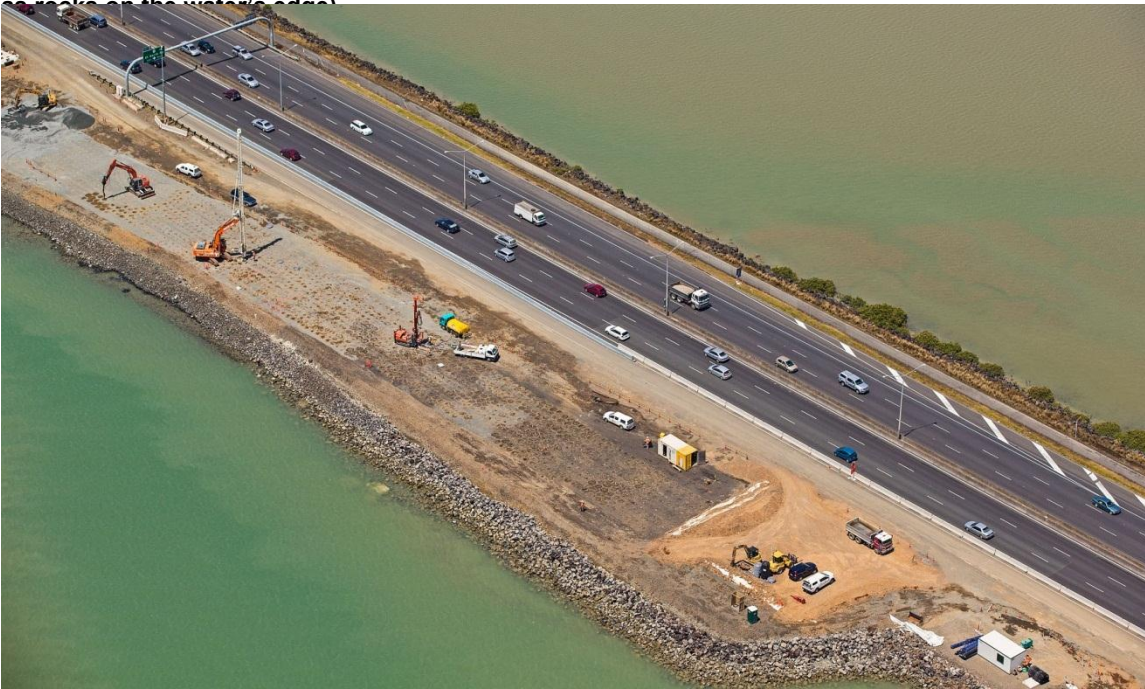


Figure 2-12: State Highway 16 causeway extension - showing work to fill the interior of a cell (exterior bund shown on the water's edge)



Construction of the causeway extension will be undertaken by 'end-tipping' at the eastern end of the causeway as the water in this location is too deep to use the construction method described above. End-tipping gradually builds outwards from the end of the causeway by depositing rocks into the sea. This is done by reversing trucks to the end of the causeway to deposit the rocks and then using excavators to place and arrange the rocks. In this way, the causeway is extended bit-by-bit and the truck and excavator can move out onto the newly formed causeway to continue work. Detailed design of the causeway extension will specify the rock sizes required for the stability of the causeway and to avoid adverse effects on the Greenhithe Bridge structure as the rocks are being deposited.

End-tipping is a common construction technique and has been used on similar projects. Figure 2-13 and Figure 2-14 show end-tipping being employed on the Machans Beach Seawall project in Queensland, Australia.

Figure 2-13: End-tipping used on the Machans Beach Seawall (source: <http://mangrovecreatures.blogspot.com.au/2014/11/constructing-machans-beach-seawall.html>)



Figure 2-14: End-tipping used on the Machans Beach Seawall (source:

<http://mangrovecreatures.blogspot.com.au/2014/11/constructing-machans-beach-seawall.html>)



The new watermain and NI pipelines will be installed following construction of the causeway reclamation. The pipes will be installed by open trench within the causeway and the potential construction effects associated with pipe installation (particularly sediment control) are addressed in Section 6 of this AEE.

Causeway construction is expected to take approximately 14 months. Construction of the widening and extension will be carried out in a sequence that will be determined by the contractor. A construction yard may be formed to the west of the proposed causeway widening, as shown on Drawing 2010673.008 in Volume 3. The construction yard will be a levelled area, providing for construction support such as parking, lay-down of materials and temporary site offices. Construction access may be gained from the proposed construction access road at the western end of the causeway (refer Drawing 2010673.008) and/or directly from the highway, these options are discussed further in Technical Report F Traffic Assessment Report in Volume 2. Additional construction support facilities/equipment including water tanks, cranes and site offices may be located on the shared path or widened causeway. Disruptions on the shared path will be avoided where possible, but where construction activities require use of the shared path, alternative cyclist and pedestrian access along SH18 may be provided. Where alternative access is required, safety controls such as security gates and barrier systems will provide sufficient separation of construction activity and public users. This is discussed further in Technical Report F Traffic Assessment Report (Volume 2).

2.3.6.2 New Watermain to NH1 pipe connection – west end

The pipe connecting the new watermain to NH1 at the western end of the causeway will be pipe-jacked under SH18 between temporary driving and receiving pits. The driving and receiving pits will be located north and south of SH18, within the widened causeway and adjacent to Station Street respectively (locations shown on Drawing 2010674.005 in Volume 3).

The rectangular shaped driving pit on the northern side will measure approximately 5m wide x 4m long x 4m deep, and will likely be constructed using sheet piles vibrated into the ground. A water-tight reinforced concrete structure is likely to be required for the receiving pit on the southern side because the depth of the connecting pipeline on this side is approximately 11 – 12m (refer Drawing 2010674.005).

Once the interior of the pits has been excavated, a 1200mm diameter concrete pipe will then be driven from the driving pit to the receiving pit (determination of which pit is to be used for driving and receiving will be made by the contractor prior to construction, but the driving pit is likely to be on the northern side). Spoil removed from the pits and the pipe will be either stockpiled on site for use in the causeway widening or transported to an appropriate disposal location.

On completion of the pipe driving, the driving pit will be extended to approximately 10m in length to accommodate 12m long, 800mm diameter steel pipes which will be inserted through the 1200mm concrete

pipe. The steel pipes will be joined while in the driving pit and then pushed through. After the steel pipe installation is complete, the void between the concrete and steel pipes will be grouted with concrete.

Each pit will also have a work area around it to accommodate delivery vehicles, precast units and general access. The receiving pit work area will measure approximately 10m x 20m and the driving pit area will be approximately 15m x 20m. The work area located to the south of SH18 will require earthworks to create a level surface and an access track within the planted batter enabling access via the Squadron Drive westbound off-ramp and/or Station Street. The original ground level will be reinstated following completion of the works. Access to the work area north of SH18 will be gained via the construction access area at the western end of the causeway or directly from the highway.

This element of the project is expected to take approximately four months and maybe done in parallel with other work.

Construction of the valve chambers that will house the connections with NH1 and the new GBWD is described in section 2.3.4.6 below.

2.3.6.3 New Watermain Connection to the Greenhithe Bridge

The new watermain will be attached to the Greenhithe Bridge from the bridge itself (i.e. no access is required from the harbour). Two options are being considered for constructing the pipe on the bridge; these are described as follows and will be confirmed by the contractor.

Both options would take approximately eight months.

Option 1: Launch the pipe downhill from the eastern end of the Greenhithe Bridge

This option would involve installing the pipe brackets using a mobile under-bridge access unit (as shown below in Figure 2-15). Once the brackets are installed, the pipes will be launched from a 'launch-bay' that will be constructed at the eastern end of the bridge to accommodate 1.5 pipe lengths (each pipe length is approximately 12m). One pipe at a time will be welded to the next within the launch-bay and pushed through onto the brackets, gradually extending towards the western end of the bridge.

Figure 2-15: Example under-bridge access unit (shown here undertaking inspections on the Greenhithe Bridge)



Option 2: Install pipe piece by piece using overhead access

A moveable scaffolding system will be constructed to provide access to the top and bottom of the bridge superstructure. This scaffolding will provide access to approximately 25m of the bridge at a time, which will allow for three brackets and two sections of pipe to be installed before the scaffolding is moved along the bridge. Figure 2-16 shows an example of the moveable scaffolding that may be used.

Figure 2-16: Example of movable scaffolding used on a similar project (the Khyber Pass Viaduct)



Installation of the new watermain from the scaffolding will involve connecting the brackets to the box girder using threaded steel rods. Each bracket will be lowered into position from above by a hydraulic arm mounted on a truck. The sections of pipe will then be lowered onto the brackets in the same way and welded together.

2.3.6.4 New Watermain Transition Structure (west end of Greenhithe Bridge)

A reinforced concrete or structural steel transition structure will be formed on the causeway beneath the western end of the bridge to support the transition of the new watermain from the causeway to the bridge.

The transition structure (shown in Figure 2-4) will be constructed near the eastern extent of the extended causeway on a foundation of rock. Three piles will be installed, each with a permanent casing to prevent pile hole collapse during construction and assist in protecting the structure from corrosion. A thrust block within the transition structure will be formed on the piles from a combination of cast in-situ concrete, steel, and precast concrete elements brought to site by trucks.

This element of the project is expected to take approximately six months.

2.3.6.5 New Watermain to NH1 pipe connection – east end (Greenhithe)

At the eastern end of the Greenhithe Bridge the new watermain will be constructed adjacent to the NH1 pipeline and connections between the pipes will be made within a valve chamber at the eastern end. The valve chamber will measure approximately 6m x 4m and 3.5m deep.

The valve chamber will be constructed around the existing NH1 pipe. A 20 tonne excavator will be used to form a pit for the valve chamber. The sides of the pit will be supported during construction using sheet piling or trench shoring. The chamber will have a cast in-situ concrete base and the walls will be either cast in-situ or precast concrete (with poured concrete used to stitch the the precast units together). Figure 2-17 and Figure 2-18 provide examples of these construction techniques.

Figure 2-17: Construction of a cast in-situ concrete base



Figure 2-18: Assembly of pre-cast concrete walls (example from existing stormwater chamber adjacent to the causeway)



Valve fitting, connections between pipes and associated works will be completed within the chambers. The final connections of the NH1 and the new watermain will only be made after installation of the whole length of the new pipeline. Once works within the chambers are complete a precast concrete lid will be fitted to each chamber. Backfilling around the chamber walls and removal of sheet piling/trench shoring will also occur when structural works are complete.

The grassed area to the north of the existing shared path will provide a laydown and works area for construction of the chamber. Access to the works area will be confirmed by the contractor prior to construction. Options for access are described in Technical Report F – Traffic, attached in Volume 3; vehicle access may involve:

- Temporary closures, full closures during periods of low traffic flow, or reconfiguration of the Tauhinu Rd off-ramp to provide access to the works area from the off-ramp via the shared pathway; and Traffic movements from the SH18 east-bound crawler lane, through a break in the barrier to the shared pathway, while blocking the shared pathway using a gated system for construction vehicles to cross into the works area; or
- Diversion of the shared pathway to a dedicated lane using the SH18 crawler lane with barriers and fencing for safety protection; or
- Use of attenuators to facilitate construction traffic movements to and from the highway.

This element of the project is expected to take approximately seven months.

2.3.6.6 New watermain to NH1 pipe connection – west end (Hobsonville)

Valve chambers will be constructed within the driving and receiving pits (described above in section 2.3.4.2) to house the connections to NH1 and the new watermain. The chamber will measure approximately 4m long x 5m

wide x 3m deep. To the south of SH18 (around NH1) the chamber will measure approximately 4m long x 3m wide x 3.3m deep.

The chambers will be constructed in a similar manner to the east end valve chamber described in Section 2.3.4.5 above. This element of the project is expected to take approximately four months.

2.3.6.7 Scour chamber

The NH1/new watermain scour chamber will be installed along-side the valve chamber to the north of SH18 described in Section 2.3.4.6 above. The scour chamber will be a 2550mm diameter manhole (see Figure 2-2). Two pipes will connect to the scour chamber. The first will link to the pipe which connects NH1 and the new watermain and the second will provide an outlet to the CMA. A reinforced concrete headwall structure will be installed at the outlet with a combination of precast and cast in-situ elements, and a rip-rap apron will be installed to protect against seabed erosion.

2.3.7 NI construction related issues

The proposed causeway widening along the northern edge of the SH18 motorway corridor includes provision for the new Greenhithe Bridge watermain and the NI Phase 1 and NI Future Phases pipelines.

From the widened causeway, the NI pipelines will cross the harbour to reach the Greenhithe foreshore, from where they will continue to the Rosedale WWTP.

The harbour crossing section of the NI pipeline will be constructed either by Horizontal Directional Drilling (HDD) under the seabed, or by trenched construction methods in the seabed. Resource consent is being sought for both construction methods.

Watercare will confirm the proposed construction method for the NI Phase 1 harbour crossing once the preferred contractor is appointed. The decision on which option to pursue will be based on the availability of specialist plant and contractors, the contractors proposed environmental and construction management techniques, and cost.

2.3.7.1 Land-based requirements at Hobsonville

The land-based requirements for the HDD and the trenched construction methods for NI Phase 1 are markedly different on the Hobsonville side of the harbour. In particular:

- The HDD method requires additional localised work around the mid-point of the widened causeway to create a construction platform from which to set up the drilling rigs and achieve the required cover for the pipeline before it enters the seabed;
- The trenched construction method can be undertaken from the eastern end of the widened causeway, without the need for an additional construction platform.

These key differences are indicated in the Figures 2.19 and 2.20 below:



Figure 2.19 Directional drilling



Figure 2.20 HDD

A further notable difference is that the trenched option would require extension of the NI Phase 1 pipeline to the eastern end of the widened causeway. The proposed widening of the causeway by 15 metres is already required in order to construct the watermain. The extension of the NI Phase 1 pipeline can be accommodated within that proposed land area, without the need for further widening.

2.3.7.2 Allowance for a further harbour crossing for the NI Future Phases

The NI Future Phases will also require a harbour crossing between the widened causeway and Greenhithe. It is currently envisaged that this would be required in around 15 – 20 years.

The future harbour crossing could also be constructed by HDD or trenched construction methods. At this stage it is envisaged that HDD is more likely. As the work is still many years away, it is not included in the current resource consent applications.

If the confirmed construction method for the NI Phase 1 harbour crossing is HDD, and therefore a construction platform is required, this same construction platform could also be used for the NI Future Phases harbour crossing if it is constructed by HDD. This possibility is envisaged in the current concept design for the NI Phase 1 construction platform.

If the confirmed construction method for the NI Phase 1 harbour crossing is trenching, then the construction platform is not required and would not be built as part of the current proposed works. The land-based construction requirements for the NI Future Phases harbour crossing would be assessed and consented at that time.

2.3.7.3 Assessment of effects and proposed mitigation

Watercare's overall design objective for the causeway widening and construction platform will be to contain the footprint to the minimal practicable area (and therefore to minimise the associated cost and potential environmental effects), whilst providing for an efficient and practical layout for construction activities and permanent works.

The technical assessments which support the consent applications have assessed the effects of both harbour crossing methods as they pertain to the associated land based and causeway widening construction requirements. An indicative landscape concept plan has been prepared for the proposed causeway widening both with the additional construction platform (associated with HDD) and without the construction platform. Ecological mitigation measures are also incorporated within those indicative landscape concept plans.

The proposed causeway widening along the northern edge of the SH18 motorway corridor includes provision for the new Greenhithe Bridge watermain and the NI Phase 1 and NI Future Phases pipelines.

From the widened causeway, the NI pipelines will cross the harbour to reach the Greenhithe foreshore, from where they will continue to the Rosedale WWTP.

The harbour crossing section of the NI pipeline will be constructed either by Horizontal Directional Drilling (HDD) under the seabed, or by trenched construction methods in the seabed. Resource consent is being sought for both construction methods.

Watercare will confirm the proposed construction method for the NI Phase 1 harbour crossing once the preferred contractor is appointed. The decision on which option to pursue will be based on the availability of specialist plant and contractors, the contractors proposed environmental and construction management techniques, and cost.

2.3.8 Construction management

The overall construction timeframe for the GBWD and causeway is expected to be approximately 18-24 months. The construction programme has been developed to allow elements of the works to be completed in parallel where possible and is summarised in Figure 2-21.

Figure 2-21: Indicative construction programme

Task	Work Duration - Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mobilisation (and pre-mobilisation)	■	■	■	■																				
Causeway widening and extension and installation of new pipes					■	■	■	■	■	■	■	■	■	■	■	■	■	■						
Connection pipe between NH1 and new watermain – west end							■	■	■	■														
New watermain connection to the Greenhithe Bridge												■	■	■	■	■	■	■	■					
Watermain transition structure at the west end of the Greenhithe Bridge													■	■	■	■	■	■	■					
Connection between NH1 and new watermain – east end														■	■	■	■	■	■	■	■			
West end valve chambers										■	■	■	■	■	■	■								
Scour chamber														■	■	■	■							
Commissioning																						■	■	■

This construction timeframe includes the watermain duplication and causeway works, and includes elements of the NI project as shown on Drawing 2010673.006 (Volume 3). As shown on the drawing, three NI wastewater pipelines will be installed in the widened section of causeway. This will enable future construction of the NI harbour crossing. Construction of the NI harbour crossing is outside of the scope of this application, but is likely to commence at the end of this construction programme to avoid conflict with the watermain duplication and causeway works.

The management of potential construction effects on the community and environment have been an integral part of identifying the construction methodology described above. Once a contractor is appointed, and prior to the start of the main construction programme, a construction management plan (or plans) will be prepared to set out the detail of the proposed construction methodology, sequencing and the measures to be taken to further minimise potential adverse effects.

Work will mostly occur during normal work hours but some after hours, night work or work on weekends may be required for various reasons including (but not limited to) the following:

- (i) Need to work efficiently between tidal cycles to access the site for temporary and permanent works;
- (ii) The driving of the 1200 mm pipe jack under the SH on the western side is likely to be a 24 hour 7 day a week operation to minimise risks of hole collapse. The majority of the work will be below ground level which will mitigate noise effects however the removal of excavated material by truck may need to continue at night;
- (iii) Work off the motorway for access either for construction reasons or if required by the motorway owner. In this case out of rush hour times or night work maybe required (depending on the contractor's construction methodology and site requirements); and /or
- (iv) On occasions some parts of the work may need to continue after hours to minimise the risk to the construction. Examples are completion of work activity such as piling (bored or driven) to complete a coffer dam or drill to depth to minimise groundwater effects.

The construction management plan will address the potential environmental effects of the GBWD and Causeway construction including, amongst other things, the following matters:

- Erosion and sediment control;
- Dust management;
- Construction noise and vibration management;
- Archaeological/cultural protocol for sites found or disturbed during construction;
- Coastal bird management protocols;
- Traffic management; and
- Soil management.

3. Description of the Existing Environment

3.1 Physical Environment

3.1.1 General Route Description

The GBWD and Causeway Project will be located within road reserve, CMA and private property along and adjacent to a 1.5km section of SH18, including the Greenhithe Bridge. Within the motorway reserve, the western extent of the GBWD and Causeway is adjacent to Station Rd in Hobsonville Point, and generally extends east along the motorway to approximately 100m east of the Greenhithe Bridge. The eastern and western project extents are shown on Drawing 2010673.006 in Volume 3.

As described in Section 2 of this AEE, the existing SH18 causeway will be widened along the northern side into the CMA by between approximately 15m and 52m and extended at the eastern end by approximately 100m. There will be a localised widening of the causeway to allow for the future construction of the NI pipelines. The proposed causeway widening and extension is shown on Drawing 2010673.007 in Volume 3.

3.1.2 Summary of Land Uses

A number of different activities and land-uses are present in the GBWD and Causeway project area and surrounds, including:

- The SH18 motorway corridor and associated utility corridor;
- Local roads within Hobsonville Point and on the northern end of Squadron Drive;
- Coastal marine area in the Upper Waitemata Harbour with a range of characteristics such as tidal mangrove habitats, coastal cliffs and mooring areas;
- Areas of vegetation are located adjacent to the coast in several locations, including the existing causeway embankment and the coastal cliffs at the eastern end of the Greenhithe Bridge;
- A retirement home (Summerset at Monterey Park) is located at the northern end of Squadron Drive and is currently being constructed;
- A dwelling is located to the east of Summerset at Monterey Park; and
- Residential areas are located around the project area in Hobsonville Point and Greenhithe. Significant residential development is currently occurring in the Hobsonville Point area. Currently, the closest residences are located on Station Street, approximately 15m from the location of the proposed NH1-GBWD cross connection valve.

3.1.3 Geology

The Greenhithe Bridge approaches are underlain by the East Coast Bays Formation (Waitemata Group), overlain along the western approaches by Pleistocene aged fine grained alluvial deposits, with occasional peat lenses of the Puketoka Formation (Tauranga Group) and recent shallow marine sediments.

Shallow surficial marine and estuarine mud generally in the order of 0.5m thick, but locally up to approximately 2.3m thick, is encountered along the causeway overlying the shore platform.

The original causeway (constructed in 1973) is constructed from fill comprising up to 5.5m of soft to very stiff clay and silt fill with rock riprap armouring along the outer edges. The northern widening to the causeway carried out in 2005/06 comprises engineered fill which includes a granular or cement stabilised shear key along the northern edge, sands, and mudcrete fill overlain by silts and clay material.

3.1.4 Contaminated Land

Historic aerial photos and Council records were reviewed for evidence of contamination in the project area. Aerial photography indicated that key historical activities in the project area included farmland, road development and the Hobsonville Air Base. Council records have not revealed any evidence of contaminated discharges (pollution incident files or contaminated discharge consents) occurring on or near the project footprint.

Testing of sediments, soils and groundwater within the project footprint was carried out to determine whether these may have become contaminated from run-off from surrounding land uses. This testing showed:

- Soil contaminants were below the Soil Guidance Values (SGV) of the NES (for commercial and industrial land use) and below the Schedule 10 criteria (ACRP:ALW) and, for most organic parameters, below the laboratory limit of detection.
- Sediment contaminants were also below the SGV, Schedule 10 criteria and ANZECC ISQG-Low Trigger criteria. Marginally elevated concentrations of arsenic and the organic parameter benzo(a)pyrene were recorded in the sediment when assessed against the Auckland background soil concentrations for non-volcanic soils.
- Groundwater contaminants were below the ANZECC Freshwater and Marine water quality guidelines, for 95% level protection of species, as specified in the permitted activity criteria in the ALW Plan.

Based on the above, the site is not considered to be contaminated land as defined in the ACRP:ALW. Further information on the contaminated land investigations is included in Technical Report B Soil, Sediment and Groundwater Contamination in Volume 2.

3.1.5 Groundwater

Groundwater investigations were undertaken in the project area during 2014 and a detailed description of the hydrogeology is contained in Technical Report C Groundwater in Volume 2. Key elements of the hydrogeology of the project area include:

- Groundwater flows regionally towards the harbour where it discharges, and locally towards topographic low points.
- Recharge occurs via rainfall to the shallow groundwater that is hydraulically connected to the Waitemata Group rock aquifer.
- Groundwater levels in the project area were shown to fluctuate up to 0.45m. This fluctuation may be a result of tidal, rainfall and anthropogenic factors and will influence in-flow rates to earthworks in the project area.
- Maximum water levels of 1.85mRL (2.6-3.4m below ground level) were observed at the west end of the Greenhithe Bridge and 22.8mRL (3.8m below ground level) east of the bridge.
- The geology consists of fill material (approximately 7 m thick in the coastal area) overlying the weathered sandstone and siltstone units of the East Coast Bays Formation (ECBF). The unweathered ECBF is encountered at relatively shallow depths (approximately 10 m) and shows evidence of fracturing.
- The hydraulic conductivity (permeability) varies depending on the geological units. Testing in the shallow units (area of interest is less than 10 m depth) shows relatively low hydraulic conductivity values that reflect the geology (sand/silt). The hydraulic conductivity will influence in-flow to excavations in the project area and the zone of influence of any resulting drawdown.

3.1.6 Ecology

Ecology in the GBWD and Causeway project area is discussed in Technical Report D Ecological Assessment, in Volume 2. The habitats in and around the GBWD and Causeway have been modified by development in the

surrounding area, including that of the bridge and existing causeway. Two terrestrial significant ecological areas (SEAs) are identified in the works area under the PAUP, these are:

- SEA_T_3409 - a narrow strip of land along the rocky batter slope of the existing causeway; and
- SEA_T_8319 – a vegetated area north of SH18.

Both areas are identified in the PAUP as having ecological values associated with “Threat Status and Rarity” and “Stepping Stones, Migration Pathways and Buffers” and are shown on Figure 3- 8 and Figure 3-9 later in this section. No SEAs are located with the CMA section of the project area and no Coastal Protection Areas are identified under the Auckland Council Regional Plan: Coastal within the project area.

The intertidal habitat in part of the proposed causeway widening area may also be considered significant as a number of threatened coastal birds are present.

No nationally threatened or at risk species marine invertebrates have been identified in the project area.

In 2014 and 2015, sampling and surveys of several types of flora and fauna were undertaken by the project ecologist in and around the project area, this included:

- Benthic and sub-benthic flora and fauna, and micro-fauna;
- Coastal birds, including banded rail; and
- Vegetation.

The surveys and sampling were also supplemented with ecological information available from Auckland Council monitoring in the area and previous upgrades to SH18. As a result, the following ecology has been identified as relevant to the GBWD and Causeway project:

3.1.6.1 Marine Ecology

Marine intertidal fauna has been identified based on several habitat types including rock wall, mangroves, sandstone reef and pacific oyster beds, firm muddy sand and soft mud. A range of species were present in these habitats including pacific oysters, barnacles, snail species, worm species, amphipods, shrimp species, cockles and whelk species. Several of these species are identified as kaimoana, however, the kaimoana value of the area is generally considered to be low.

Likely fish species in the project area include yellow-eye mullet, striped mullet, speckled sole, yellow belly flounder, New Zealand flounder, goby, and triplefin.

Mature mangroves are present at the western end of the causeway. Neptune’s necklace is present in the sandstone reef habitat.

3.1.6.2 Coastal Birds

Sixteen species of coastal birds have been identified as users of the project area. The diversity of species is considered to be moderate and four species in particular are ‘threatened: nationally vulnerable’ (pied shag, Caspian tern, banded dotterel and red-billed gull). A further six were ‘at-risk’ (pied oystercatchers, pied stilts, white-fronted terns, variable oystercatcher, banded rail, and black shag). The birds observed on site were predominantly using the area for foraging. Banded rail, however, was shown to be resident and to breed within the project area.

3.1.6.3 Terrestrial Ecology

Four vegetation types were identified in the project area during the 2014 site visits:

- Mangroves in the intertidal mudflats;
- Saline vegetation comprising oioi, sea rush and needle grass;
- Native plantings on the causeway embankment; and

- Exotic/native mixed forest on the headlands.

Exotic/mixed forest in the project area may provide habitat for skinks on the coastal private property at the western end of the proposed causeway widening and adjacent to the eastern abutment of the Greenhithe Bridge.

3.1.7 Water Quality/Stormwater

3.1.7.1 Stormwater

Stormwater outfalls within the existing causeway consist of five stormwater culverts (including a twin culvert) and these are proposed to be extended and modified as described in Section 2 of this AEE. The existing culverts were installed as part of the 2005 causeway extension and include stormwater treatment devices in accordance with the former Auckland Regional Council's Technical Publication 10.

3.1.7.2 Coastal Water Quality

Marine water quality was monitored in 2011 at various sampling locations, in particular the Upper Waitemata Harbour (refer State of the Environment, Auckland Council Technical Report 2013/031, July 2013). Hobsonville Jetty is the most relevant sampling location for characterisation of existing marine water quality close to the GBWD and Causeway project area. Low levels of contaminants (Total Suspended Solids, ammonia, nitrate, nitrite, nitrogen, phosphorous) were reported. In addition, enterococci concentrations ranged from 5 to 30 CFU/100mL at Hobsonville Jetty which is a very low concentration when compared to marine water quality and bathing beach standards (source: Ministry for the Environment, 2003). Overall, the water quality in the project area was ranked as excellent for both 2010 and 2011 State of the Environment monitoring rounds. It has been subsequently ranked with a marine water quality index of "Fair" in Auckland Council Marine Water Quality Annual Report, 2013, TR2014/030.

Marine water quality was sampled at four locations on 2 July 2014 and analysed as part of the ecological assessment (Technical Report D Ecological Assessment, Volume 2). Overall the water quality results suggest that the receiving water quality has some nutrient and microbial issues, particularly at Site 1 (refer Drawing A.2, Appendix A in Technical Report D Ecological Assessment, Volume 2) which was located near a stormwater outfall that flows into the harbour. The water monitoring data is summarised as follows:

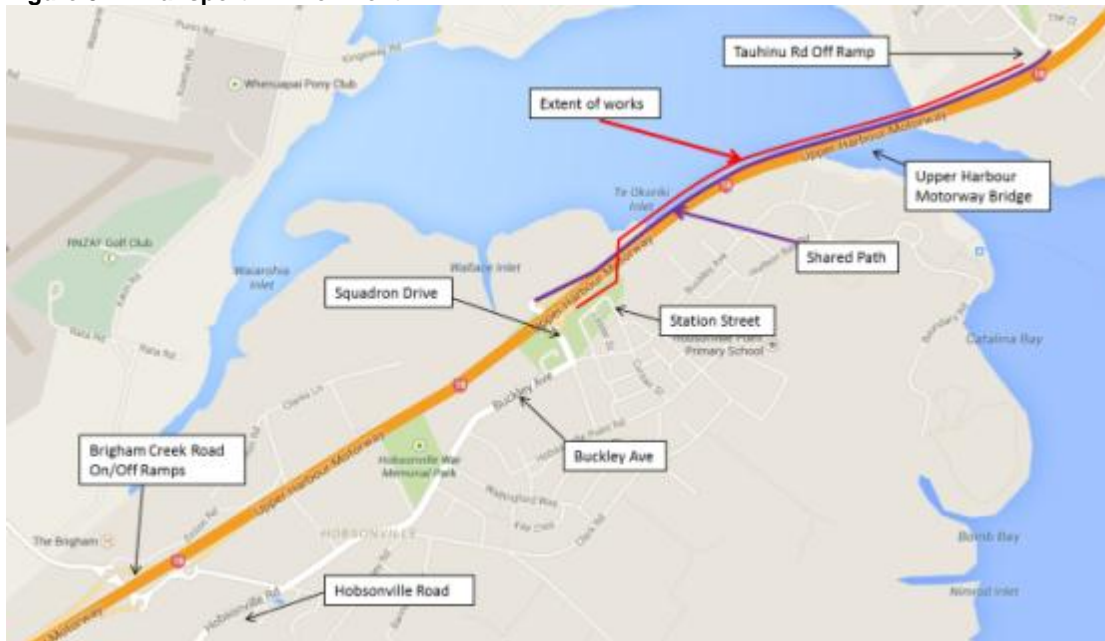
- Dissolved oxygen levels were similar at sites 2-4 and fell within the minimum and maximum ANZECC guideline values for marine systems. Dissolved oxygen levels at Site 1 were slightly lower and fell below the minimum ANZECC guideline (90%);
- Total suspended solids were below the detection limit at Sites 2-4 but were relatively high (34 mg/L) at Site 1;
- Total ammoniacal nitrogen levels were below ANZECC guidelines at all sites. Total nitrogen levels were below ANZECC guidelines at Sites 2-4, Site 1 (1.0 mg/L) exceeded the ANZECC guideline of 0.3 mg/L;
- Total phosphorous levels were all slightly above the ANZECC guideline (0.025 mg/L) at all sites;
- Faecal coliforms and Escherichia coli levels were higher at Site 1 (200 cfu/100 mL) compared to values at Sites 2-4 (24-27 cfu/100 mL). These values were all below the MfE guideline value for Enterococci of 280 cfu /mL (source: Ministry for the Environment, 2003); and
- Total Petroleum Hydrocarbons (TPH) values were below detection limits at all sites.

3.1.8 Traffic Environment

- The proposed works will be undertaken within and adjacent to SH18 between Squadron Dr and Tauhinu Rd. Key elements of the transport environment in this area are shown in Figure 3-1 and include:
- This section of SH18 is the main motorway connection between West Auckland and the North Shore and has a posted speed limit of 100 kph;
- SH18 is two-lanes in each direction with an additional crawler lane, east-bound on the Greenhithe Bridge.

- A shared path (for cyclists and pedestrians) is located along the northern side of SH18 and connects to Squadron Dr and Tauhinu Rd.
- Access to Hobsonville Point and Greenhithe from the motorway is provided from off-ramps at Squadron Dr and Tauhinu Rd respectively.
- Average annual daily traffic volume on the Greenhithe Bridge (east-bound) is 17,800 per day.

Figure 3-1: Transport Environment



Further description of the traffic environment can be found in Technical Report F Traffic Assessment Report, in Volume 2.

3.1.9 Noise and Vibration

Construction noise and vibration from the GBWD and Causeway Project will be most readily perceived by residential properties located near to the project area. These properties (sensitive receivers) are described in Technical Report G Construction Noise and Vibration in Volume 2 and include properties in Hobsonville Point, Greenhithe and the small headland located at the western end of the existing causeway.

The existing noise environment in the GBWD and Causeway project area is heavily influenced by traffic on SH18. The average traffic volume on SH18 in this location is in the order of 37,000 vehicles per day in both directions (2013), of which, approximately 4% are heavy commercial vehicles. For the purposes of the noise assessment it has been assumed that the average vehicle speed on this section of SH18 is equivalent to the speed limit of 100 kph. Traffic speeds will vary across the day as traffic volumes vary across the day, with speeds lower than the speed limit during the peak periods when traffic volumes are the greatest. Therefore this assumption is considered conservative. The perception of noise generated by this traffic from the nearest residential dwellings (on the headland at the western end of the causeway) is reduced to a level of approximately 52 dB LAeq, 24h by the Hobsonville noise barrier, which runs along the north-western edge of SH18 at the western end of the existing causeway.

There will be no noise or vibration effects during the asset operation.

3.1.10 Coastal Processes

The GBWD and Causeway project is located in and adjacent to the Upper Waitemata Harbour (UWH). The UWH is a drowned river valley with basement rock, over which sediments have been deposited. Coastal processes in the project area are summarised below and are discussed further in Technical Report H Coastal Processes Report, in Volume 2.

The project area is a relatively low energy environment dominated by tidal flow concentrations through the narrow channel and wind generated wave conditions on the intertidal flats. The intertidal flats are likely to be depositional areas.

Changes to coastal processes associated with existing development including the existing motorway causeway and bridge include:

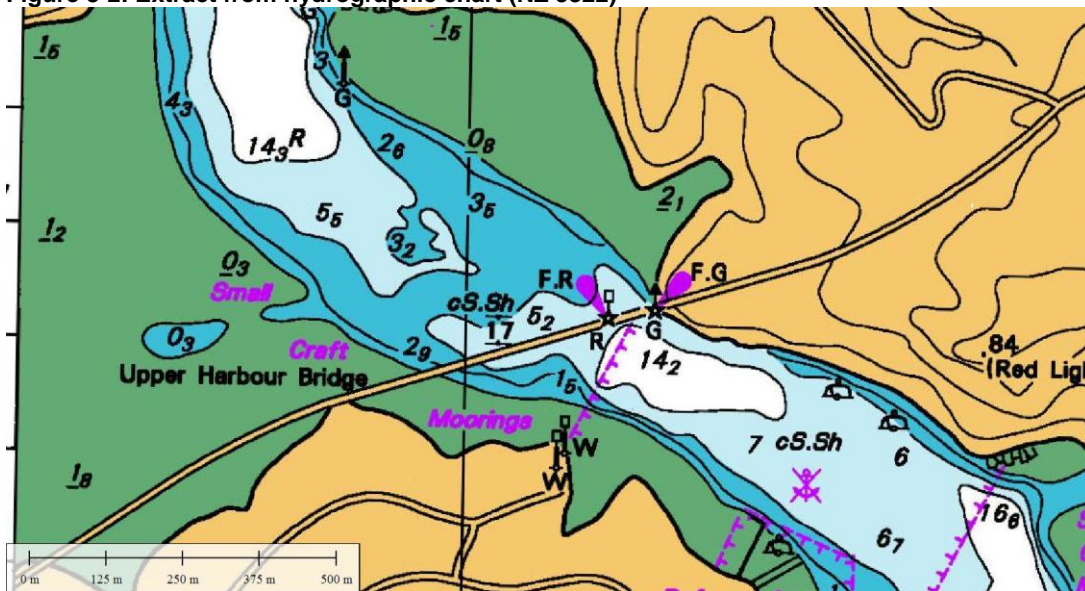
- A minor retreat of the intertidal flat on the southern side of the western bridge abutment;
- Mangrove growth; and
- Development of drainage channels associated with the drainage works through the causeway.

The coastal processes occurring in the project area are influenced by a number of physical environmental features as summarised below.

3.1.10.1 Bathymetry

A hydrographic survey of the project area is shown in Figure 3-2 below. The chart shows a narrow channel, approximately 200m wide beneath the Greenhithe Bridge. Depths in the channel are typically between 5 and 10 m below Chart Datum and extend to 14.2m below Chart Datum. The intertidal sand flats to the west of the causeway are around 0.3 to 1.8 m above Chart Datum.

Figure 3-2: Extract from hydrographic chart (NZ 5322)



3.1.10.2 Sediments

Sediments in the project area generally comprise fine sands, although shells were evident in samples in the channel and a greater proportion of silts were observed in the intertidal flat adjacent to the causeway. The more silty sediments suggest lower energy environments where currents are weaker, enhancing settling.

3.1.10.3 Water levels

The tide follows a typical spring/neap cycle, with a spring range of 3.7m and a neap range of 2m. Tide levels near the bridge site shows on average that high tide levels are 0.15 m higher and low tide levels 0.12 m lower than at Queens Wharf (NIWA, 2000). During a 100 year flood event, tide levels reach 2.56m Auckland Vertical Datum (AVD) and tide levels reach 2mAVD during Highest Astronomic Tide (HAT).

3.1.10.4 Waves

Waves at this location are fetch and depth limited. Maximum wave heights of between 0.5 m and 0.7 m are possible at this location, with periods of between 2 and 3 seconds along the causeway. During south easterly conditions wave heights could reach up to 1.0 m within the channel with periods of around 3 seconds.

3.1.10.5 Currents

Currents within the UWH are governed mainly by local bathymetry (channels, mud banks, headlands, bays). Peak tidal currents measured in the channel are shown in Table 3 1 below.

Table 3-1: Measured tidal currents in the Hobsonville Channel

Tide	Peak ebb velocity (m/s)	Peak flood velocity (m/s)
Spring tide	0.70	0.58
Neap tide	0.42	0.30

Tidal flow currents in the vicinity of the bridge and causeway are lower on the intertidal area and there are low velocity (less than 0.1 m/s) flood tide eddies that form along the causeway that would contribute to sediment deposition

3.1.11 Landscape and Visual

The GBWD and Causeway is located in a highly modified environment that comprises a mixture of residential development, dominant infrastructure and natural coastal landscape. The landscape attributes are of varying quality and consistency particularly those immediately around or within the project site. There is a reasonably high level of landscape amenity with the presence of the harbour and relatively continuous coastal vegetation - though much of this exists on private property as there is a lack of coastal public open space. Key landscape and visual elements of the existing site and surrounding area are described as follows:

3.1.11.1 The existing causeway

The proposed causeway widening site is bounded by the rock revetment that forms the edge of the existing SH18 causeway. The existing causeway is flat and its harbour edge is occupied by a 1m strip of coastal planting. This vegetation includes a mixture of planted vegetation and vegetation that has established from natural seed dispersal, including approximately 10-year old pohutukawa. Adjacent to the planting is a cycle path that is separated from SH18 by a 2m high wire fence.

The coastal margin varies along the length of the existing causeway. At the western end there is an upper tidal area of mangroves and a small patch of shell bank, and this transitions to sandstone reef in the middle of the existing causeway. The eastern end of the causeway tapers out under the Greenhithe Bridge to a deeper channel – this end of the causeway is used for fishing.

3.1.11.2 The surrounding environment

The GBWD and Causeway is situated on the Upper Waitemata Harbour, which has a number of bays and inlets. The area of harbour surrounding the project site is bound by Greenhithe in the north-east, Herald Island to the north (800m across the Upper Harbour) and Hobsonville Point to the south-east.

The site is part of a wider coastal/residential setting that is typical of the northern Auckland region. The combination of these has resulted in a high level of amenity and recreation activities in and around the harbour – in particular boating activities and cycling along the existing cycle path.

Both Herald Island and particularly Greenhithe are established suburbs comprised mainly of low density residential development with significant tracts of mature vegetation along the coastline. Both suburbs feature residential development that is located and orientated seaward and elevated terrain has meant that dwellings are typically set back from the water's edge but overlook the harbour below. The Greenhithe coastline facing the site is comprised of established mature native and exotic bush. A narrow public path meanders along the edge between private lots and the shoreline. Herald Island has no continual coastal walkway, but there are a small number of narrow access ways linking Ferry Parade to the harbour. A local wharf is located at the eastern-most end of the island. West of Herald Island is Whenuapai – a low density residential area based around the Whenuapai airbase.

Hobsonville Point to the south-east is predominantly residential but comprised of much denser residential development and a greater mixture of non-residential activities such as schools, commercial, marine industry and recreational land uses. As the area was previously established as an airbase and the residential area is undergoing significant change, the overall landscape setting is less mature than that of Greenhithe and Herald Island. A band of mature vegetation hugs the original western coastline that sits south-east of SH18 and this provides a dense visual buffer between Hobsonville and SH18.

Increasing residential growth is also planned for the small headland located at the western side of the existing causeway. This area is comprised of a large-lot residential site and the Summerset Retirement Village: Monterey Park, which is currently under construction. The headland is partly pastoral land with a small section of mature trees at the base of the gully in the location of the proposed construction access. The form of the headland is somewhat modified with the northern coastline featuring a battered, grassed slope. An existing esplanade reserve extends around the base of the residential lot and will continue along the edge of the retirement development.

SH18, as it extends up over the Greenhithe Bridge is a significant and obvious physical element within the immediate landscape. A noise wall runs along the coastal side of SH18 for approximately 295m commencing at the Squadron Drive on-ramp. The motorway side of the wall is bright orange, whereas the coastal side is natural wood with the supporting posts/frame visible from Herald Island and Whenuapai. Pedestrian and cyclist access from Hobsonville to the north-western foreshore and the cycleway is obtained from Squadron Drive.

A landscape and visual assessment is provided in Technical Report I Landscape and Visual Assessment in Volume 2.

3.1.12 Archaeology and Heritage

Archaeology and heritage in the GBWD and Causeway project area is described in Technical Report J Heritage Impact Assessment in Volume 2. Additional information on cultural heritage is also presented in the Cultural Impact Assessments (CIAs) prepared for the project by Ngati Maru, Ngai Tai ki Tamaki and Te Kawerau a Maki which will be provided to Auckland Council separately to this application.

The upper harbour and the Greenhithe and Hobsonville Point areas have a history of occupation by Maori for generations prior to settlement by Europeans in the 18th Century. For early Maori the harbour provided abundant marine resources and some significant communication and portage routes. Archaeological sites around the Greenhithe Bridge relating to Maori occupation are mostly small and dispersed around the shoreline of the upper harbour.

The CIAs provided describe the relationship of each iwi group with the project area, including:

- Ngati Maru had tribal Pa and nohonga settlements located along the North Shore coastline, and use of land further west for smaller settlements or activities such as food gathering.
- Te Kawerau settled West Auckland and the North Shore including a settlement at Tauhinu (in current day Greenhithe) and Motu Pakihi (Herald Island), Te Onekiritea (Hobsonville Point) was also used for harbour access and bird snaring grounds.
- Ngai Tai has an association with the land, coast and estuaries of the Waitemata in Te Atatu and te Raki Pae Whenua (North Shore).

European settlement of Hobsonville Point dates to the 1850s when brickworks and potteries were developed in the area. Agricultural and gum digging activities were also carried out in the area. In the later 1920s the Hobsonville Airbase was established on the peninsula and dominated activities in the area until its closure in 2002.

European settlement in Greenhithe dates to at least the 1840s, and settlement was initially sparse due to lack of access. Initially the timber industry established in the area, exploiting the Kauri resource and gum diggers soon

followed. After the timber industry the area was developed for farming including commercial fruit growing and settlement of the area gradually increased.

Auckland Council's GIS shows several archaeological sites in the area around the proposed works, and one site (R11/495) is shown directly within the works area.

This site comprises a shell midden which was recorded in the 1970s in the immediate vicinity of the proposed area of works, but could not be located and is presumed to have been destroyed by construction works associated with the motorway and bridge development.

The PAUP identifies land to the immediate west of the proposed causeway widening as a Historic Heritage Place being "Duke House and servants quarters" (item 130 in the Schedule of Significant Historic Heritage Places). However, the proposed works are well removed from this heritage place and associated Historic Heritage Extent of Place under the PAUP. An archaeological assessment did not identify any other archaeological or other historic heritage sites within the GBWD and Causeway project area.

Figure 3-3: Auckland Council GIS showing recorded archaeological sites in the vicinity of the works. R11/495 indicated with an arrow.



The project area was found to have been extensively modified through works over the last few decades and it is considered unlikely that any subsurface archaeological remains will have remained intact along the existing road reserve and bridge abutments.

3.1.13 Utility Services

In addition to the existing NH1 watermain, there are a number of existing services within the causeway and on the Greenhithe Bridge including a Vector high-pressure gas main, telecommunication ducts and stormwater pipes. A number of these utilities, for example the high-pressure gas main, have minimum clearance requirement for the location of other utilities or construction activities nearby. Much of this infrastructure runs under the cycleway on the existing causeway and has influenced the decision to locate the GBWD on the widened section of causeway to avoid service clashes and minimise the risk to the damaging existing assets—this is discussed further in the assessment of alternatives (Section 5 of this AEE). Additional infrastructure is located on the southern side of the existing causeway, including stormwater pipes and a stormwater pond servicing both SH18 and Hobsonville Point.

3.2 Zoning

The following district and regional plans are relevant to the GBWD and Causeway project area:

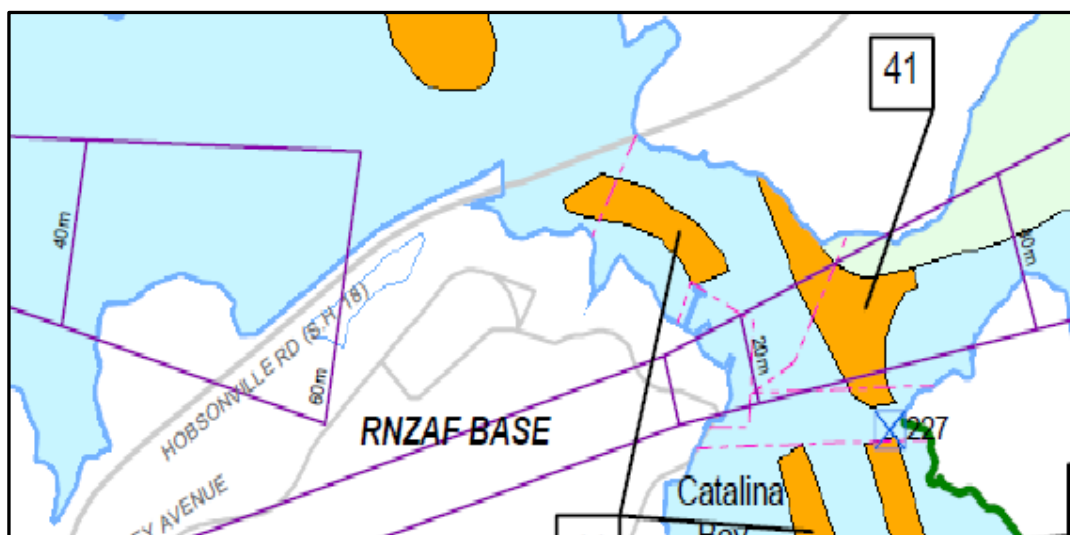
- Auckland Council Regional Plan: Coastal 2004 (ACRP:C);
- Auckland Council Regional Plan: Sediment Control 2001 (ACRP:SC);
- Auckland Council Regional Plan: Air, Land and Water 2013 (ACRP:ALW);
- Auckland Council District Plan: Waitakere Section 2003 (ACDP:WS);
- Auckland Council District Plan: North Shore Section 2002 (ACDP:NS); and
- Proposed Auckland Unitary Plan (PAUP).

Each plan attributes specific values to areas within its jurisdiction by way of zonings and overlays. The relevant planning notations are summarised as follows.



3.2.1 Auckland Council Regional Plan: Coastal 2004

The proposed works will be within the General Management Area under the ACRP: C, as shown in Figure 3-4. The General Management Area is not within one of the specific management areas and it is by far the largest management area in the ACRP:C. Mooring areas are situated both north and south of the Greenhithe Bridge.

Figure 3- 4: ACRP:C Planning Map 28



Legend

- | | |
|---|-------------------------|
|  | Mooring Management Area |
|  | General Management Area |

3.2.2 Auckland Council Regional Plan: Sediment Control 2001

The landward component of the proposed works will be within the Sediment Control Protection Area (SCPA), which includes the area 100m landward of the CMA.

3.2.3 Auckland Council Regional Plan: Air, Land and Water 2013

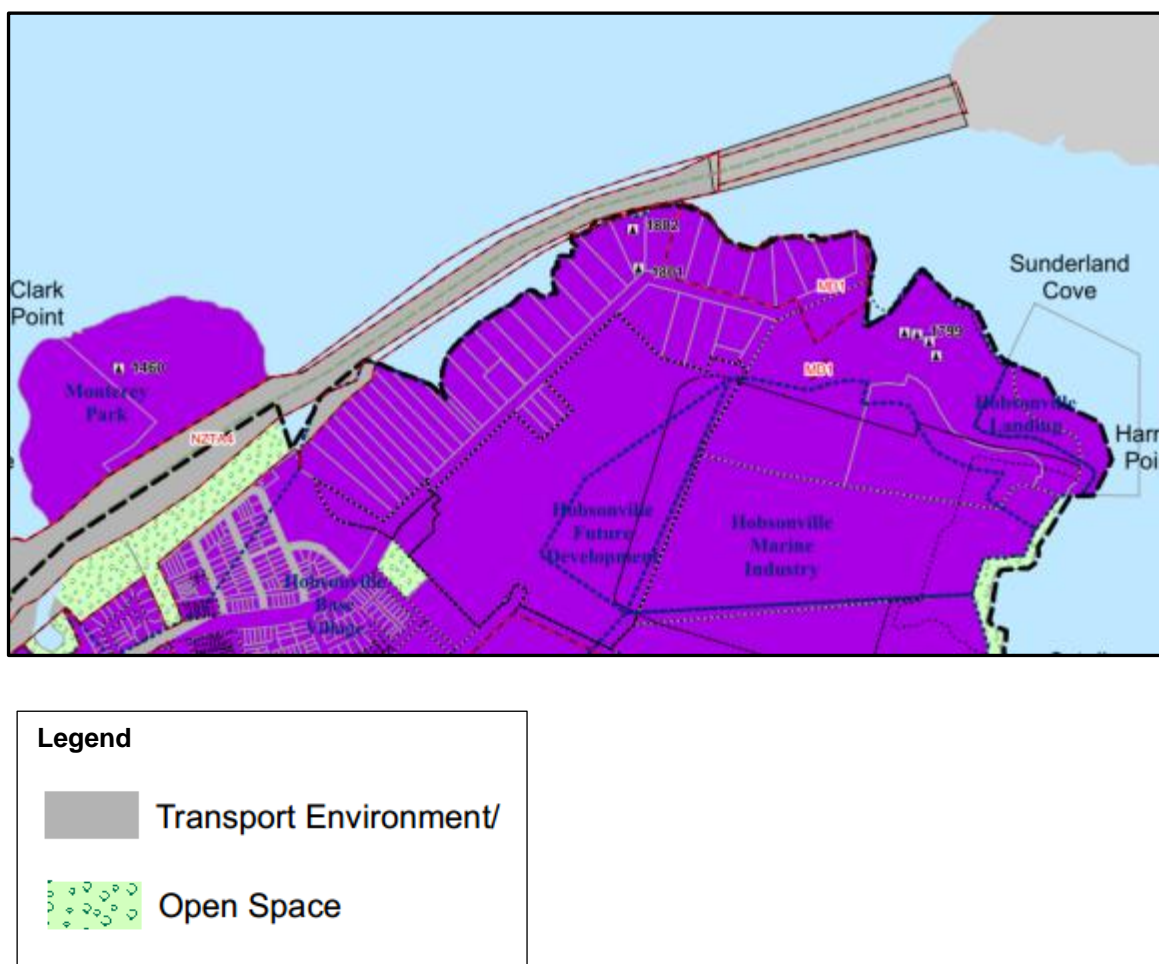
The project area is identified in the ACRP:ALW as being located within the Kumeu Waitemata Aquifer, a High Use Aquifer Management Area.

3.2.4 Auckland Council District Plan: Waitakere Section 2003

The area of the causeway to the west of the Greenhithe Bridge (and on the landward side of mean high water springs (MHWS) is within the jurisdiction of the ACDP:WS. The project area is identified on the relevant Human Environment Map (Figure 3-5 below) as being within the following areas:

- The majority of the project area is within the Transport Environment, being roads owned by the NZ Transport Agency or Auckland Transport;
- A small section of works in road reserve on the southern side of SH18 is within the Open Space Zone which relates to parks (as one of part of the four distinctive urban landscapes).
- A small section of works on the southern side of SH18 is within the Special Area – Hobsonville Base Village. As stated in the ACDP:WS “this is a former part of the Hobsonville Airbase that will be developed for a range of urban activities”; and is currently being developed as Hobsonville Point.
- Designation NZTA4 ‘State Highways 16 and 18 – Hobsonville’ applies to large areas of the project around the existing motorway, with the NZ Transport Agency (NZTA) the Requiring Authority.

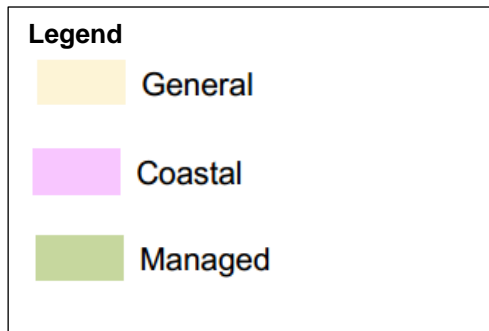
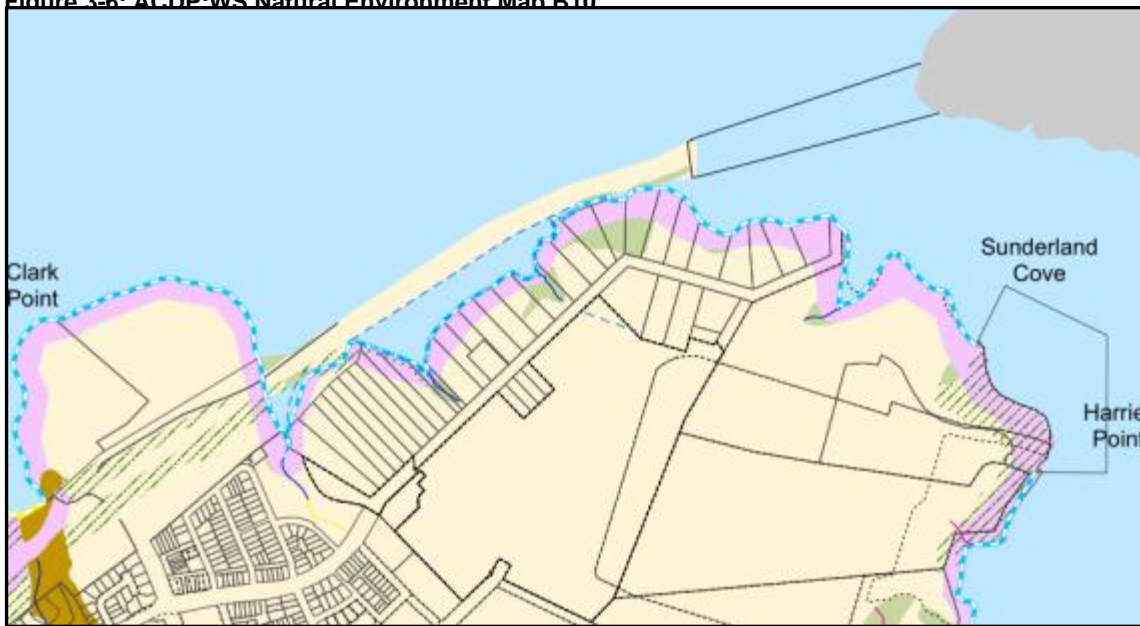
Figure 3-5: ACDP:WS Human Environment Map B10



The project area is also identified on the relevant Natural Environment Map (Figure 3-6) as:

- Largely within the General Natural Area;
- An area within the Coastal Area.
- A small area at the western most extent of the existing causeway embankment is Managed Natural Area.
- The western most extent of the causeway is subject to a 20m coastal edge notation.

Figure 3-6: ACDP:WS Natural Environment Map B10



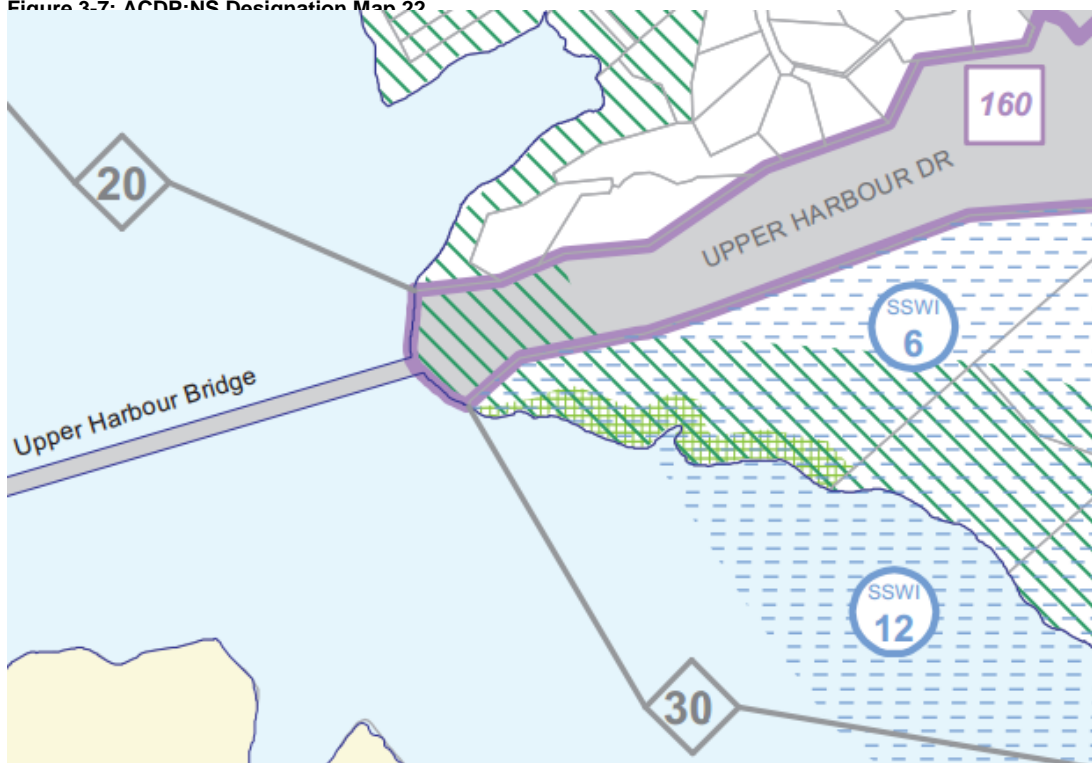
3.2.5 Auckland Council District Plan: North Shore Section 2002



The area of the proposed works to the east of the Greenhithe Bridge is within the jurisdiction of the ACDP: NS.

The project area is identified on the relevant planning maps as being within the road reserve. The project area is within:

- Designation 160 'Upper Harbour Highway' with NZTA being the Requiring Authority;
- The Coastal Conservation Area.
- A 20m Foreshore yard on the northern side of SH18 and a 30m Foreshore Yard to the south of SH18.

Figure 3-7: ACDB-NS Designation Map 22



Legend	
Road, Service Lane, Accessway (Designated / Vested)	
Coastal Conservation Area	

3.2.6 Proposed Auckland Unitary Plan

The PAUP was notified on 30 September 2013. Submissions have been received and the hearings process is underway. Some rules have immediate legal effect as noted in Section 4 of this AEE.

A number of zones, overlays, and designations are shown throughout the project area. Not all the zones and overlays listed below are associated with provisions that currently have legal effect.

PAUP zones and overlays that are relevant to consent triggers for the GBWD and Causeway project area include the following and are shown on Figure 3-8:

- General Coastal Marine
- Significant Ecological Areas (SEA) – SEA_T_8319 and SEA T 3409 (shown in Figure 3-8 and Figure 3-9). These are described in Section 3.1.6 above ;
- Historic heritage place (item 130 in the Schedule of Significant Historic Heritage Places) described further in Section 3.1.12.



- The project area is also subject to the following designations:

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- Designation 6741 'State Highways 16 from Westgate interchange, Westgate to Brigham Creek Road intersection, Whenuapai and Upper Harbour Highway from Westgate interchange, Westgate to Greenhithe Bridge' with the NZTA the Requiring Authority;
- Designation 6739 'Hobsonville Road: To undertake maintenance, operation, use and improvement to the State Highway network, Designations with the NZTA the Requiring Authority; and
- Designation 6756 'Upper Harbour Highway: To undertake maintenance, operation, use and improvement to the State Highway network with the NZTA the Requiring Authority.

4. Resource Consents Sought

In summary, coastal permits, water, discharge permits and land use consents are sought from Auckland Council for the following activities associated with the GBWD and Causeway (and not limited to the rules specified):

Table 4-1: Resource Consents Sought

RMA Section	Type of Consent	Activity	Geographic Extent	Plan and Rule	Activity Status	Comments
12	Coastal Permit	Reclamation of foreshore or seabed	Causeway	ACRP:C 13.5.3, PAUP I.6.1.1	Non complying Discretionary	Construction of the proposed causeway.
		Occupation of the CMA by temporary and permanent structures	Causeway and Greenhithe Bridge	ACRP:C 10.5.9, PAUP I.6.1.10	Discretionary Restricted discretionary	Structures for construction, the watermain located on the bridge, and associated infrastructure outfall structures and erosion protection and the causeway embankment below MHWS.
		Erection of temporary structures and permanent structures	Causeway and Greenhithe Bridge	ACRP:C 12.5.18, 12.5.19, PAUP I.6.1.10	Discretionary Discretionary Discretionary	Structures for construction, the watermain located on the bridge, and associated infrastructure outfall structures and erosion protection.
		Disturbance of the foreshore and seabed	Causeway	ACRP:C 16.5.17, PAUP I.6.1.4	Restricted discretionary Discretionary	Construction activities, including excavation and vegetation removal
14	Water Permit	Damming or diversion of coastal water	Causeway	ACRP:C 19.5.5, 19.5.6, PAUP I.6.1.6	Discretionary Discretionary Discretionary	Damming and diversion associated with construction of the proposed causeway.
		Diversion and taking of groundwater during construction	GBWD and Causeway	PAUP H.4.17.1	Restricted discretionary	Dewatering of earthworks

RMA Section	Type of Consent	Activity	Geographic Extent	Plan and Rule	Activity Status	Comments
		Diversion of an overland flow path	Causeway	PAUP H.4.12.1	Restricted discretionary	Altering the exit point of an overland flowpath at the west end of the causeway.
15	Discharge Permit	Discharge of contaminants to the CMA.	Causeway	ACRP:C 20.5.6, PAUP I.6.1.7	Discretionary Discretionary	Potential sedimentation during construction.
		New impervious surfaces	GBWD and Causeway	ACRP:ALW 5.5.2	Controlled	Diversion and discharge of stormwater from new impervious areas on the causeway.
9	Land Use Consent	Land disturbance	GBWD and causeway	ACRP:SC 5.4.3.1	Restricted discretionary	Proposed earthworks, including tracking to form construction accessways (excluding the proposed reclamation).
		Vegetation alteration, removal, and works in the dripline of trees.		ACDP:NS 8.4.6.3(b) ACDP:W GNA2.2, MNA2.2 – 2.4 CNA2.2-2.4 PAUP H.4.3.1.2	Discretionary Controlled Discretionary Discretionary Discretionary	Removal, alteration, and works within the dripline of trees within the road reserve and removal of trees within a significant ecological area.
		Earthworks	Western side of the Greenhithe Bridge	ACDP:W GNA3.4, MNA3.3, CNA3.3	Discretionary Discretionary Discretionary	Earthworks during construction
		Creation of impermeable surfaces	Western side of the Greenhithe Bridge	ACDP:W GNA4.2, MNA4.2, CNA4.2	Restricted discretionary	Metalled construction access roads
		Site works	GBWD and Causeway	ACDP:NS 9.4.1.4(f)	Discretionary	Excavations, exceeding 3m in depth
		Earthworks to install the watermain, wastewater pipes and associated infrastructure	GBWD and Causeway	PAUP H.4.2.1.1,	Restricted	Earthworks to install infrastructure within a Significant Ecological Area and a Heritage Area.

RMA Section	Type of Consent	Activity	Geographic Extent	Plan and Rule	Activity Status	Comments
				H.4.2.1.2	discretionary	
		Land use	Causeway (specifically land currently in the CMA proposed for reclamation)	s87B and s89(2) RMA	Discretionary	All land use activities within and on the proposed causeway reclamation including location of utilities, construction activities including earthworks, and use of the causeway for infrastructure access and as public open space.

In addition to the rules listed above, it is noted that permitted activity rules have been relied upon for the following activities:

- Discharges of potable water from the GBWD pipeline to the CMA for the purpose of inspection, repair and maintenance – ACRP:C Rule 20.5.3 and PAUP Rule I.6.1.7
- Discharges of contaminants to air, land or soils associated with construction activities, the generation of dust, the disturbance of soil or discharge of groundwater – ACRP:ALW Rules 5.4.1, 5.5.41 and 5.5.42A and 5.5.57, PAUP Rules H.4.1.1, H.4.5.1 and H.4.18.1. No consent is required under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health as a detailed site investigation has shown that soil contamination is below background levels.
- Underground infrastructure within the road reserve in the former Waitakere District – ACDP:W Transport Environment Rule 5.1(b), and underground infrastructure in the former North Shore District – ACDP:NS Rule 14.4.2

Overall the application to construction the widened causeway is a non-complying activity. All other consents are bundled within each regional or district plan to be discretionary activities.

For the avoidance of doubt, resource consent is sought under the above rules, and any other rules which may apply to the activity (and generate a consent requirement) even if not specifically noted.

It is noted that, separate to this resource consent application, a parallel process will be initiated to formalise a minor variation to existing NZ Transport Agency stormwater discharge consents to account for the proposed change in discharge locations. The timing and process for this will be discussed with the NZ Transport Agency and Auckland Council.

5. Consideration of Alternatives

A comprehensive consideration of the alternatives to the project (“the Assessment of Alternatives Report”) is contained in Appendix B to this AEE.

The Assessment of Alternatives report sets out the issues associated with a single reticulated water supply point across the upper Waitemata Harbour and the need for a new wastewater pipeline, Northern Interceptor, to support proposed growth in the northwest of Auckland. Issues include providing for growth, security of supply and network resilience, maintenance and operational/access and in the case of NI providing for future construction phases.

The route alignment, various means of crossing the Waitemata Harbour and construction methodologies for both the GBWD and the NI projects have been considered in some detail and the relative merits of each are presented in the report. A summary of the preferred options for each is provided below.

5.1 Greenhithe Bridge Watermain Duplication

The construction of the northern Greenhithe Bridge crossing in 2005/6 made structural provision for conveyance of a new watermain across the Upper Waitemata Harbour. The route selection process therefore concentrated on the approach to the western side of the bridge and resulted in the preferred option of widening the existing motorway causeway to accommodate the new watermain via access from Squadron Drive.

The preferred option is for GBWD to be installed in a trench within the widened causeway and transition up onto the Greenhithe Bridge. The pipeline will then be attached to the underside of the bridge in order to cross the harbour and transition back to ground level at Greenhithe end of the bridge.

5.2 Northern Interceptor

Phase 1 of the NI project will convey wastewater from Hobsonville to Rosedale WWTP via a crossing of the Upper Waitemata Harbour. The preferred harbour crossing route involves the installation of the wastewater pipelines within a widened causeway within an integrated infrastructure corridor shared with the GBWD. The Greenhithe Bridge does not have structural capacity to support a new sewer line and hence an alternative crossing methodology was required.

The preferred option is for crossing the harbour between the widened causeway and Rahui Road using either horizontal directional drilling (HDD) or marine trenching. Should HDD be selected a construction platform will be required along the widened causeway to enable the appropriate HDD alignment and drilling equipment placement to be achieved. The preferred method will be confirmed once a contractor has been appointed for the works.

6. Assessment of Effects

This section provides an assessment of the actual and potential effects on the environment of the proposed Greenhithe Bridge Watermain Duplication (GBWD) and Causeway project. The existing environment is described in Section 3 of this AEE. The assessment also draws upon the technical reports contained in Volume 2 of the AEE, being:

- Technical Report A Earthworks, Erosion and Sediment Generation
- Technical Report B Soil, Sediment and Groundwater Contamination
- Technical Report C Groundwater
- Technical Report D Ecological Assessment
- Technical Report E Arboriculture
- Technical Report F Traffic
- Technical Report G Construction Noise and Vibration
- Technical Report H Coastal Processes
- Technical Report I Landscape and Visual Assessment
- Technical Report J Heritage Impact Assessment

6.1 Positive effects

The project will have significant positive effects on the social, cultural and economic well-being of Auckland including:

- Addressing the operational and supply risks of the existing North Harbour No.1 Watermain on Greenhithe Bridge by providing a secure and resilient water supply to the North Shore;
- Providing additional water supply infrastructure to accommodate future growth in north and north western Auckland;
- Providing for wastewater infrastructure to service growth in north-western parts of Auckland;
- Improvement of cycle and pedestrian amenity through construction of a new shared access way along the coastal edge which connects to the existing cycleway infrastructure on the causeway;
- Enhanced recreation opportunities through the provision of a passive recreation space;
- Reducing disruption and environmental effects by facilitating the construction of Phase 1 of the Northern Interceptor wastewater project at the same time as installing the GBWD;
- Integrating critical water and waste water projects to enable efficient infrastructure development.

6.2 Earthworks, Erosion and Sediment Generation

Earthworks activities have the potential to lead to soil erosion and sediment generation. The erosion and sediment generation effects associated with the GBWD and Causeway have been assessed and are summarised in this section. An outline Erosion and Sediment Control Plan (ESCP) has been prepared in response to the proposed construction methodology (described in Section 2.3.4 of this AEE). It is provided in Volume 2, Technical Report A and Drawing 2010674.040 in Volume 3. It follows industry best practice and in particular was developed having reference to:

- Auckland Council Erosion and Sediment Control Guidelines for Land Disturbing Activities Technical Publication 90 (TP90);
- Auckland Council, Best Management Practice: Catchpit protection;

- Auckland Council, Best Management Practice: Dewatering;
- Auckland Regional Plan: Sediment Control.

6.2.1 Construction Elements and Potential for Effects

Seven major Construction Elements (CE) for the project have been identified in Section 2.3.4 and are listed below.

- 5) Causeway widening and extension and installation of new pipes within the causeway;
- 6) Connection pipe between NH1 and the new watermain – west end;
- 7) New watermain connection to the Greenhithe Bridge;
- 8) Watermain transition structure at the west end of the Greenhithe Bridge;
- 9) Connection between NH1 and the new watermain – east end;
- 10) West end valve chambers; and
- 11) Scour chamber.

If not appropriately managed these activities will, or have the potential to, release sediment laden water to the receiving environment thereby affecting water quality in the vicinity of such a release and potentially effecting benthic fauna as a result of sediment deposition.

6.2.2 Erosion and Sediment Generation Assessment and Mitigation

An assessment of the erosion and sediment generation effects potentially generated by the CE 1 to 7 is provided in Table 6-1. This table also includes suggested mitigation measures to address each erosion and sediment generation issue.

Further detail can be found in Volume 2, Technical Report A- Earthworks, Erosion and Sediment Generation.

It is noted that whilst Technical Report A provides a tool box of approaches and recommends appropriate mitigation measures, it is intended that a detailed ESCP will be prepared by the successful contractor and submitted to Council prior to commencement of earthworks.

Table 6-1: Erosion and sediment generating activities for the GBWD and Causeway

Construction Elements	Potential Earthworks and Sediment Generating Activity	Suggested Mitigation Erosion and Sediment Control Measures (ESCMs)
CE1 – Causeway widening, extension and pipe installation	Potential runoff of sediment to CMA during Causeway construction and trench and filling activity.	Stabilisation by placing geotextile, covering with clean hardfill or hydroseeding as soon as practicable. Rock armouring of seaward side of causeway to reduce losses due to wave action. Monitor truck filling to ensure no overfilling and develop processes to reduce soil losses during loading and transport . Where required lockage tailgates will be provided to minimise leaching of silt laden water from saturated excavated material.
	Disturbance of marine sediments and potential use of Lime cement mixing to create shear key.	Use of appropriate ESC techniques such as floating silt curtains and super silt fences.
	Access track construction and use may be a source of sediment generation.	Designed with a surface treatment that minimises erosion and sediment generation including super silt fences along the full length on the seaward side of the road.
	Spill of soils and sediments transported	Monitor truck filling to ensure no overfilling and develop

Construction Elements	Potential Earthworks and Sediment Generating Activity	Suggested Mitigation Erosion and Sediment Control Measures (ESCMs)
	by vehicles.	processes to reduce soil losses during loading. Where required lockage tailgates will be provided to minimise leaching of silt laden water from saturated excavated material.
	Removal of excess groundwater/stormwater from the trench and bunded causeway cells.	Dewater excavations by pumping and passing water through a pre-treatment device to reduce sediment levels prior to discharge.
	End tipping of rock at end of extended causeway	Installation of Floating Silt Curtain (FSC) Tipped rock sourced with as little fines content as possible to minimise fines being introduced into the sea (method previously used for SH16 Causeway construction).
CE 2, CE 5,6 and 7 Connection pipe between NH1 and the new watermain – west and east ends. Construction of watermain valve chambers and scour valve chambers	Ground disturbance during excavation and tracking of construction equipment. Disturbance during set up of site yard.	Site stabilisation, silt fences and use of wheel wash to manage tracking off site. Monitor truck filling to ensure no overfilling and develop processes to reduce soil losses during loading. Where required lockage tailgates will be provided to minimise leaching of silt laden water from saturated excavated material.
	Dewatering of excavation chambers if required.	Dewater excavations by pumping and passing water through a pre-treatment device to reduce sediment levels.
CE 3 New watermain connection to Greenhithe Bridge	If launched over ground from eastern end will require disturbance of sloped ground in excess of 14% close to CMA.	Use of super silt fence to intercept sediment conveyance on slope.
CE4 Watermain transition structure western end of Greenhithe Bridge	Sediment generation from the creation of the rock foundation, installation of piling and casing.	Installation of FSC and use of rock with low proportion of fines.

6.2.3 Universal Soil Loss Equation

The Universal Soil Loss Equation (USLE) is a soil loss estimation model used to estimate sediment yields from earthwork sites. This method is recommended in TP90¹ and provides an estimation of soil loss for works on land with exposed ground.

The USLE has been applied to CE 1, 2, 5 and 6.

Table 6-2: USLE Equation for the GBWD and Causeway

Work Area	Total Soil Loss (Tonnes)
CE 1	0.426
CE 2	0.016
CE 5	0.162
CE 6	0.073

¹ Auckland Council Erosion and Sediment Control Guidelines for Land Disturbing Activities Technical Publication 90 (TP90)

The results of the USLE indicate that the majority of sediment generation occurs when exposed ground is left unstabilised, thus rapid stabilisation is key to reducing sediment generation. It is unlikely that a work site will be left completely exposed without stabilisation for an extended length of time. Therefore, the volumes of soil loss calculated by the USLE are likely to be conservative estimates.

6.2.4 Monitoring, Maintenance and Decommissioning

As stated in the Erosion and Sediment Control Plan (refer Volume 2 Technical Report A), all erosion and sediment control measures (ESCMs) will be inspected on a regular basis. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will then be undertaken. A visual inspection of adjacent water ways shall be performed after a rainfall event. All erosion and sediment control measures will be maintained in accordance with TP90.

ESCMs will be decommissioned only after there is no further potential for erosion or sediment generation.

6.2.5 Earthworks, Erosion and Sediment Generation Assessment Conclusion

Without appropriate erosion and sediment control measures being implemented, the effects of the proposed earthworks associated with the GBWD and Causeway have the potential to generate adverse effects on the receiving environment, in particular in the CMA. However, as described in the Erosion and Sediment Control Plan (ESCP), the ESCMs will be an integral component of the works methodology and therefore potential effects will be mitigated as far as practicable and effects are considered less than minor.

It is intended that a detailed ESCP will be prepared by the successful contractor and submitted to Council prior to commencement of earthworks.

6.3 Contamination of Soil and Effects on Human Health

Contamination of soil, sediments and groundwater associated with the GBWD and Causeway has been assessed and are summarised in this section. More detail is provided in Volume 2 Technical Report B Soil, Sediment and Groundwater Contamination.

Site assessment and sampling were undertaken in order to assess the potential effect on human health and contamination of soils, sediments and groundwater.

Soil, sediment and groundwater contamination were tested between May and June 2014 by OPUS and additional sediment sampling in the area of the proposed construction platform of the NI project was conducted in November 2014 by Tonkin and Taylor (refer Appendices E and J of Technical Report B Soil, Sediment and Groundwater Contamination).

6.3.1 Potential for Effects

The disturbance of soil and sediments during the construction of the GBWD and Causeway has the potential to affect human health, ground water and marine waters through the release and uptake of contaminants contained within the disturbed and excavated materials. The levels of contamination will also determine the suitability of the soils and sediment for reuse on site and disposal to an appropriately licensed facility.

6.3.2 Soil Contamination Assessment

No activity or industry listed on the Hazardous Activities Industries List (HAIL) was identified within the Project site. It is therefore considered that the requirements of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES Soil) do not apply to the Project site.

Seven soil samples were assessed against the Soil Guideline Values (SGVs) from the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES: Soil), the Schedule 10 criteria of the ACRP:ALW and the Auckland Council Technical Publication 153 Auckland cleanfill criteria (TP 153). The results indicated that the concentrations of contaminants (Total Petroleum Hydrocarbons – TPH, Polycyclic Aromatic Hydrocarbons – PaH, Organochlorine Pesticides – OCP, heavy metals) met the Auckland background soil quality for non-volcanic soils. Therefore spoil from the proposed excavation locations being (i) new Watermain to NH1 pipe connection- west end (CE2) comprising the jacking and receiving pits located north and south of SH18 and (ii) Watermain to NH1 pipe connection- east end (CE5) comprising the pit to form the valve chamber) can be removed off-site to a licensed cleanfill site (if required), or reused on-site. Inadvertent spillages of fuel while refuelling construction plant and equipment could generate potential contamination of soil and procedures to manage this risk will be addressed in a Construction Management Plan (CMP).

6.3.3 Sediment Contamination Assessment

Fourteen sediment samples were assessed against the Schedule 10 criteria of the ACRP:ALW, TP 153 background soil concentration (typically used as cleanfill criteria) and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) sediment quality guidelines. The results indicated that:

- TPH, OCP, Tributyl Tin (TBT) test results and heavy metals concentrations met the standards of regulations listed above;
- PaHs were reported in three out of the fourteen samples, the highest at sample location HA214a, where the Benzo(a)pyrene (BaP) equivalent concentration, was 0.27 mg/kg. The HA214a BaP concentration of 0.27 mg/kg is well below the NES-SGV of 35 mg/kg, below the ACRP:ALW Schedule 10 criteria of 2.15 mg/kg and also below the ANZECC Interim Sediment Quality Guidelines (ISQG)-Low value of 0.43 mg/kg. Another PaH parameter, Phenanthrene, was slightly elevated in two sediment samples (0.33 mg/kg and 0.25 mg/kg) when assessed against the ISQG-Low value (0.24 mg/kg) but both samples were well below the ISQG-High value (1.5 mg/kg). Arsenic was slightly elevated in eight out of fourteen sediment samples when compared to the Auckland background values for non-volcanic (12 mg/kg). In three of the eight samples, arsenic exceeded the ANZECC ISQG-Low criteria. The two options are proposed:
 - Option 1: off-site disposal: Arsenic was slightly elevated in eight out of fourteen sediment samples when compared to the Auckland background values for non-volcanic (12 mg/kg). Therefore if the sediment requires off-site disposal during future earthworks at the site, it should not be disposed of at a licensed cleanfill site, but to a licensed managed fill site or a licensed solid waste landfill.
 - Option 2: On-site reuse: If off-site disposal of the sediment is not required and the sediment can remain on-site the assessment is as follows: In three of the eight samples, arsenic exceeded the ANZECC ISQG-Low criteria. However, as 95% Upper Confidence Limit (UCL as per MfE Guideline No 5, 2004) of the fourteen arsenic sediment test results is approx. 20 mg/kg (ISQG-Low), the sediment can remain at the site, or be reused on-site e.g. as a component of mudcrete/rockfill or the lime cement stabilisation process.
- At one of the fourteen sample locations, Mercury was slightly elevated (0.20 mg/kg), compared to the ISQG-Low criteria of 0.15 mg/kg, but below the Auckland background value for Mercury (0.45 mg/kg). Similar to arsenic, the sediment can remain at the site location or be reused on site.
- All sample results were below the soil contaminant criteria specified in Rule 5.5.41 of the ACRP:ALW and below the soil contaminant criteria specified in provision H.4.5.2.1.3 of the PAUP.

Overall, based on the sediment sampling undertaken between May and November 2014, the quality of the materials at GBWD and Causeway locations can be assessed as generally good and not contaminated. On the basis of the arsenic levels, should be disposed of to a licensed managed fill or solid waste site.

6.3.4 Groundwater Contamination

Groundwater quality testing results are below Levels of Detection (LOD) and less than the Permitted Activity (PA) criteria for Freshwater and less than the Permitted Activity criteria for Marine water, therefore no resource consent is required under the ACRP:ALW since the requirements of Rule 5.5.42A(i) are met. Namely that the groundwater contaminant levels are below the ANZECC (2000) Freshwater criteria for 95 % level of protection of species. No resource consent is required under the PAUP since the requirements of Rule H.4.18.2.1.1.2 are met. If temporary removal of groundwater during the construction of the receiving pit located south of SH18 is required, it may be discharged to the stormwater system.

The potential effects of groundwater contamination on the receiving environment are considered as being minor for this project. In addition, a CMP is recommended proposed for implementation during future construction works in order to anticipate and mitigate any potential groundwater contamination.

6.3.5 Contamination Assessment Conclusion

In summary, the contamination assessment has identified:

- The concentrations of contaminants in the soils sampled met the Auckland background soil quality for non-volcanic soils. The soil is considered not to be contaminated and can therefore be removed off-site to managed fill disposal or be reused on site.
- Minor contamination of sediments with PaH was detected and the concentrations of arsenic and mercury were slightly elevated at some locations within the footprint of the proposed causeway widening (e.g. HA214a, refer Appendices E and J of Volume 2 Technical Report B Soil, Sediment and Groundwater Contamination) compared to the ISQG-Low criteria. As 95% of UCL were below the criteria, the risk of detrimental effects resulting from the disturbance of these sediments can be managed by: (i) remaining in situ, (ii) being reused on site or (iii) being disposed to a licensed managed fill site or a licensed solid waste landfill.
- Levels of contaminants in groundwater were below the ANZECC Freshwater standards and less than minor effects were envisaged in the groundwater environment.

Contamination testing will be carried out during construction and any contaminated soils detected will be appropriately mitigated and managed through the Construction Management Plan (CMP).

Overall, the potential soil, sediment and groundwater contamination effects related to the construction, operation and maintenance of the GBWD and Causeway are considered as being less than minor on the receiving environment. As discussed previously, it is recommended that a CMP is implemented during construction works at the site in order to appropriately avoid, mitigate and remedy the potential for adverse effects on the environment. The CMP will be prepared once the contractor has been appointed and it will be submitted to Council prior to construction as discussed in Section 2.3.4 of the AEE.

Potential effects on human health will also be managed during the construction works by the implementation of a Health Safety and Environment Plan (HSEP) to protect excavation workers and assist with soil and groundwater disposal options. Potential risks will therefore be less than minor with appropriate measures in place.

6.4 Groundwater

The groundwater effects related to the GBWD and Causeway construction works have been assessed in terms of potential groundwater drawdown, diversion, quality, potential for settlement and possibilities for impacts on neighbouring groundwater users.

This section summarises the groundwater assessment carried out and more detail is provided in Volume 2 Technical Report C Groundwater.

6.4.1 Construction Activities and Potential Groundwater Effects

Construction activities with the potential for generating groundwater effects have been identified and assessed in parallel with information gathered from previous groundwater studies and by on site monitoring. The anticipated construction works and excavations that may result in effects on groundwater are:

- **Western end:**
 - Connection of NH1-GBWD: invert depth ranging from 2.5 to 11.5 mBGL, invert level ranging from 8.4mBGL to 0.88 mRL with a shallow gradient in the first 60m followed by a steep descent until approximately 70m and a shallow gradient for the pipejack/micro tunnel pipe until approximately 190m along the pipejack/micro tunnel route.
 - Pipejack/microtunnelling preparation will involve installation of a temporary jacking pit (GBWD) and receiving pit (NH1) prior to beginning the works. The jacking pit is proposed to be approximately 4 m long by 3m wide by 6 m depth with a maximum invert level of approximately -0.6 mRL.
 - Valve chambers will be constructed within the receiving and jacking pits (respectively 4m wide x 3m long x 3.5m deep and 5m wide x 4m long x 3m deep) on either end of the connecting pipeline, and a scour chamber (6m long by 3m wide by 5.5m deep) will be located beside the GBWD valve chamber within the jacking pit sheet piles to the north of SH18.
- **Causeway:**
 - Invert depth for the first 860 m along the proposed causeway embankment varies from 2 to 3.5 mBGL (below ground level) with the invert level ranging from 6.58 mRL (relative to mean sea level) at the start of the GBWD route to -0.20 mRL towards the western end of the causeway.
 - Widening of the existing causeway by 15 m along the northern side for a length of approximately 860m.
 - Construction of a platform (150 m long by 53 m wide) approximately 600 m along the causeway from the western end to enable future phases of work on the NI pipeline.
 - Excavation at low tide of 1.5 m deep and 3 m wide trench along the toe of the future batter before being filled with rock fill to the existing ground levels.
- **Eastern end:**
 - Excavation to connect the valve chamber (6 m long by 4 m wide by 3.5 m deep) located approx. 26 mRL.

Section 3 of the AEE provides a description of the existing environment including geology and groundwater respectively in Sections 3.1.3 and 3.1.5. Four boreholes were drilled and three piezometers installed including two on the western end of Greenhithe Bridge in the vicinity of the receiving pit (BH201), jacking pit (BH202) and one on the eastern end of the bridge (BH204). Figure 6-1 displays the location of these boreholes.

Figure 6-1: GBWD and Causeway Groundwater Bores Location



6.4.2 Groundwater Drawdown Assessment

Groundwater drawdown will potentially occur at construction locations identified in Section 6.4.1. The assessment of drawdown at each location is described below.

- **Western end**

Maximum drawdown in the immediate vicinity of the jacking pit is anticipated to be approximately 2- 2.5 m, due to the construction works for GBWD valve and scour chambers. Installation of sheet piles or concrete caissons will also assist in the reduction of potential groundwater drawdown effects at these locations.

The effects of construction of the NH1-GBWD connection construction on the groundwater drawdown is not considered significant (low flow rates and hydraulic conductivity of 3×10^{-5} m/s) as it will be confined to the immediate vicinity of the works (approximately 2m) therefore the effects are considered less than minor on the groundwater environment.

- **Causeway**

Groundwater ingress along the coastal excavation is anticipated during the construction activities for the causeway, however pumping to remove the water is not expected to have any adverse effects as the groundwater flow directions will remain unchanged and the ingress per metre length is expected to be less than minor (e.g. less than 1 L/s/m of excavation although dependent on depth and width of excavation)..

- **Eastern end**

Water levels at BH204 located in the vicinity of the proposed chamber located near the eastern end of Greenhithe Bridge were observed at 3.8 to 4.1 mBGL (22.8 to 22.5 mRL). Given that the proposed 3.5 m deep chamber is expected to be installed at approximately 26 mRL. It is assessed that there is no potential groundwater drawdown effect on the receiving environment associated with this activity.

6.4.3 Groundwater Diversion Assessment

Similar to groundwater drawdown, groundwater diversion will potentially occur at the construction locations identified in Section 6.4.1. The potential effects are described below.

- **Western end**

Installation of temporary pits and pipejack/micro tunnelling to enable the NH1-GBWD connection are not expected to have an adverse effect on groundwater diversion.

The long term effects have been considered and the construction of valve/scour chambers has the potential to cause the greatest diversion effects due to the permanency of the structures. However in this instance the overall groundwater flow regime will remain unchanged.

- **Causeway**

Groundwater ingress during excavation will be removed by pumping and will be managed on site as required by the Erosion and Sediment Control Plan (refer Section 6.2 of the AEE). The pumping will have minimal impact as it will not interfere with the natural groundwater flow path. The trench will be filled with permanent rock which will also not affect the groundwater flow regime in the long term. Therefore construction activities along the causeway alignment are not anticipated to generate groundwater diversion effects. In addition, the pipes to be constructed within the causeway for both GBWD and NI will be located above approximately 2 m above the mean sea level. Based on groundwater levels recorded within BH204 (the closest groundwater bore to the causeway location) these pipes will be located above groundwater and as such, there will be no effect on groundwater flow as a result of the construction of these pipes.

- **Eastern end**

As previously assessed for groundwater drawdown and based on the proposed depth of the connection chamber located above the water table, this construction activity will not result in any change to the groundwater flow regime.

6.4.4 Groundwater Quality Assessment

Groundwater contamination is assessed in Section 6.3.4 of this AEE and more detail is provided in Volume 2, Technical Report B Soil, Sediment and Groundwater Contamination. On site testing did not identify any areas of groundwater contamination for the proposed GBWD and Causeway site.

6.4.5 Neighbouring Groundwater Users Assessment

Neighbouring groundwater users located within 2 km of the GBWD and Causeway site have been identified from the Auckland Council bore database (refer Section 3.1.5) and are listed in Table 6-3 below.

Table 6-3: Groundwater takes within 2km radius of the GBWD Project Sites

Consent no.	Depth (m)	Casing depth (m)	Purpose	Address	Distance from proposed works (km)
-	-	-	Groundwater and contaminated site investigation	12 Clark Road (BP Oil NZ Limited)	1.2
28653	5	2.6	Monitoring (3 bores)	0 Buckley Avenue	0.5
13844	200	65	Stock and domestic supply	124 Hobsonville Road	1.3
23230	200	65	Stock and domestic supply	5 Upper Harbour Drive	0.9
21320	200	65	Domestic supply	74 Upper Harbour Drive	1.0
27736	200	70	Domestic supply	124 Upper Harbour Drive	1.5

The neighbouring bores appear to be taking water from the Kumeu-Waitemata high use aquifer for water supply (four deep bores) and investigation purposes (two bores). As the effects of groundwater drawdown and diversion have been previously assessed as being no more than minor on the receiving environment, adverse effects on neighbouring groundwater users are not anticipated.

6.4.6 Settlement Assessment

Due to the proposed trenching, tunnelling works, causeway widening and pipe construction works, it is possible that settlement may occur in some locations associated with the GBWD and Causeway if not appropriately managed. This potential risk will need to be managed through design and construction in the existing environment to provide a robust outcome for the GBWD and Causeway, and to minimise effects on property owners, motorway (SH18), road structures, utilities within the road corridor and any other potentially affected stakeholders. Commentary on the potential for settlement effects is provided hereafter.

- **Western end**

The pipe connecting GBWD to NH1 will be pipe-jacked/microtunnelled under SH18 between temporary jacking and receiving pits. Valve chambers will be installed in the two pits and a scour chamber installed alongside the launching pit valve chamber.

Ground settlement may potentially occur under three conditions: groundwater drawdown during construction; ground loss due to pipe jacking during construction; long term groundwater drawdown.

Based on the Groundwater Drawdown Assessment the calculated settlement for groundwater drawdown is 15 mm and will occur immediately adjacent to the launching and scour chamber pits and taper to 5mm at 25m distance (corresponds to 1 m groundwater drawdown at 25 m distance). The use of sheet piling or concrete caissons in the jacking and receiving pits will minimise groundwater inflow into the pits and reduce the predicted 2.5 m drawdown which would occur without sheet piling.

Pipe jacking beneath SH18 is expected to have a minimum cover of three times the pipe diameter i.e. for the 1,200 mm diameter pipe the depth to invert is likely to be approximately 4.5 m below existing ground surface. There is expected to be minimal ground loss above the front pipe as the pipes are jacked beneath SH18.

The receiving pit, which is located below the existing SH18 noise bund, will be approximately 12 m deep and is expected to be below groundwater level. The same amounts of groundwater drawdown and settlement as for the launching pit are expected at the receiving pit.

Settlements will be monitored around the pits and along the line of the pipe jack/microtunnel. Any settlement effects observed are most likely to occur on the ground and road surfaces. Mitigation measures if required include reducing groundwater pumping to minimise settlements, and reinstating ground and road surface levels by filling.

- **Causeway**

Ground settlement may potentially occur under three conditions: causeway widening; groundwater drawdown during construction; long term groundwater drawdown.

The construction method for causeway widening is described in Section 2.3.6. Settlement is not expected to be induced beneath the footprint of the existing causeway where it is overlain by the widened causeway as very soft marine sediments were removed and a mudcrete/rockfill shear key constructed during the 2005/06 causeway widening. The top of the shear key was above high tide which allowed fill to be placed to complete the causeway construction independent of tidal constraints. The settlement monitoring data, which commenced after the shear key was formed, indicates that settlement varied between 50 mm and 150 mm along the length of the causeway. The settlement occurred progressively as fill was placed and ceased when the finished causeway level was reached.

Settlements will be monitored along the cycleway on the existing causeway. If required, mitigation of any settlement will involve restoring the cycleway level by filling or rebuilding portions.

The eastern end of the causeway widening is close to the location of the existing abutment and piers of the bridge. Effects on the existing bridge and piers will be mitigated through design and construction. The piers will be sleeved so that causeway fill loads are not transferred onto the bridge piers. No settlement effects on the bridge are expected.

The Stage 1 of the NI wastewater pipeline will be installed using trenching techniques through engineered fill to the point where the causeway widens. The pipeline will be above groundwater level in the widened causeway and thus groundwater drawdown and associated ground settlement are not expected.

Mitigation measures such as impermeable cut off zones to prevent the pipe granular bedding acting as a drainage layer and affecting the local groundwater levels will be designed and implemented for the watermain at the western end of the causeway (near to the valve and scour chambers) where the pipeline is close to, or below, groundwater level.

- **Eastern End**

The watermain transitions off SH18 on to a concrete slab on the ground surface before terminating in a combined chamber approximately 3.5 m below existing ground level. Groundwater levels were measured to be approximately 4 m below existing ground level (Borehole BH204). It is not expected that any dewatering or associated settlement will occur.

6.4.7 Groundwater and Settlement Assessment Conclusion

To summarise, the potential effects on groundwater and potential for settlement due to the construction works associated with the GBWD and Causeway are considered to be minor and are summarised below:

- Groundwater drawdown of approximately 2- 2.5 m is expected to occur at the western end of the causeway and will be managed by installation of sheet piles around the excavations which will reduce the groundwater drawdown to 0.03 m; overall minimal effect on groundwater levels and flows.
- Minimal groundwater drawdown due to the pipe jack/micro tunnelling activity.
- Groundwater ingress anticipated during excavation for causeway widening purposes will be mitigated through pumping and implementation of Erosion and Sediment Control Plan. Minimal impact on the groundwater flow regime and natural groundwater flow path is anticipated.

- Settlement is not expected to be induced beneath the footprint of the existing causeway where it is overlain by the widened causeway as very soft marine sediments were removed and a mudcrete shear key constructed during the 2005/06 causeway widening.
- The new pipelines will be laid above the groundwater level and thus groundwater drawdown and associated ground settlement are not expected.
- No settlement effects around the bridge structure are expected but the risk will be managed through design and construction. The piers may be sleeved so that causeway fill loads are not transferred onto the bridge piers. Mitigation measures to address potential settlement effects will be confirmed in detailed design.

Overall the groundwater (groundwater flow regime, direction and levels) and settlement effects are anticipated to be less than minor on the receiving environment or on the existing infrastructure.

It is noted, however, that pipejacking or microtunnelling under the motorway will require consultation with Auckland Motorways Alliance (AMA) and a risk identification, management and monitoring approach will be agreed with them to address this component of the works.

6.5 Ecology

This section provides an assessment of effects of the GBWD and Causeway on ecology. The assessment addresses potential effects on the following:

- Marine benthic ecology;
- Water quality;
- Sediment quality;
- Coastal seabirds;
- Terrestrial and coastal vegetation;
- Lizard habitat.

Further detail is provided in Volume 2, Technical Report D – Ecological Assessment.

6.5.1 Marine Ecology

A range of site investigations were undertaken to inform the assessment of effects on marine ecology, and these are summarised below:

- A semi-quantitative study of the estuarine benthic (surface) and sub-benthic (below surface) flora and fauna of the Upper Waitemata Harbour affected by the proposed GBWD Project was carried out at low tide on 30 May 2014 with further work undertaken on 21 November 2014 in response to the addition of the NI construction platform to the causeway footprint.
- Water quality samples were collected at four predetermined sites on the ebb tide on 2 July 2014 between 11:15 and 11:55 am. The locations of these sites are shown in Figure 6-2. Field measurements of dissolved oxygen, pH and temperature were also undertaken. Data were compared against ANZECC marine guidelines and NZ Bathing Water guidelines.
- Five sediment samples were collected by Opus between 5 - 9 June 2014 and a further three sediment samples were collected by T&T on 21 November 2014. The locations of these additional sampling sites are shown in Figure 6-2. To assess the ecological sediment quality status of the site, the results were compared to the Auckland Council Environmental Response Criteria (ERC).

These investigations found that the marine sediments had relatively low contaminant levels overall and are similar to those recorded in previous studies. Sediment quality was considered a low risk factor for the biology located at the site. Water quality results suggest that the receiving water has some nutrient and microbial issues, most noticeable at a site located near the discharge point of an existing stormwater drain.

Marine fauna was generally dominated by in-faunal worm species and no threatened marine invertebrates were identified. Kaimoana species were generally small, of low abundance and not attractive as an edible resource.

6.5.2 Terrestrial Ecology

Vegetation and habitat types within the study area were also recorded during the site visits to assess the value of the area and its significance to coastal birds. These are also shown on Figure 6-3.

Terrestrial vegetation within the footprint of the works consists of mangroves, saline vegetation, native re-vegetation and exotic mixed forest vegetation. The location of each type of vegetation is shown on Figure 6-3.

Exotic and native mixed forest located at the eastern and western ends of the causeway (Figure 6-3) comprises habitat suitable for native copper skinks (*Oligosoma aeneum*). Suitable skink habitat within this vegetation type comprised thick leaf litter ground cover and woody debris.

6.5.3 Coastal Bird Survey

The coastal bird survey area encompasses 29.7 ha of inter-tidal zone located within the GBWD Project footprint and immediate surrounds (Figure 6-3).

The coastal bird survey included 24 site visits between May 2014 and March 2015. Eight site visits were completed between 27 May and 20 June 2014, a further eight between 20 November 2014 and 4 December 2014, and another eight between 16 February and 10 March 2015 (late summer/early autumn). The site visits were timed to ensure that bird surveys were undertaken across a range of tides, including two surveys each at low, mid-low, mid-high and high tides.

During the bird surveys, all coastal bird species present were identified and their abundance within the study area recorded. Birds were categorised as roosting or non-roosting.

Additionally, surveys for banded rail (*Gallirallus philippensis assimilis*) were undertaken on 9 December 2014 within the saltmarsh vegetation and mangroves located to the immediate northwest of the Greenhithe Bridge (refer Figure 6-7).

A total of 289 birds from 17 species were identified within the survey area. Of the species recorded, four were classified as threatened and nationally significant. These were Red-billed Gull, Pied Shag, Caspian Tern and Banded Dotterel. Six species are classified as "At Risk" (pied oystercatchers, pied stilts, white-fronted terns, banded rail, black shag and variable oystercatcher). 26 of the 289 birds were noted as roosting while the remainder were predominantly foraging.

Figure 6-2: Water Quality Sampling Locations



Figure 6-3: Bird Survey Locations at GBWD and Causeway



6.5.4 Ecology Assessment Conclusion

The footprint of the proposed works covers approximately 2.7 hectares. This area will no longer be available to the benthic ecology and birds once the widened causeway is in place. The areas of these habitats within the footprint and the percentage of total works footprint are presented in Table 6-4.

Table 6-4: Ecology habitat covered by GBWD and Causeway works

Habitat Type	Area covered by Footprint (ha)	Percentage of total works footprint (%)
Mangroves	0.22	8.0
Firm muddy sand	0.03	1.1
Sandstone reef	0.78	28.5
Soft gloopy mud	0.62	22.6
Sandstone reef with oyster bed	0.19	6.9
Rock wall	0.62	22.6
Subtidal Channel	0.28	10.2
TOTAL	2.74	100.0

Overall, due to the relatively small area (2.7ha) of habitat loss compared to the available habitat throughout the Waitemata Harbour, the fact that the species composition of the site is generally dominated by in faunal worm species and that no threatened marine invertebrate species were identified, it is considered that the loss of intertidal habitats in the project area will have only minor adverse effects on intrinsic marine ecological values. Indirect effects on coastal birds from loss of foraging habitat are discussed further below.

The intrinsic value of the area for kaimoana gathering is low, the abundance of edible species is deficient and the individuals observed are small. Long term effects of the project will include the loss of approximately 2.24 hectares of foraging habitat for coastal bird species which include four nationally “threatened” species and five “At Risk” species. The project will also result in the loss of approximately 0.22 hectares of mangrove foraging habitat for Banded Rail.

The adverse effects on birds are considered to be more than minor on the basis that the project footprint and immediate surrounds includes habitat for several nationally “threatened” and “at risk” species as well as the internationally important bar-tailed godwit.

Effects on terrestrial ecology are less than minor given that no notable species were identified, most areas will quickly be recolonized after the construction is completed and a planting plan will be developed and implemented for the project site.

Copper skink habitat (herpetofauna) has been identified in the exotic vegetation located at the western end of the proposed works footprint, therefore without mitigation there will be effects on copper skink through loss of habitat and potentially injury.

6.5.5 Recommended Mitigation

Due to the relatively small area affected by the project footprint compared with the wider Waitemata Harbour and that part of the project footprint (the rock wall) will be recolonized, it is considered that no specific mitigation for the long-term effects on marine ecology is required.

Short-term, construction related effects can be managed by standard construction management techniques, such as sediment control appropriate storage of environmentally hazardous substances, so that they do not find their way into coastal environments, and selection of tracking routes to, through and around the active construction site, which avoid areas of highest ecological value.

To avoid or minimise potential adverse effects on birds, construction activities would ideally be undertaken outside of September - December, which is the breeding season for banded rail, and is also when international migratory species are present. However, this is unlikely to be practicable for a project of this scale. The proposed mitigation package (below) is intended to address both the construction effects of the project, as well as the permanent loss of 2.24 ha of foraging habitat for nine nationally Threatened or At Risk and one internationally important coastal bird species (bar-tailed godwit) and loss of 0.22 ha of foraging habitat for banded rail. The proposed mitigation package expected to adequately mitigate for loss of 0.22 ha of foraging habitat for banded rail comprises the following elements:

- Saltmarsh and coastal margin revegetation and weed control within the area outside the project footprint to the north-west of the Greenhithe Bridge, which has been identified as banded rail habitat (nesting and foraging habitat);
- 5 years of mammalian pest control within the area described above and within SEA-T-4791, which is expected to include banded rail based on the size and availability of suitable nesting and foraging habitat for this species.

The proposed package is expected to partially mitigate for the loss of 2.24 ha of foraging habitat (inter-tidal sand/mud flats) for coastal birds, including nine nationally “Threatened” or “At Risk” species. Proposed compensation efforts include:

- The creation of an approximately 1,000 m² raised artificial shellbank roost site on the area known as ‘The Tab’ that is situated at least 20 m from the nearest pathway;
- The addition of at least 12 piled roosts located on the side slope of the reclamation extension, to the immediate west of the Greenhithe Bridge;
- Fencing between the artificial shellbank roost site and the walkway to minimise disturbance from humans and disturbance from dogs;
- 5 years of mammalian pest control (traps and bait stations) along the northern causeway and “Tab” to protect roosting and possibly nesting birds from predation by hedgehogs, rats, cats and stoats; and
- Signage to highlight the importance of the wider area and artificial roost site for the protection of coastal birds.

In addition, to avoid or minimise adverse effects on copper skinks associated with the loss of terrestrial vegetation, pre-construction and construction-assisted salvaging be undertaken by a DOC-permitted herpetologist is recommended. Any salvaged skinks captured should be relocated into the terrestrial vegetation at the eastern end of the Greenhithe Bridge that is located within the project footprint. This habitat should be enhanced for copper skinks through the addition of logs from trees felled during vegetation clearance activities associated with this Project.

Overall, a mitigation package has been proposed to address long-term effects on coastal birds from loss of foraging habitat. The creation of an artificial roost site in the Project footprint will benefit most of the affected species, and a programme of predator control will benefit all species, and particularly banded rail. The detailed design phase of the Project will include ecological input, to assist with the final design of the mitigation package, taking into account any subsequent changes in the footprint of the causeway widening.

6.6 Arboriculture

An arboricultural survey was carried out on 22 December 2014 to assess the effects the proposed works may have on vegetation. Full details of this assessment are provided in Volume 2, Technical Report E Arboricultural Assessment. A summary of the assessment is presented below.

6.6.1 Potential Effects

6.6.1.1 Connection between NH1 and the new watermain – Western end and Scour Valve

To the south of the motorway, the location of the southern chambers and jacking pits is in an area that was previously vegetated as part of the previous NZTA causeway works. The vegetation is predominantly native with some weed species and is not protected by the District Plan rules or PAUP rules as the vegetation is less than 6m in height. Some of this vegetation will need to be removed whilst some can be retained and protected through the use of fencing.

On the northern side of motorway, the works consist of construction of the Western access way (CE2) and the installation of valve chambers and a scour valve. In the vicinity of the western access way and proposed site yard, the vegetation is much older and comprises mature exotic trees in the private property adjacent the SH18 road reserve. Works associated with the site yard may require trees to be removed if the root zones are compromised whilst excavation for pipe installation adjacent to the property boundary will require tree removal. Installation of the a temporary access way as shown on Drawing 2010673.008 requires the removal of a group of exotic trees and all the trees east of the private road. These trees are protected (when over 6m in height) according to the District Plan due to the site on which they are growing not meeting the definition of 'urban environment' according to the RMA Simplify and Streamline (2009) Bill. Resource Consent is required for their removal.

6.6.1.2 Causeway widening and Installation of pipes within the causeway

Widening of the existing motorway causeway embankment will involve the removal of all vegetation located on the causeway. This vegetation includes native and exotic plant species. The native plant species include pohutukawa trees (*Metrosideros excelsa*), Muehlenbeckia shrubs (*Muehlenbeckia astonii*), and flax (*Phormium sp.*). The exotic plant species include and weed plant species such as brush wattle (*Paraserianthes lophantha*) and pampas grass (*Cortaderia selloana*).

The pohutukawa trees within the causeway area include a total of 122 trees greater than 1.2m in height. The pohutukawa trees are a mix of self-seeded trees and planted trees. The planted trees, established after causeway widening completed in 2005, have stakes and ties still attached to their main stems. The self-seeded pohutukawa have colonised the causeway embankment from local seed-source. These naturally-occurring trees highlight the resilience of coastal pohutukawa and the viability of natural seed source for natural regeneration. The removal of the trees will be a temporary set-back to the process of natural regeneration.

6.6.1.3 Connection between NH1 and the new watermain – Eastern end and valve chambers

These works will be carried out in an area characterised by long grass that is devoid of trees. However, alongside the northeast corner of Greenhithe Bridge there are four young pohutukawa (*Metrosideros excelsa*) and four ti kouka (*Cordyline australis*) that surround a series of brass plaques that commemorate the opening of the bridge. These trees will require removal.

6.6.2 Mitigation

The following tree protection methodology is recommended:

- Where the clearance of vegetation is required, the works will be carried out in a manner that avoids harm to protected trees and other native vegetation that is to be retained.
- All protected trees proposed to be retained and growing in close proximity to the works associated with the pipeline construction and associated works, are to be protected in a manner that ensures that potential adverse effects are avoided and/or minimised.
- A suitably experienced arborist (appointed arborist) should be engaged to provide specific advice in relation to the protection of trees and their roots whilst works are being carried out.
- Areas for stockpiling materials and for storing machinery will be outside of the dripline area of the trees that are to be retained.

- Where appropriate, protective fencing (consisting of 1.8 metre high pole mesh fencing or protective water-filled barriers or acceptable equivalent) is to be erected and positioned between the line of works and all permeable areas within the dripline of protected trees so as to restrict access to/storage on such areas. The protective fencing is to be erected prior to any works occurring in close proximity to protected trees.
- All excavation machinery is to operate from outside the dripline of protected trees unless the machinery can operate from and remain fully on top of an existing impermeable hard surface or temporary surface emplaced for this purpose.
- Treatment of tree roots associated with the pipeline installation and open cut trenching works is to be undertaken in accordance with accepted arboricultural practices.
- Removal of vegetation within the works site areas will be mitigated by replacement planting of suitable species in locations where they were removed from or in new areas where there is agreement from respective landowners, Council and/or NZTA. It should include a comprehensive landscape mitigation planting plan suitable to offset the effects arising from the removing substantial trees.

6.6.3 Arboriculture Effects Conclusion

It has been established that the proposed works will require removal of vegetation from four areas along the route, including one on private property.

The vegetation that is affected by the works on private property consists of large, mature exotic trees that form a sizable stand of trees. The proposed works results in more than minor effects from the removal of these mature trees, which can be mitigated by replanting.

The majority of the vegetation that is affected by the works consists of small, recently planted trees within the road reserve of SH18. The proposed works results in a temporary set-back to the establishment of vegetation within the areas of works.

Provided the proposed works are carried out in accordance with the tree protection methodology set out in Technical Report E – Arboriculture and replacement planting is carried out in the vicinity of where vegetation is removed, adverse effects on protected vegetation will be suitably avoided and mitigated and residual adverse effects will be less than minor.

6.7 Water Quality

This section provides an assessment of potential effects on water quality at the proposed GBWD Project site.

6.7.1 Stormwater Outfalls

Stormwater outfalls within the GBWD Project area consist of five stormwater culverts (including a twin culvert) and are proposed to be extended and modified as described in Section 2.3.3.1 of this AEE.

The existing stormwater culverts will be extended and relocated to accommodate the proposed works (refer to Drawings 2010674.002, 2010674.003, 2010674.004 and 2010674.007 for the location of the stormwater culverts, and Drawings 2010674.030, 2010674.031 and 2010674.032 for further detail). The stormwater culvert modifications will not generate changes in the upstream catchment; in addition, stormwater discharge volumes, capacity and stormwater discharge quality are anticipated to remain as the current situation, with the implementation of effective erosion and sediment control measures during construction.

A number of possible measures have been considered to minimise the potential risk of contamination of existing stormwater discharges during the proposed construction works. These are listed as follow:

- Filter sock: Attach to dewatering discharge hose from sedimentation tank before any discharge to stormwater network;

- Catchpit protection: Cover catchpit grate and inlet with geotextile to filter sediment laden runoff before discharge into stormwater network;
- Management and protection of the existing stormwater culverts to be considered as these will continually inundate the bunded area during causeway widening. Any water requiring pumping from the site will be routed through a Sedimentation Tank (ST) before discharge to receiving waters. STs will typically require the addition of flocculation agents to allow sediment to settle in the relatively short detention time available.

Stormwater from the existing upstream catchment is currently treated in a variety of consented treatment devices. This project will not affect this level of treatment either during construction or in the longer term.

The effects of the stormwater structure modifications on existing stormwater discharges are considered as being less than minor on the receiving environment providing mitigation measures are implemented. Further details are provided in Volume 2, Technical Report A – Earthworks, Erosion and Sediment Generation.

6.7.2 New Impervious Areas

In addition to the existing shared path, which was previously constructed and consented by NZTA as part of the 2005 causeway extension, a new concrete access way is proposed, extending from the western embayment towards the point where the watermain transitions from the causeway to the Greenhithe Bridge (refer to Indicative Landscape Plan in Appendix 3 of Technical Report I – Landscape and Visual Assessment). It will have a resulting surface area of approximately 3,200 m².

The access way will provide for Watercare's future access for routine inspection maintenance and operational purposes and will also connect to the existing shared pedestrian and cycleway and provide closer access to the CMA for those users.

Maintenance visits will be carried out generally using light vehicles but access will also be required to cater for heavier vehicles such as small trucks and (cherry picker type) equipment. The frequency of these visits is expected to be no more than six times per year.

The extent of the surface area of the new access way means it is a Controlled Activity under Rule 5.5.2 of the Auckland Regional Plan - Air Land and Water. Table 6-5 addresses this requirements (a – g) of this rule.

Table 6-5: Requirements of Auckland Regional Plan - Air Land and Water Rule 5.5.2

Statutory Reference	Assessment
a) Combined Impervious Area	The existing access way within the motorway designation has been assessed and consented by NZTA. The total impervious area of the new access way will be approximately 3,200 m ²
b) Stormwater Network Discharge Consent	Stormwater runoff from the proposed access way is not authorised by an existing Stormwater Network Discharge Consent
c) Erosion control and fish passage	Fish passage is not relevant as the stormwater will not be discharged directly to a water course. Erosion and sediment control will be implemented through the use of a grassed swale or filter strip alongside the access way.
d) Habitable Floor Flooding	There are no habitable floors in the vicinity of the access way and hence there is no potential for habitable floor flooding.

Statutory Reference	Assessment
e) Stormwater treatment	<p>The volume of runoff generated from the access way has been estimated using 24 hour rainfall depths from TP108 to be 136m³ in a 2 year event, 171m³ in a 10 year event and 207 m³ in a 100 year event with climate change. The increase in peak flows generated by the access way are 17 l/s, 23 l/s and 30 l/s respectively for these storm events.</p> <p>Given the very infrequent use of the pathway by motorised vehicles the resulting contaminant load generated will be minimal.</p> <p>The stormwater runoff from the new access way will be managed and treated at source using grassed swales or filter strips designed with reference to Auckland Council Technical Publication 10 (TP10).</p>
f) Overland Flow Path	<p>Stormwater flow generated from the new access way surface during a 100 year Annual Return Interval storm event will be directed overland via the vegetated swales/filter strips, where it will either percolate into the ground or flow over the grassed surface to a manhole inlet where it will be piped under the embankment to the CMA. Due to topography constraints, it is proposed to cut down the slope of the new embankment allowing for the new access way and diversion of overland flow. At the western end on the causeway the existing topography generates an overland flow path that directs stormwater flows to the low lying area around the existing sand filter structure and outlet to the CMA. Construction of the proposed temporary then permanent access roads on to embankment will require permanent modification of the ground profile in this area effectively cutting off the existing overland flow path outlet. Future overland flow will be captured at the current outlet position by an inlet manhole then piped below the extended embankment to the proposed CMA outlet location.</p>
g) Future Ownership of stormwater assets	<p>No new outfalls, pipe work or “hard” stormwater assets are proposed. The future ownership and management of the land to be erected by the causeway widening and extension is yet to be confirmed unless the stormwater discharge consent is transferred, ongoing management of the stormwater swales/filter strips will continue to be undertaken by Watercare, as consent holder.</p>

On the basis of the above assessment and with the provision of swales or filter strips, the effects of the new impervious area created are considered to be less than minor.

6.7.3 Potential Water Quality Effects

Several construction activities have the potential to affect marine water quality. In particular, sediment generation during construction and the widening of the causeway using Lime Cement Mixing may generate potential contamination that will have to be appropriately addressed in the Erosion and Sediment Control Plan (ESCP) and Construction Management Plan (CMP) in order to reduce the potential for contamination of receiving waters.

Lime cement mixing or mudcrete/rockfill is commonly used to stabilise contaminated sites and weak soils and sediments because of its ability to bind contaminants, reduce leaching and increase soil stability. In fact it was a key part of the construction methodology for the 2005/06 causeway widening. Though commonly used in the marine environment for reclamation projects this process has the potential to release contaminants to the receiving waters in the form of locally generated particulates and an increased pH. However, extensive monitoring undertaken for the Ports of Auckland on other projects in the Waitemata Harbour has found no problems with contamination or biotoxicity. The potential risks can be managed on site and this typically involves appropriate sediment control measures. Contaminant risks on the environment and to human health due to chemical use and storage will be identified and managed through the CMP and Health, Safety and Environmental Plans (HSEP).

In the longer term, stormwater runoff from the proposed access way has the potential to convey sediment and other contaminants to the harbour, however given the frequency of use by motorise vehicles and the provision of treatment swales or filter strips the potential for adverse effects is considered to be less than minor.

6.7.4 Water Quality Assessment Conclusion

Water quality is generally fair to good in this part of the Upper Waitemata Harbour but has been found to be slightly compromised in the immediate vicinity of a discharge from an existing stormwater drain. Whilst it is anticipated that the existing stormwater outlets will have to be extended/relocated, the level of service will remain the same.

Construction activities are generally not anticipated to significantly increase the level of contaminants in the receiving water providing that mitigation and management protocols are put in place to minimise the discharge of sediment and other contaminants such as fuels, bulk chemicals and those derived from the LCM process. In the long term the provision of a new concrete access way along the length of the causeway will introduce a new impervious area of approximately 3,200 m². The runoff from this access way will be treated and managed using vegetated filter strips or grass swales. The water quality at the site is expected to have similar annual water quality index following the widening of the causeway. Any potential risk of contamination will be identified, managed and mitigated through the CMP.

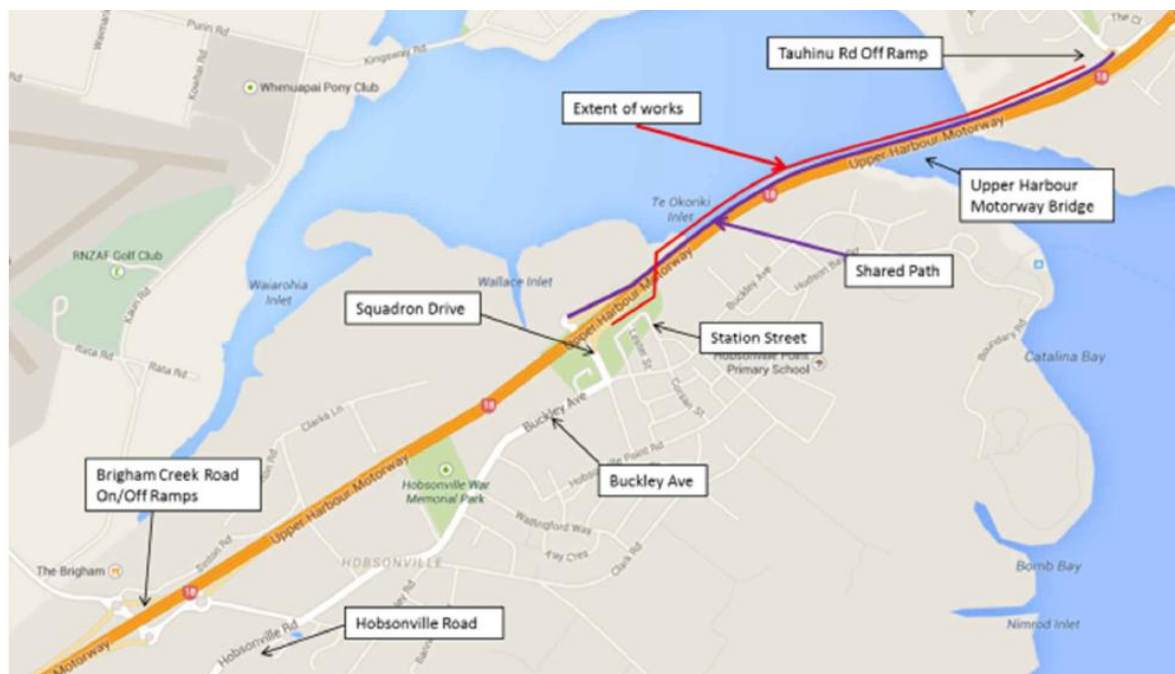
The overall effects have been assessed as being less than minor on the water quality.

6.8 Traffic

This section summarises the traffic assessment carried out and more detail is provided in Volume 2 Technical Report F Traffic Assessment Report.

The transport effects related to the construction of the Greenhithe Bridge Watermain Duplication and Causeway Project have been assessed in relation to the seven construction elements and locations described in Section 2.3.4. Figure 6-4 presents an overview of the local transport network.

Figure 6-4: Overview of Local Transport Network



For the purposes of this assessment, transport system users were defined as pedestrians, cyclists and general vehicles (light and heavy vehicles not associated with the proposed construction works) using the publicly accessible road reserve. Any movement of construction vehicles outside of the publicly accessible road reserve will not affect the transport system users and therefore has not been considered as part of this assessment of effects.

It will be the responsibility of the successful contractor to adopt a construction methodology and staging which allows the outcomes presented in this AEE to be achieved. To do so will require the contractor to develop a logistics plan for construction vehicle movements on the construction site.

The traffic management measures presented have been considered at a high level based on the available information description of works and construction methods in Section 2 of this AEE and these options may change as further information becomes available design details are finalised and construction methods are confirmed. It will be the responsibility of the successful contractor to prepare detailed Traffic Management Plans (TMPs) prior to construction which detail construction access and egress to site. The TMPs will be in accordance with the New Zealand Transport Agency's Code of Practice for Temporary Traffic Management (CoPTTM).

6.8.1 Potential Effects on Transport System Users

Potential effects on the transport system users include:

- Road closures and detours
- Obstruction by construction vehicles
- Increased traffic volume
- Closure of cycleways and footpaths
- Increased parking in residential streets
- General delay
- Safety issues due to increased numbers of general and heavy vehicles

These potential effects have been assessed and options to manage and mitigate such effects have been evaluated. The recommended options are outlined as follows.

6.8.2 Assessment of Traffic Management Measures

Traffic management is an integral part of infrastructure works throughout Auckland and there are well established procedures to manage these potential effects.

A number of options for construction access and egress as part of the Greenhithe Bridge Watermain Duplication and Causeway project were assessed for the key elements of construction and the transport effects of these have been explored. The detailed analysis of these options is provided in Technical Report F – Traffic Assessment. The preferred traffic management measures are discussed below.

6.8.2.1 CE 2 and 6- Pipe connection west end and west end valve chambers

To facilitate these works, Option 1 (access and egress from Station Street) was selected for light vehicles and Option 3 B for heavy vehicles (use of Squadron Drive roundabout to turn around and egress via Station Street or left onto Squadron Drive).

The daily volume of construction traffic accessing the receiving pit may be in the order of 25 vehicles per day. This volume is not considered to be of a significant quantum and will have a less than minor effect on the operation of SH18 and the local road network providing that staff car parking arrangements are managed.

The selected options are considered to minimise effects due to both light vehicles and heavy construction vehicles. Option 1 provides easy and safe access for light vehicles and Option 3B will avoid the use of the narrow local roads for heavy vehicles but will require construction vehicles to cross the Squadron Drive off-ramp. This is considered to have a less than minor safety impact due to the low volume of general vehicles using the off-ramp, the length and uphill gradient of the off-ramp and the fact that vehicles currently turn right and merge with vehicles on the off-ramp. Construction vehicles will be required to give way to vehicles coming off the motorway.

6.8.2.2 CE 1, 6 and 7 (Causeway widening, West end chambers and Scour chamber)

Option 1A has been selected as the preferred option for all vehicles used to carry out these works and it consists of access via the private road off Squadron Drive. This option will have the least effect on general vehicles as construction vehicles would not use SH18 for access or egress, therefore no temporary traffic management would be required on SH18.

A minor increase in traffic on the local road network is expected during the works. The daily volume associated with this activity is likely to be in the order of 50 construction vehicles per day. On Hobsonville Road / Buckley Avenue the additional construction traffic is in the order of 5% of the existing traffic in each direction assuming that construction material comes from the west and it would be less than this 5 % if construction traffic approached from the east. This increase is considered to have a less than minor effect on the local road network.

6.8.2.3 CE 3 and 4 (New watermain connection to Greenhithe Bridge and Watermain transition structure west end Greenhithe Bridge)

The daily volume of construction vehicles associated with this activity is likely to be in the order of 20 vehicles per day. It is proposed that they would access the construction area via the causeway or the motorway and would exit either via the existing shared path at the eastern end of the bridge or at the western end of the project site (Option1).

Cycle path and pedestrian access will be maintained during this element of the works by diverting the shared path into the eastbound crawler lane separated from general traffic by a temporary concrete or steel barrier. This is considered to have a less than minor effect on cyclists and pedestrians but will reduce the number of lanes available on the motorway for general traffic use to two. The assessment considers that the volume of traffic using the motorway can be accommodated within these remaining lanes.

6.8.2.4 CE 5 Connection between NH1 and new watermain – East End

The daily volume of construction traffic associated with this activity is likely to be in the order of 25 vehicles per day.

Option 3A has been suggested as the preferred option for this element in terms of minimising traffic effects. It involves access from Tauhinu off-ramp with modifications to the existing traffic island to allow the left turn for larger vehicles and will require construction traffic to reverse approximately 350m to the site. Option 3B has a similar impact on the transport environment and may be a more practical option. If sufficient space is made available at the construction site, vehicles can turn around which removes the need to reverse to or from the site. Both options would also require the closure of the left turn onto Tauhinu Road from the motorway off-ramp.

Access to the shared path would be maintained and safety managed through the use of a gated system which will exclude pedestrians and cyclists when construction vehicles cross the shared path.

The preferred option will require a detour to be set up for general vehicles wishing to turn left from the off-ramp onto Tauhinu Road. The detour would use the roundabout at Upper Harbour Drive / William Pitcher Place which is approximately 250 m from the off-ramp. The volume of vehicles which would be detoured would be less than 1,600 vehicles per day. This is considered a less than minor effect on general vehicles as the additional distance they are required to travel is minimal.

6.8.3 Traffic Assessment Conclusion

In conclusion, the following traffic management measures have been assessed to have the least adverse effect on the transport environment and are preferred from a transport perspective.

- Construction elements 2 and 6: A combination of Option 1 for light vehicles (via Station Street) and Option 3B for heavy vehicles – alternative access from the east.

- Construction elements 1, 6 and 7: Option 1A – access and egress via the private road off Squadron Drive with construction traffic arriving from the east.
- Construction elements 3 and 4: Option 1 – divert the shared path into the eastbound crawler lane.
- Construction element 5: Option 3A or 3B – access from Tauhinu off-ramp with modifications to the existing traffic island to allow the left turn for larger vehicles (i.e. closure of off-ramp with diversion 350 m down the shared path).

Although these are the traffic management measures with the least effect on the transport environment, it is recognised that they may not be the preferred options in terms of constructability or the preferred options of all stakeholders. If they are deemed unacceptable from a constructability or stakeholder perspective, an alternative option could be chosen. The potential effects of the alternative options presented in this report can be managed providing the following key outcomes are achieved:

- The preferred option would be to maintain the shared path connectivity between Squadron Drive and Tauhinu Road for the duration of the project. Any temporary closures necessary for construction should be discussed with Auckland Transport (AT) and the New Zealand Transport Agency (NZTA) to agree an acceptable temporary closure period. Temporary diversions of the pathway may be required as agreed with NZTA/AT. This could be by utilizing the shoulder/crawler lane of the motorway. Such diversions will afford full safety protection for users to the standards required by NZTA/AT, similar to those measures undertaken in locations along SH16 at Waterview.
- Temporary closures may be required from time to time and will be implemented in full consultation with NZTA/AT. Working out of hours will be minimised unless imposed by NZTA/AT. Consideration will be given to providing shuttle transport. The option for publically advertised closure at nominated periods may also be required for safety reasons.
- The clear through width of any temporary shared path must be at least 2.5 m wide or an alternative method of transporting users across the bridge in a short term
- The successful contractor must complete detailed Traffic Management Plans (TMP) for all necessary stages of work in accordance with CoPTTM as per the normal requirements for proposed works within the road reserve.
- The New Zealand Transport Agency, Auckland Motorway Alliance and Auckland Transport are to be consulted on the contractor's TMP prior to construction beginning.
- A 0.9m safety /deflection zone is provided between any temporary barrier separating motorway traffic from pedestrians and cyclists. This differs to the requirement in CoPPTM and reflects the current performance of temporary barriers available in Auckland.
- Closure of motorway on and off-ramps should be restricted to after 11 pm and before 6 am where possible. In addition, long term of Tauhinu off-ramp (months) will be subject to TMP and stakeholder communications with the New Zealand Transport Agency and Auckland Transport.
- Two traffic lanes must be operational in both directions on SH18 for the duration of the project. If necessary, the shoulder or crawler lane with reduced land width and 80kph speed restrictions maybe required.
- Where possible construction materials and supplies shall arrive to site from the east via SH18.
- A dedicated site staff car park should be provided.
- Upon completion of the project the existing transport environment shall be restored to the preconstruction condition.

If the above outcomes are achieved, the overall effect of the Greenhithe Bridge Watermain Duplication and Causeway Project is considered to have a less than minor effect on the transport environment.

6.9 Noise and Vibration

The proposed Greenhithe Bridge Watermain Duplication and Causeway project has the potential to result in temporary construction noise and vibration effects in the vicinity of the proposed construction works. Construction activities and sensitive noise receivers were identified and the levels of noise and vibration have been estimated and compared to relevant standards and guidelines. Once completed, there will be no noise effects during the watermain operation.

This section summarises the noise and vibration assessment carried out and more detail is provided in Volume 2 Technical Report G Construction Noise and Vibration.

6.9.1 Construction Activities and Locations

The GBWD and Causeway project will involve seven construction elements (CE1 – CE7). Based on the construction methodologies proposed for the CEs, particularly relevant work locations in terms of noise and vibration effects have been identified as shown in Table 6-6. These seven locations are related primarily to the relative proximity of sensitive receivers.

Table 6-6: GBWD and Causeway work areas in relation to Noise and Vibration

Construction Element	Activity	Sub-task
CE1	Causeway widening and extension and installation of new pipes within the causeway	Initial works
		Causeway widening
		Pipe installation
CE2	Connection pipe between NH1 and the new watermain – west end	Sheet piling
		Excavation
		Pipe jacking
		Steel pipe insertion
CE3	New watermain connection to the Greenhithe Bridge	Bracket installation
CE4	Watermain transition structure at the west end of the Greenhithe Bridge	Causeway extension
		Piling
		Thrust block construction
CE5	Connection between NH1 and the new watermain – east end	Sheet piling
		Chamber construction
		Pipe jacking
		Piling
		Thrust block construction
CE6	West end valve chambers	Sheet piling
		Excavation
		Chamber construction
CE7	Scour chamber	Sheet piling
		Excavation
		Chamber construction

The sensitive noise receivers were identified in terms of their proximity to the construction site (refer Figure 6-5) and are summarised in Table 6-7.

Table 6-7: Location of Sensitive Noise Receivers relative to each work area

Construction Element	Description	Closest sensitive receiver	Distance
CE1	Causeway widening and extension and installation of new pipes within the causeway	15 Buckley Avenue, Hobsonville	70 m
		1 Squadron Drive, Hobsonville	90 m
		2 Squadron Drive, Hobsonville	230 m
CE2	Connection pipe between NH1 and the new watermain – west end	29 Station Street, Hobsonville	12 m
		1 Squadron Drive, Hobsonville	90 m
		2 Squadron Drive, Hobsonville	200 m
CE3	New watermain connection to the Greenhithe Bridge	4 Beach Road, Hobsonville	125 m
		8 Marine Parade, Hobsonville	170 m
		15 Buckley Avenue, Hobsonville	180 m
CE4	Watermain transition structure at the west end of the Greenhithe Bridge	4 Beach Road, Hobsonville	125 m
		15 Buckley Avenue, Hobsonville	150 m
		8 Marine Parade, Hobsonville	200 m
CE5	Connection between NH1 and the new watermain – east end	23 Austin Road, Greenhithe	200 m
		14 The Knoll, Greenhithe	220 m
		12 The Knoll, Greenhithe	240 m
CE6	West end valve chambers	29 Station Street, Hobsonville	12 m
		1 Squadron Drive, Hobsonville	90 m
		2 Squadron Drive, Hobsonville	200 m
CE7	Scour chamber	1 Squadron Drive, Hobsonville	110 m
		29 Station Street, Hobsonville	210 m
		2 Squadron Drive, Hobsonville	270 m

The sensitive receivers identified above include the Summerset retirement village and private property on Squadron Drive. Whilst there are other properties close to the work areas, the receivers listed above are the closest and hence most potentially affected properties. Properties at greater distances from the work areas will experience lower noise levels due to the increased separation.

Figure 6-5: Nearest residential receivers to the work site (red shading) of the GBWD and Causeway Project



6.9.2 Noise Level Assessment

Noise and vibration levels associated with the construction works without mitigation were assessed using the method provided in NZS 6803, and the relevant long term construction noise criteria. Table 6-8 to Table 6-13 include the predicted noise levels L_{Aeq} . These have been separated into sub-tasks for each construction element, which are expected to be performed in a sequential manner.

The predicted noise levels are colour coded based on the noise criteria. These are as follows:

- Day (D), weekday and Saturday, meets limit, ≤ 70 dB Green
exceeds limit > 70 dB Red
- Night (N), all days meets limit ≤ 45 dB Green
exceeds limit > 45 dB Red

Table 6-8: Indicative noise levels for the CE1

Construction element	Task	70 m			90 m			230 m		
		15 Buckley Ave			1 Squadron Dr			2 Squadron Dr		
CE1 – Causeway widening and extension and installation of new pipes within the causeway	Initial works	65 dB	D	N	62 dB	D	N	54 dB	D	N
	Causeway construction	67 dB	D	N	65 dB	D	N	57 dB	D	N
	Pipe installation	66 dB	D	N	64 dB	D	N	55 dB	D	N

Table 6-9: Indicative noise levels for CE2

Construction element	Task	12 m			90 m			200 m		
		29 Station St			1 Squadron Dr			2 Squadron Dr		
CE2 – Connection pipe between NH1 and the new watermain – west end	Sheet piling	90 dB	D	N	72 dB	D	N	65 dB	D	N
	Excavation	75 dB	D	N	57 dB	D	N	51 dB	D	N
	Pipe jacking	74 dB	D	N	57 dB	D	N	50 dB	D	N
	Steel pipe insertion and grouting	80 dB	D	N	63 dB	D	N	56 dB	D	N

Table 6-10: Indicative noise levels for the CE3

Construction element	Task	125 m			170 m			180 m		
		4 Beach Rd			8 Marine Pde			15 Buckley Ave		
CE3 – New watermain connection to the Greenhithe Bridge	Bracket installation	70 dB	D	N	69 dB	D	N	66 dB	D	N

Table 6-11: Indicative noise levels for the CE4

Construction element	Task	125 m			150 m			200 m		
		4 Beach Rd			15 Buckley Ave			8 Marine Pde		
CE4 – Watermain transition structure at the west end of the Greenhithe Bridge	Causeway extension	60 dB	D	N	58 dB	D	N	56 dB	D	N
	Piling	60 dB	D	N	58 dB	D	N	56 dB	D	N
	Thrust block construction	61 dB	D	N	59 dB	D	N	57 dB	D	N

Table 6-12: Indicative noise levels for the CE5

Construction element	Task	200 m			220 m			240 m		
		23 Austin Rd			14 The Knoll			12 The Knoll		
CE5 – Connection between NH1 and the new watermain – east end	Sheet piling	65 dB	D	N	63 dB	D	N	62 dB	D	N
	Chamber construction	58 dB	D	N	56 dB	D	N	54 dB	D	N
	Pipe jacking	50 dB	D	N	48 dB	D	N	46 dB	D	N
	Piling	56 dB	D	N	54 dB	D	N	52 dB	D	N
	Thrust block construction	57 dB	D	N	55 dB	D	N	53 dB	D	N

Table 6-13: Indicative noise levels for the CE6

Construction element	Task	12 m			90 m			200 m		
		29 Station St			1 Squadron Dr			2 Squadron Dr		
CE6 – West end valve chambers	Sheet piling	90 dB	D	N	72 dB	D	N	65 dB	D	N
	Excavation	75 dB	D	N	57 dB	D	N	51 dB	D	N
	Chamber construction	82 dB	D	N	65 dB	D	N	58 dB	D	N

Table 6-14: Indicative noise levels for the CE7

Construction element	Task	110 m			210 m			270 m		
		1 Squadron Dr			29 Station St			2 Squadron Dr		
CE7 – Scour chamber	Sheet piling	70 dB	D	N	65 dB	D	N	62 dB	D	N
	Excavation	56 dB	D	N	50 dB	D	N	48 dB	D	N
	Chamber construction	63 dB	D	N	57 dB	D	N	55 dB	D	N

6.9.3 Construction Traffic

The proposed construction access road is located behind the Hobsonville noise barrier (shown in Drawing 2010673.850), with a minimum distance of approximately 50 m to the nearest sensitive receiver.

The cumulative effects of construction traffic on existing traffic flows would not result in a significant noise level change.

6.9.4 Hobsonville Noise Barrier

Access to the work site along the causeway may be possible without the removal of the Hobsonville noise barrier. However, should the removal of sections of barrier be required during construction, a length of up to 160m may be affected.

The noise barrier was constructed to reduce noise levels from SH18 at two noise sensitive receivers to the north of the highway (retirement village and the large residence on Squadron Drive). The removal of the barrier has the potential to increase operational road traffic noise levels and therefore an assessment has been undertaken of the likely effects of these works. Removal of the noise barrier will likely be required e.g. CE6 is directly under the noise barrier, however it will be avoided if possible in detailed design.

The potential change in noise due to the temporary removal of the barrier has been undertaken by comparing the predicted level of current road traffic noise with and without the barrier.

An increase of up to 6 dB (depending of the extent of barrier affected) is predicted to occur with the removal of the barrier (52 to 58 dB LAeq, 24h). Although a noise change of this magnitude would be perceptible to residents, it is not deemed to be a major change in noise level and would not be a permanent effect. The most sensitive time period will be at night where there is the potential for sleep disturbance effects to occur.

The removal of the barrier will not alter the character of the road traffic noise, rather it will simply elevate existing noise levels. At night, NZS 6802:20082 recommends a night time limit of 45 dB LAeq so that residents can sleep with windows open and 55 dB LAeq with windows closed. The night time level is likely to be below 55 dB LAeq, and therefore the potential for adverse sleep disturbance effects would be less than minor with closed windows.

Sections of the barrier need to be removed and the change in operational road traffic noise from SH18 at the closest receivers can be minimised by:

- Removing only those sections of barrier that are necessary for construction;
- Minimising the length of time that the panels are removed;
- Installing a temporary noise barrier when and where practicable.

6.9.5 Daytime and Night-time Noise Levels

The recommended daytime noise criterion (70 dB, Monday to Saturday) is expected to be met for all construction activities (including traffic on haul roads) at all residences without the need for noise mitigation and management procedures. Sheet piling activities conducted adjacent to the residences on Station Street may result in noise levels close to the 70 dB criterion. Such activities would be of relatively short duration and could be appropriately managed through communication with the property owners. Should Sunday works be required in the Station Street area then enhanced noise mitigation, such as screening of noisy equipment, will be required to meet the 55 dB daytime noise criterion. This should be investigated as part of a detailed assessment in the Construction Noise and Vibration Management Plan (CNVMP).

Cumulative noise from the works may be slightly higher than the predicted levels where work is being conducted simultaneously at multiple locations; however, due to the spatial distribution of construction activities and receiver locations, the cumulative noise is expected to remain below the recommended daytime noise criteria (70 dB, Monday to Saturday).

² NZS 6802:2008 – Acoustics – Environmental Noise

Cut-in to NH1 pipeline will require 24/7 operations with welding /lighting plant noise for a period of approximately 48 hours. Stakeholder management communication will be required.

Without mitigation the night-time criterion of 45 dB may be exceeded for a number of activities at the nearest residences. These include pipe jacking, watermain connections and chamber construction, causeway widening, and bracket and watermain/pipeline installation. The criterion will generally only be exceeded when the construction equipment is operating at the closest point within a particular activity zone to the nearest residence, and it may still be possible to meet the night-time criterion at most other locations within the activity zone. Equipment positioning, task scheduling and limiting haulage traffic should be investigated as part of a detailed assessment in the CNVMP.

Equipment positioning and shielding by terrain may be sufficient to allow night-time works at the remaining locations and should be considered in the CNVMP along with use of low noise equipment.

6.9.6 Vibration Level Assessment

The vibration predictions for Project's proposed construction works have been assessed using the method for percussive and vibratory piling through medium dense granular soils as provided in Annex E of BS 5228-8:2009. The resultant values are in the form of PPV, which can be readily compared to the DIN 4150-3 limits and indicative vibration levels are provided in Table 6-15:

Table 6-15: Indicative vibration levels for GBWD and Causeway Works

Activity	Nearest residence	PPV
Vibratory sheet piling	12 m	5.0 mm/s
Impact piling	125 m	1.93 mm/s
Vibratory compaction	70 m	0.6 mm/s

- Vibration levels will meet the DIN 4150-3 limits (5 mm/s PPV) at the nearest properties. However ground vibration may be perceptible to nearby residents and it would be appropriate to advise those affected of the expected times when piling will occur.
- Vibration on buried pipework due to sheet piling may exceed the recommended 50 mm/s if located within 2 m of the pipework. Vibration on buried plastic pipework due to impact piling will not exceed the recommended 50 mm/s at all practical piling locations.
- The bridge has been designed to withstand a 1 in 1000 year seismic event in accordance with NZS 4203 (which was current at the time the bridge was designed). The effect of vibration from either auger or impact piling is considered to be negligible in comparison to a seismic event and therefore there would be no risk of structural damage to the bridge from piling activity.

6.9.7 Operational Effects

The proposed works do not result in operational noise sources, such as pump stations. The ongoing operational noise effects associated with this project will be negligible.

6.9.8 Mitigation and Management

The results of the noise and vibration assessment indicate that without specific mitigation or management measures, construction noise should meet the daytime criteria for all activities and vibration should meet the daytime criteria at the nearest properties (assuming that vibratory sheet piling will not be used at western pipe connection – CE1 and CE6, close to properties on Station Street). Night-time works would require the implementation of noise and vibration management procedures for some activities. Accordingly, noise management and mitigation measures have been identified in order to mitigate noise levels. Following detailed design and contract award a detailed Construction Noise and Vibration Management Plan (CNVMP) will be prepared and will address the matters listed hereafter:

- Property owners who may be affected by noise should be contacted and simple control measures such as closing windows should be discussed;
- Sheet piling activities are recommended to be conducted during the day and on week days. Appropriate communication will be required to inform the property owners;
- Equipment positioning and activity scheduling should be finalised as part of a detailed assessment prior to the CNVMP.
- Equipment positioning and shielding by terrain may be sufficient to allow night-time works at the remaining locations and could be considered in the CNVMP along with low noise generating equipment.
- Should the Hobsonville noise barrier be removed it should be reinstated as soon as practicable and the use of a temporary barrier (i.e. wooden fence) will be considered in the interim.

Vibration management and mitigation measures have also been identified:

- Work scheduling and communication with the affected residents should be detailed in the CNVMP for both day and night works as required;
- Appropriate monitoring of the vibration levels for the 'at-risk buildings' as defined in DIN 4150-3 by a suitably qualified expert in case sheet piling was required within 12m of the nearest property on the western side of GBWD.

6.9.9 Noise and Vibration Assessment Conclusion

The construction activities are expected to meet the daytime (Monday to Saturday) noise and vibration criteria, with most noise levels comparable to existing sources of road traffic. Construction work may be heard and/or felt by the nearest residents; however, less than minor noise and vibration effects are anticipated. If impact and sheet piling is required in close proximity to properties, the effects can be appropriately managed through direct communication with the residents.

At night or on Sundays, mitigation and management measures will be required to comply with noise and vibration criteria. With these measures in place the noise and vibration levels should not cause sleep disturbance for most people and the effects are again considered acceptable.

The resulting noise effects due to temporary removal of parts of the Hobsonville noise barrier are considered manageable and less than minor on the receiving environment.

Appropriate mitigation and management measures will be confirmed when the specific construction methodology and equipment are known and documented in the CNVMP. With the implementation of mitigation of noise and vibration actions through a CNVMP, it is considered that both daytime and night-time noise and vibration effects will be managed and can be considered as minor.

6.10 Air Quality and Dust

The proposed Greenhithe Bridge Watermain Duplication and Causeway project has the potential to result in dust and air quality effects in the vicinity of the proposed construction works.

This section identifies the air quality and dust sources and provides an assessment of likely effects.

6.10.1 Dust Sources

Based on the construction methodology described in Section 2.3.4, two main activities that could give rise to dust during the construction process have been identified: traffic on haul roads and placement of fill.

Construction activities will require an estimated placement of 96,500 m³ of material which will be transported to site by truck. In addition, the construction of the NI platform creates a larger exposed surface from which there is potential for dust to be blown towards the motorway and nearest residential properties.

6.10.2 Potential for Dust Effects

Typically dust effects have the potential to be experienced within 100 m of source. The level and type of effects depend on the extent of works, and to a large extent meteorology (wind speed and moisture levels). Beyond 300 m there is generally little potential for effects as any dust that might be generated has already settled. Very close to source (less than 50 m) the potential for effects is largely independent of wind strength, particularly close to haul roads.

Based on the Whenuapai wind rose (2008 to 2014), the prevailing winds (56%) in this area are from the western quadrant. This means that a significant proportion of any dust that might be generated will be carried away from residential areas into the harbour.

However there is potential for winds at speeds greater than 5 m/s to occur on a regular basis (about 8% of the time) from the northern quadrant which could blow towards both SH18 which is adjacent to the causeway (within 6 m) and the Hobsonville Point residential development (closest residences within 60 m, although most residences are more than 100 m).

The effects that could occur are reduced visibility on the SH18 and soiling on residential properties.

A qualitative assessment of the potential for dust nuisance, using the FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) assessment tool is provided in Table 6-16 below.

Table 6-16: Air quality and dust assessment using FIDOL tool

FIDOL Criteria	Dust and Air Quality Assessment
Frequency	Through the use of appropriate mitigation measures the frequency of any off-site nuisance effects should be low. In any event, effects at residential properties at Hobsonville Point should only occur when winds are from the northern quadrant. Based on Whenuapai windrose, winds strong enough to carry dust occur from the northern quadrant about 15% of the time.
Intensity	In the absence of mitigation, there is the potential for brief intense emissions in dry conditions, particularly from vehicles using the haul roads. However through the use of appropriate mitigation it is considered that the intensity of any dust events should be low.
Duration	Any dust events should be of short duration as there will be staff on-site who can implement reactive mitigation if required, although it is considered that through the use of proactive mitigation measures such as watering, the need for additional mitigation should be low.
Offensiveness	Given the potential for dust to obscure visibility on SH18, it is considered that any uncontrolled dust event could be considered offensive. Dust effects with mitigation in place should not be offensive.
Location	Given the locations of the works adjacent to SH18, and the number of houses within 100 m of the site, there is a high potential in the absence of mitigation, for dust nuisance effects. However through the use of appropriate mitigation including appropriate monitoring, it is considered that any potential effects can be controlled.
Overall FIDOL Assessment	Based on a consideration of all of the factors, it is assumed that in the absence of mitigation there is the potential for nuisance effects to occur on occasions. However through the use of a comprehensive dust mitigation plan, it is considered that the potential for nuisance effects reduces significantly, to the extent that effects could be considered no more than minor.

6.10.3 Mitigation

The potential effects associated with construction at large exposed areas such as the causeway are well understood, as are the mitigation measures that need to be utilised in order to control the potential for effects to manage dust. Consequently the Contractor, either as a standalone document or as part of an overall Construction Management Plan (CMP) will develop a construction dust management plan which identifies

measures required to control dust emissions together with guidance on when to implement them. The plan should also contain monitoring and contingency measures.

The following are examples of measures that could be included in such a plan:

- Limit vehicle speeds to 20 kph;
- Ensure haul road has clean running surface by regularly placing clean gravel or sweeping any sealed surfaces;
- Minimise drop heights when placing material;
- Where practical stabilise surfaces;
- Keep haul roads damp;
- Consider wind directions and strength when placing fine materials.

While large construction activities typically use water carts for dust control, it is considered that given the relatively limited access along the causeway it may be appropriate to consider the use of fixed sprinklers to avoid additional traffic volumes. This could also be useful for controlling the potential for effects outside of work hours.

The types of monitoring that would be required, includes but is not limited to:

- Checking weather forecasts on a daily basis;
- Inspecting adjacent properties for dust;
- Checking the haul road for dampness;
- Having a process in place to deal with queries or complaints from property owners.

With these measures in place the effects are considered no more than minor.

6.11 Coastal Processes

The proposed Greenhithe Bridge Watermain Duplication and Causeway project has the potential to result in adverse coastal effects. The assessment of coastal effects addresses the potential effects of the permanent works (long term effects) as well as potential effects of the shorter term construction activity as it relates to the physical coastal processes (reclamation within the Coastal Marine Area – CMA). It is based on the results of the hydrodynamic modelling report of the Upper Harbour Causeway completed in March 2015 by Tonkin and Taylor (refer Appendix C of Technical Report H).

The model is based on data from 2010 Waterview Connection Project (extended north using various data sets to include the Greenhithe Bridge area and northern parts of the Waitemata Harbour).

This section summarises the coastal assessment carried out and more detail is provided in Volume 2 Technical Report H Coastal Processes Report.

6.11.1 Coastal Processes Generation

There are three components that have potential to affect the physical coastal processes operating in this area in the long term, including:

- The 85 m extension of MHWS by the causeway (100 m extension of the toe) extending into the tidal channel (Drawings 2010673.851, 2010673.854, 2010674.855, 2010674.007 and 2010673.007);
- The general encroachment of the 15 m causeway widening (Drawings 2010673.851, 2010673.852 and 2010673.853);
- The localised effect of approximately the additional 40 m by 130 m widening of the causeway to create a platform to accommodate future phases of work for the Northern Interceptor project;

- The modifications at the western end of the causeway providing connections from the public road to the causeway embankment (Shown on Drawing 2010673.008).

This development could have an effect on water level and current velocity due to the additional constriction within the main channel as well as the displacement of volume as a result of the reclamation mass.

The area of the route that impacts on coastal processes is along the south-western approach to the Greenhithe Bridge within the Upper Waitemata Harbour. This area is a relatively low energy environment dominated by tidal flow concentrations through the narrow channel and wind generated wave conditions on the intertidal flats. The intertidal flats are likely to be depositional areas.

6.11.2 Coastal Effects

Based on the results of the coastal process study and hydrodynamic modelling carried out in, it has been shown that the proposed causeway widening will have no significant effect on the coastal processes operating in this area in the longer term. The extension to the causeway will have a minor, short term and localised effect on coastal processes which will quickly stabilise once construction has ceased. The resulting changes are likely to include localised lowering of sand at the tip of the causeway extension and minor levels of deposition on the intertidal areas to the north-west and along the main channel to the south-east. There will be less than minor effects on seabed levels within the main channel or influence on the existing bridge structures. The effects of the proposed works are unlikely to change with increasing sea level rise.

6.11.3 Mitigation

The short term effects can be mitigated by optimal construction techniques (refer Section 2.3.4), including location of the foundation and initial construction works at periods of slack tide and by use of a silt curtain or other appropriate management approach where sediment discharge is possible and ensuring clean rockfill is used for end-tipping.

6.11.4 Coastal Processes Effects Assessment

The coastal process investigation and hydrodynamic modelling assessment has indicated that the proposed causeway widening will have no adverse effects apart from the permanent occupation of the CMA.

The causeway extension will have a minor and localised effect on coastal processes at this location. However, soon after the works are completed the shoreline and seabed will stabilise taking into account the new structure. There will be no significant effects on seabed levels within the main channel or influence on the existing bridge structures.

6.12 Navigation and Mooring

The proposed causeway widening and extension beyond the existing causeway length will result in the tip of the causeway extending a short distance into the main channel. The navigable portion of the channel is located towards the northern/northeastern shoreline and away from the causeway works and thus will not be affected by the extended causeway's presence.

The location of the proposed causeway does not impact on mooring sites in the vicinity.

The effects of the proposed works on navigation and boating are less than minor.

6.13 Recreation and Public Access

Existing recreation and public access areas are described in Sections 3.1.2 and 3.1.11 of the AEE. An assessment of effects on these areas has been carried out and summarised in this section. More detail can be found in Volume 2 – Technical Report I – Landscape and Visual.

An Indicative Landscape Concept Plan (LCP) is proposed to be implemented for the site (depicted in Appendix 3 of the Technical Report I and is provided in Volume 3 Drawings) to mitigate the potential effects of the proposed package of works on the recreation, amenity and visual environment.

The provision of open space along the top of the causeway will provide opportunities for a number of landscape improvements, most notably the provision of open space for recreation purposes that is well connected to the coastal environment.

The opportunities for recreation will therefore be enhanced compared to the existing situation. These proposed enhancements are outlined below:

- Increased space for recreation along the top of the causeway;
- An improved pedestrian/cycle path located closer to the coastal edge which connects to the existing cycleway infrastructure on the causeway;
- Opportunities for enjoyment of views to the harbour;
- Opportunity for connection to other key locations such as the currently designated esplanade reserve in the vicinity of the western embayment and new housing development on the Hobsonville Peninsula.
- Opportunities for public and/or cultural features.

For recreation and public access purposes, it will involve the implementation of:

- Developing appropriate public art in consultation with relevant stakeholders;
- Ongoing maintenance and/or management plan.

The overall assessment of recreation and public access effects is perceived as an improvement based on the landscape concept presented and with the opportunity for further enhancement. The Indicative Landscape Concept Plan will be developed in consultation with key parties, and an ongoing management and maintenance regime will be established in agreement with the future landowner.

6.14 Amenity Values

The landscape attributes surrounding the GBWD and Causeway site are of varying quality and consistency particularly those immediately around or on the site. There is a reasonably high level of landscape amenity with the presence of the harbour and relatively continuous coastal vegetation, on private property. However, there is a lack of coastal public open space, from which amenity values can be realised. Existing amenity areas are described in Sections 3.1.2 and 3.1.11.

The potential effects on amenity values are summarised in this section, with more detail provided in Volume 2 Technical Report I Landscape and Visual Assessment.

The GBWD and Causeway works result in a change in the scale and form of the existing causeway and this is perceived as an opportunity to increase and enhance the provision of quality public open space and amenity opportunities in one of Auckland's key urban growth areas. The causeway has the potential to become an important link between neighbouring growth areas and a space for ecological enhancement along the coastal edge.

The amenity values will therefore be enhanced compared to the existing situation and will incorporate the following:

- Opportunities for passive recreation and continued access for cyclists and pedestrians;
- Opportunities for sitting at the coastal edge or beneath a tree to enjoy the surrounds;
- Reflection of public amenity and cultural heritage values through the provision of public art.

6.15 Landscape

Existing landscape and natural character are described in the AEE, Section 3 Description of the Existing Environment. The GBWD site is located within a highly modified environment that comprises a mixture of residential development, dominant infrastructure and natural coastal landscape. This section summarises the landscape assessment and more detail is provided in Volume 2 Technical Report I Landscape and Visual Assessment.

6.15.1 Potential Effects

The potential landscape effects resulting from the GBWD and Causeway will be:

- Bulk and form effects as a result of the new landform extending into the harbour;
- The addition of visible above-ground structures;
- Removal of existing vegetation.

The effects generated by these changes can be mitigated by various landscape treatments set out in the Indicative Landscape Concept Plan.

6.15.2 Assessment of landscape effects

The overall linear shape of the proposed works is similar to the existing causeway and it is considered that overall it will have a low effect on the perceived landscape attributes that existing within and directly around the subject site.

The proposed NI Construction Platform is less consistent with the overall lineal form, and will accentuate the engineered character of this part of the site. The platform does not reference any local natural landforms, and therefore will be readily perceived as engineered infrastructure. It is considered that the size and positioning of the platform (in the middle of the causeway length) will exacerbate its effect on character, further reinforced by the appearance of some surface infrastructure such as pit covers, and its angular shape. It is therefore considered that the landscape character effect created by this part of the causeway proposed works will be high.

The new watermain and its support structure under Greenhithe Bridge will have a relatively consistent appearance with the structural elements of the bridge. The transition point between the causeway and bridge will have an increased landscape effect. The transition will require the pipe to deviate from a parallel, horizontal alignment along the bridge to an angle that descends into the causeway. In achieving this, it will be necessary to increase the area of exposed rock rip-rap under and around the end of the bridge. In addition, the pipe is likely to be screened to discourage vandalism and space will be provided for maintenance access that will include a large concrete pad for turning vehicles.

It is considered that the small section of pipe and support will have a very low effect on the landscape qualities or character of the existing environment, but as a result of the transition structure, exposed rip rap and concrete pad, it is considered that the landscape effects under and around the bridge will be moderate to high.

Overall, without mitigation, it is considered that the adverse landscape effects will be moderate to high.

6.15.3 Mitigation

The following key elements are considered necessary to provide mitigation for the proposed construction and infrastructure works. These are:

- Installing the maintenance access-way with a minimum width of 3.0m and constructed in concrete such that it provides for pedestrian and cycle access across the site. The access-way should include connections to the existing cycleway in a manner that allows these to be 'closed' should maintenance works be undertaken (protection of public safety). Ideally the surface of the access-way would be consistent with the Austroad standards for shared pedestrian and cycleways.
- Retention of the existing cycleway such that public access can always be provided along the causeway irrespective of any construction or maintenance works being undertaken.
- Aligning the access-way across the construction platform in a manner that helps to reduce its prominence as an extension into the harbour.
- Undertaking tree planting (including relocation of the existing pohutukawa trees, if possible) along the top of the site in a manner that helps to break up its lineal form. The location of trees will need to be considered with regard to the underground infrastructure in order to avoid damage to pipes and their potential to impact on future Phases of the NI project.

- Undertaking shrub planting across the site in a manner that provides for views of the harbour from the motorway, but also reinforces the connection of vegetation to the wider landscape. It is understood that in some places the shrub planting may need to be 'sacrificial' – so that it can be removed and replaced when major maintenance works are necessary.
- Incorporating low bunds or mounds (up to 1.0m in height) around the construction platform to help define views, reduce the perceived scale of the construction platform, and provide interest to the planting.
- The use of a natural screen around the transition area, such as a wire-trellis with climbers, rather than more structural forms (such as fencing or walls).
- Rolling rip-rap rocks over the top of the causeway edge so that it creates variance in the top shape, helping to reduce the lineal character of the landform.

Other mitigation measures proposed by Technical Report D Ecological Technical Assessment and Technical Report E Arboriculture Assessment have been considered as mitigation measures in terms of the landscape effects; those include:

- Addition of the shell bank to mitigate the effects of the construction platform;
- Due to the removal of some of the mature trees along the causeway, replacement planting with suitable species following the completion of the earthworks is proposed as part of the mitigation measures.

6.15.4 Landscape Assessment Conclusion

Providing that the recommended mitigation is implemented (refer Figure 6-6), it is considered that the overall landscape effects of the proposed works are moderate.

6.16 Visual

Existing visual character are is described in the AEE, Section 3 description of the existing environment. This section summarises the visual effect assessment carried out and more detail is provided in Volume 2 Technical Report I Landscape and Visual Assessment.

6.16.1 Potential Visual Effects

Visual effects are produced by changes to views and the visual amenity experienced by people. The change in relation to these proposed works will derive from the introduction of new elements into views, potentially impeding on existing sightlines and detracting from the existing features and overall character. However, it is important to note that visibility of the proposed works does not necessarily constitute an adverse visual effect.

Only permanent visual effects have been assessed as part of the assessment of visual effects, as construction works and timeframes of GBWD and Causeway are considered temporary.

6.16.2 Assessment of Visual Effects

Existing visual character is described in Section 3.1.11. This section summarises the visual effect assessment carried out and more detail is provided in Volume 2 Technical Report I Landscape and Visual Assessment.

The potential visual effects of the project will result from views of additional land area and form, plus a potential reduction in the view of the harbour from the motorway. A greater extent of the rip-rap wall will be visible, particularly around the base of the bridge, and the angular shape of the NI construction platform is likely to be evident from more elevated locations or from water users travelling around the site. The removal of existing trees (including those at the western end) will change the view and expose a greater portion of the existing noise wall. Views obtained from Greenhithe and Herald Island will vary depending on the setback of residential dwellings and the extent of intervening coastal vegetation.

In considering all views from the surrounding locality in the context of the required infrastructure components, it is considered that the physical appearance of the causeway surface will most influence the overall visual effect

of the proposed works. As a grassed surface, it is considered that the causeway will have increased prominence in the view, with visual effects ranging from low to moderate.

6.16.3 Mitigation of Visual Effects

- Location of new access way close to the top of the rip rap so that public views to the harbour can be retained.
- Aligning the access way across the NI construction platform in a manner that helps reduce its prominence as an extension to the causeway.
- Screen around the pipeline transition structure: to reduce the visibility of the pipeline as it goes beneath the bridge.
- Bunding to help reduce the visibility and prominence of the infrastructure elements. The vegetation (trees and low planting) will help mitigating the overall view of the causeway, serving to soften the hard or industrial elements and helping to integrate with the existing landscape character.
- Planting to enhance views of the causeway surface from the motorway, harbour and causeway itself.

Providing that the recommended mitigation is implemented (refer Figure 6-6), it is considered that the overall visual effects of the proposed works are low.

Figure 6-6: GBWD and Causeway Indicative Bird Mitigation Concept Plan



Figure A.4

6.17 Archaeological

6.17.1 Archaeological Assessment

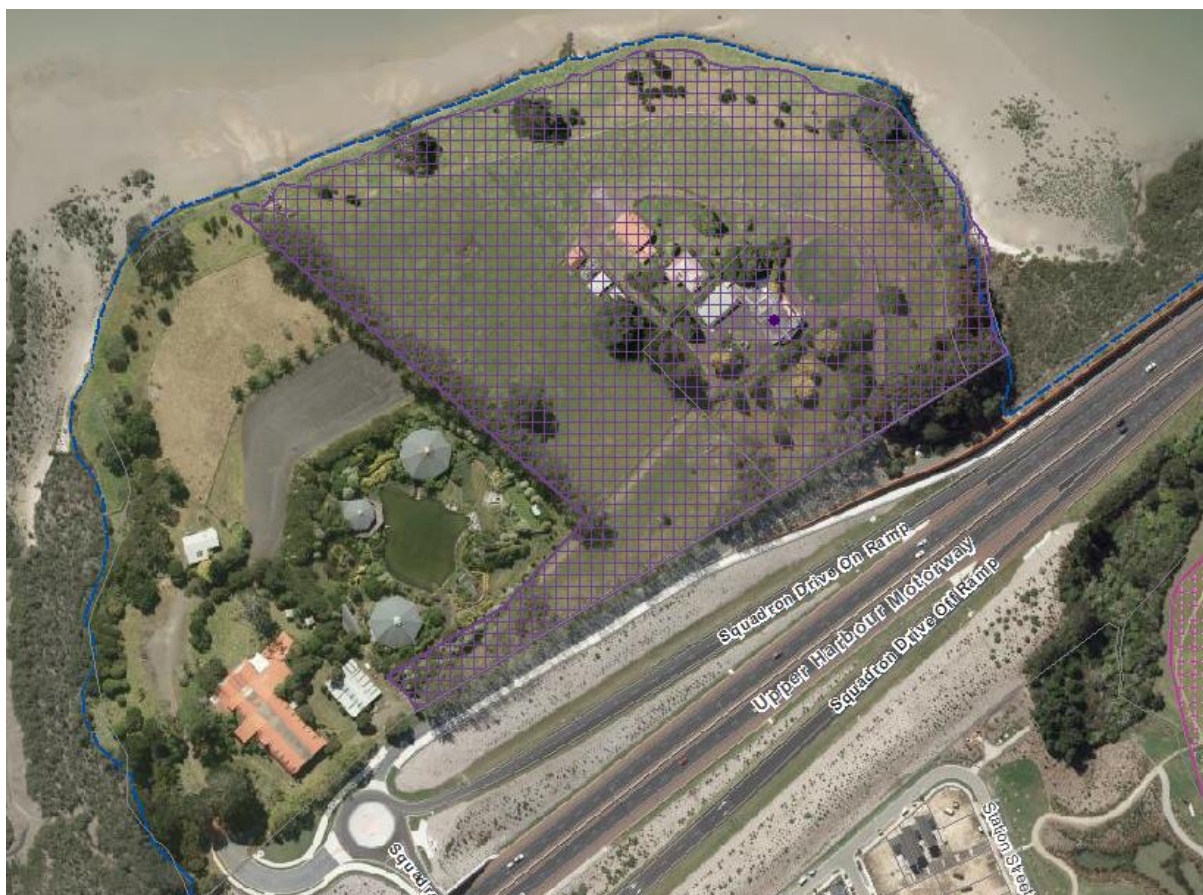
A field inspection of the general proposed areas of works for the GBWD and Causeway project was undertaken on 23 December 2013. The inspection focused upon the proposed area of works and their immediate surrounds only.

As expected, the area was found to have been extensively and significantly modified through the development of the motorway and construction of Greenhithe Bridge. Exposed soils were noted across the survey area and showed exposed yellow clay with no or very minimal topsoil evident.

A previously recorded shell midden site R11/495 was not located. The area within which it was originally recorded has been completely modified through the construction of the bridge/motorway and pedestrian/cycleway as well as the motorway fence and rock wall revetment. The site has most likely been destroyed since it was originally recorded in the 1970s.

No archaeological or other historic heritage sites were identified within the project area as a result of this appraisal and there is little potential for any unidentified subsurface remains to be present. The proposed works do however extend into the PAUP identified historic heritage extent of place for Duke House and Servants Quarters (ID 130) located on private land adjacent to the western embayment, North of SH18 and West of CE1 and CE7 (refer Figure 6-7). The buildings are set in an open grassed landscape dotted with planted trees, and with several mature trees along the southern boundary which screen the house from the Upper Harbour SH18 motorway. They are well set back from the proposed works and will not be affected.

Figure 6-7: Location of Duke House and Servants Quarters (PAUP ID 130)



6.17.2 Archaeological Assessment Conclusion

In any area where archaeological sites have been recorded in the general vicinity it is possible that unrecorded subsurface remains may be exposed during development. It is considered possible that previously unrecorded subsurface archaeological sites (e.g. shell midden deposits, historic rubbish deposits) may be exposed during development particularly at the Hobsonville end of proposed works., and it is therefore recommended that consideration is given to applying for an Authority prior to the start of earthworks so that potential delays can be avoided should sites be exposed. Procedures for accidental discovery of archaeological artefacts will be established and implemented during works. An authority under the Heritage New Zealand Pouhere Taonga (HNZPT) Act will be sought in advance of construction.

6.18 Cultural

Engagement with mana whenua groups has been undertaken as part of GBWD and Causeway project development, and will continue through the construction phase of the project and as part of Watercare's ongoing relationship with mana whenua.

Mana whenua engagement, and the resulting CIAs have provided information on the existing cultural heritage values of the project area, how the project may affect these values and potential mitigation measures for addressing adverse effects. The existing cultural environment is described in Section 3.1.12 of this AEE.

A number of the mana whenua groups have recognised the need for the proposed NI and GBWD developments to support the communities that will be serviced by the infrastructure. However, two potential adverse effects have also generally been identified in relation to the construction of the project.

Firstly, the project area and surrounding environment has a history of settlement and use by mana whenua groups. Although no specific sites are identified in the project area, there is potential for the proposed works to expose unrecorded sites or artefacts. It is considered that this risk is limited to the areas of earthworks within original ground (largely the intertidal area and the area around the eastern abutment of the bridge), as much of the project area has been significantly modified in the construction of the bridge and existing causeway.

Secondly, construction of the project will require disturbance of land, water, and ecology in the project area. Mana whenua groups have noted that this disturbance has the potential to adversely affect cultural values in these resources. In particular, some of the resources are viewed as taonga, and the mauri of the resources may be affected by disturbance that degrades the quality of the environment. Avoidance of coastal areas has been requested to avoid effects on these values, however, reclamation is required for the project. In order to minimise these effects, reclamation will be no more than necessary (as discussed in Section 5 of this AEE) and it is noted that the reclamation will be located in an already highly modified area.

To address these potential adverse effects, the following mitigation is proposed:

- Watercare's ongoing relationships with mana whenua groups will ensure mana whenua involvement through the construction and operational phases of the project. In particular, during the construction phase, opportunities will be provided for mana whenua groups to participate in site induction, to monitor earthworks within original ground and to monitor the project's erosion and sediment controls.
- An accidental discovery protocol will be developed for the project. The protocol will include the requirement to notify interested mana whenua groups should any archaeology of relevance to mana whenua be uncovered.
- Ecological and water quality effects will be managed as addressed in Sections 6.5 and 6.7 of this AEE. This will include planting of native species, enhancement of habitat for banded rail and active management of erosion and sedimentation during construction of the widened causeway.
- Opportunities for pou or other appropriate cultural art to be located on the widened causeway will be discussed with mana whenua and if appropriate incorporated in the final Landscape Concept Plan. Landscaping opportunities are also being proposed to soften the visual impact of the structure.

In addition to the effects discussed above, mana whenua groups have noted concerns related to the wider NH2 and NI projects, particularly associated with the movement of potable water from between catchments and the conveyance of wastewater. Watercare will continue to engage with mana whenua on these wider matters.

7. Consultation

7.1 Overview

The primary objective of the consultation process has been to assist with development of the project to date, and to identify matters to be considered in subsequent design and implementation phases. This section of the report identifies the parties involved to date, and summarises the key matters raised and Watercare's response.

The parties involved in the consultation process to date (May 2015) are:

- Local boards;
- Council staff – particularly the Parks, Sports and Recreation (PSR) and Regulatory teams;
- Mana whenua;
- Transport Authorities – Auckland Transport and New Zealand Transport Agency;
- Other network utilities including Vector; Transpower
- Other agencies – Heritage New Zealand Pouhere Taonga and Department of Conservation;
- Directly affected landowners;
- Landowners adjacent to key construction sites; and
- Other interest groups and organisations .

The consultation process has been led by Watercare, and will continue during the design development, pre-construction and construction phases.

7.2 Auckland Council

7.2.1 Local Boards

The project is entirely within the Upper Harbour Local Board area. Watercare staff attended meetings with the Local Board several times in 2014 and 2015 to discuss the proposed works. Watercare's proposed Northern Interceptor and Rosedale WWTP Expansion projects were also discussed. Board members noted potential opportunities associated with the causeway widening – such as improved amenity, and access to the foreshore – but most of the discussion focussed on potential impacts of the proposed Northern Interceptor project as it passes through Greenhithe.

7.2.2 Parks, Sports and Recreation

The project does not interface with any parks or reserve land currently managed by PSR.

The proposed causeway widening provides an opportunity for public amenity improvements along the existing SH18 motorway. Initial discussions have taken place with representatives of PSR regarding the design and future use of the land area to be created, and the potential future management of this land. Opportunities for a potential pedestrian link with nearby developments have also been identified. These discussions will continue during further project development.

7.2.3 Regulatory

Pre-application meetings with Council's Major Infrastructure Projects Resource Consents team commenced in late 2013. Discussion at these meetings covered matters such as the need and scope for the project, the statutory requirements and process, and the potential effects of the works. Other meetings have also taken place with Council's technical specialists on coastal matters and works in contaminated land.

7.3 Mana whenua

Watercare has led the consultation process to date with mana whenua. Watercare's summary of the consultation undertaken, and the key matters raised, is set out in the following pages.

7.3.1 Mana whenua participants

Mana whenua have a strong historical and cultural relationship with the land, water and harbours traversed by Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway, North Harbour 2 (NH2) Watermain and Northern Interceptor projects ("the projects"). As these projects cover similar geographic areas, consultation activities have been combined where appropriate.

The 19 mana whenua entities in the Auckland Council area with a potential interest in the projects are:

<u>Ngāi Tai Ki Tāmaki</u>	Ngāti Te Ata	Te Akitai*
<u>Ngāti Manuhiri</u>	Ngāti Wai	<u>Te Kawerau a Maki</u>
<u>Ngāti Maru</u>	<u>Ngāti Whanaunga</u>	Te Patukirikiri
Ngāti Paoa	Ngāti Whatua o Kaipara	<u>Te Rūnanga o Ngāti Whatua</u>
Ngāti Rehua Ngatiwai Ki Aotea	<u>Ngāti Whatua o Orakei</u>	Te Uri o Hau
Ngāti Tamaoho	Te Ahiwaru	Waikato Tainui
Ngāti Tamaterā		

Mana whenua underlined in the above list have indicated a particular interest in the projects and have participated to the greatest extent in the consultation process to date.

7.3.2 Consultation process

The consultation process has involved:

- Initial briefing to Watercare's Mana Whenua Kaitiaki Forum (MWKF) in July 2013;
- Initial briefing meetings in late 2013 with mana whenua who indicated an interest in the project;
- Further consultation with interested mana whenua, including meetings and site visits as appropriate;
- Update on the projects to all mana whenua entities in November 2014 to confirm those parties already involved in the process, and to invite others to participate if they wished to do so;
- Further engagement with the interested mana whenua entities;
- Preparation of Cultural Impact Assessments.

In the early consultation phase, the now-proposed Greenhithe Bridge Watermain Duplication and Causeway project was presented as part of the NH2 project. Early mana whenua consultation records therefore only refer to the NH2 project. The Greenhithe Bridge Watermain Duplication and Causeway project was subsequently developed as a standalone physical works package, and the later mana whenua consultation records reflect that.

7.3.3 Kaitiaki Managers' Projects List

An established process is in place for mana whenua engagement on projects initiated by Watercare. This process includes early notification of works to be undertaken by Watercare which do or are likely to require a resource consent.

A "Kaitiaki Managers Projects List" is provided on a monthly basis to nominated representatives of all 19 mana whenua in the Auckland Council area. A brief summary of each project is included in the list, along with an identification of the applicable PAUP Cultural Impact Assessment (CIA) rules. Mana whenua are invited to indicate which projects they have an interest in. Further information on the identified project or projects is then provided to those parties, followed by further engagement depending on the responses received.

The projects have been included on the Kaitiaki Managers Projects List provided to mana whenua in July 2013. 7 mana whenua entities indicated that they have an interest in this project, being:

- Ngāi Tai Ki Tāmaki
- Ngāti Manuhiri
- Ngāti Maru
- Ngāti Whanaunga
- Ngāti Whatua o Orakei
- Te Kawerau a Maki
- Te Rūnanga o Ngāti Whatua

7.3.4 Cultural Impact Assessments

Cultural Impact Assessment reports have been prepared for the projects to date by Te Kawerau a Maki, Ngati Maru, Ngati Manuhiri and Ngai Tai Ki Tamaki.

The reports prepared are:

- North Harbour No. 2 Watermain, Ngati Maru, July 2014
- Cultural Impact Assessment Report Northern Interceptor, Ngai Tai Ki Tamaki, January 2015
- Cultural Impact Assessment Report Greenhithe Bridge Duplication, Ngai Tai Ki Tamaki, January 2015
- Cultural Impact Assessment Northern Interceptor, Ngati Maru, January 2015
- Cultural Impact Assessment for Northern Interceptor Henderson to Rosedale, Te Kawerau a Maki February 2013

Key points raised in those reports are summarised within the following discussion.

7.3.5 Mana Whenua involvement

The 19 mana whenua entities in the Auckland Council area, and their engagement in the projects to date is summarised in the table below.

Table 7-1 Mana whenua entities and involvement

Mana Whenua	Involvement to Date
Ngāi Tai Ki Tāmaki	<p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Ngai Tai responded confirming they have an interest in the projects and requested further involvement.</p> <p>A meeting was held in November 2014 to update Ngai Tai on the process to date and to provide further information on the projects. Ngai Tai has requested further involvement and has prepared a CIA for each project.</p>
Ngāti Manuhiri	<p>Ngati Manuhiri was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in July 2013. Ngati Manuhiri registered their interest in the projects at that time.</p> <p>An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest.</p> <p>The works and proposed alignments were discussed at a meeting in February 2014 and the draft archaeological assessment for the NH2 watermain project provided in March 2014. Ngati Manuhiri confirmed their primary interest is in the works north of the Greenhithe Bridge, particularly works in coastal areas, stream crossings and mitigation planting. Cultural monitoring was requested for works near any known recorded archaeological sites.</p>

Mana Whenua	Involvement to Date
	<p>An update on the projects was provided in November 2014, including a request to meet to discuss the projects. Ngati Manuhiri responded confirming they wish to prepare a CIA.</p> <p>An update meeting was held with Ngati Manuhiri and Te Kawerau a Maki in November 2014. Concerns regarding proposed Northern Interceptor works within the North Shore Memorial Park were raised. Ngati Manuhiri confirmed that although their primary interest lies north of the Greenhithe Bridge, they support Te Kawerau a Maki's views on proposed works in the Upper Harbour, and also the identified opportunities to recognise cultural values. In November 2014, Ngati Manuhiri assisted Clough & Associates with their archaeological assessment of the proposed Northern Interceptor alignment in the Greenhithe area.</p>
Ngāti Maru	<p>Ngati Maru was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. Ngati Maru registered their interest at that time.</p> <p>An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest.</p> <p>Watercare met with Ngati Maru in December 2013 and provided an overview of the works. Items discussed included construction methodology, services relocation, potential for discovery of koiwi and lava caves during construction, and potential cultural monitoring requirements in some areas.</p> <p>Further updates on the projects were provided to Ngati Maru at regular meetings during 2014. Ngati Maru confirmed their primary area of interest is in the proposed works north of the Greenhithe Bridge.</p> <p>Watercare received a CIA from Ngati Maru in July 2014 relating to the NH2 project. Ngati Maru's main concerns were discussed in the CIA, including the potential impact on land of significance to Ngati Maru due to its past history and usage, and the potential for disturbance of remaining historical evidence. The project corridor intercepts two historic coastal settlement areas accessed by the Marutahu people in the west for fishing, hunting and trapping. Cultural monitoring has been requested.</p> <p>In mid-December 2014, Ngati Maru advised that they would defer to Ngati Manuhiri for the proposed works in Greenhithe, but advised that they wished to prepare a CIA for the Northern Interceptor.</p> <p>Watercare received a CIA from Ngati Maru in January 2015 for the Northern Interceptor Project. Ngati Maru's main concerns relating to the Northern Interceptor project mirrored those they had for the NH2 project described above.</p>
Ngāti Whatua o Orakei	<p>Ngāti Whatua o Orakei was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time.</p> <p>An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest.</p> <p>Watercare met with Ngāti Whatua o Orakei in February 2014. Points discussed included the opportunity for Ngati Whatua to be involved in possible cultural arts initiatives, the use of native vegetation for reinstatement planting, extent of mangrove removal associated with the proposed causeway widening, and the effects of stormwater and wastewater discharges.</p> <p>An e-mail confirming Ngāti Whatua o Orakei's key points of interest was received following the meeting. This included avoiding cultural heritage and archaeological sites, and opportunities for works around waterways to enhance ecological function and native habitat / biodiversity.</p> <p>Watercare met again with Ngāti Whatua o Orakei in May 2014 to provide an update on the projects. Topics discussed included the potential integration of project works with future cycleway development, the methodology for stream crossings, riparian planting and proposed causeway widening.</p> <p>An update on the projects was provided to Ngāti Whatua o Orakei in November 2014, including a request to meet to discuss the project. No response was received.</p>

Mana Whenua	Involvement to Date
Te Akitai	<p>Te Akitai was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time.</p> <p>An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest.</p> <p>At a meeting in December 2013, Te Akitai indicated their particular areas of interest on the NH2 watermain related to any potential discharges, stream crossings, areas of work not within road reserve, and landscape modifications.</p> <p>General project updates were provided to Te Akitai at regular meetings during 2014, and a written update provided in November 2014.</p> <p>The need for the proposed causeway widening at Hobsonville, and the options considered were a key point of discussion at a meeting with Te Akitai in November 2014.</p>
Te Kawerau a Maki	<p>Te Kawerau a Maki was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time.</p> <p>An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. Watercare met with Te Kawerau a Maki later that month to provide an overview of the NH2 and Northern Interceptor projects. Potential areas of interest to Te Kawerau a Maki were discussed. This included Lucas Creek as a significant cultural area, preference for works to take place where land has already been modified rather than coastal areas, and opportunities for ecological enhancement.</p> <p>Te Kawerau a Maki's initial CIA for the Northern Interceptor project was received in February 2014. The main points noted, and which confirmed the points discussed at the previous meeting, were:</p> <ul style="list-style-type: none"> ○ Their preference for works to take place within the road corridor or other modified sites and to avoid the shorelines and waterways. ○ Any works within the coastal environment should be deep or well under harbour channels. Ecological enhancement will be necessary where works pass through the coastal environment. ○ A taniwha is present in the South East portion of the project corridor; therefore works around Hellyers Creek should be avoided. ○ Lucas Creek and Bomb Point should be avoided due to high environmental and cultural values, and the future development of a Marae. <p>Watercare and Te Kawerau a Maki met again in March 2014. Feedback from Te Kawerau a Maki included support for integration of the NH2 project works with future cycleway development, their preference for the proposed pipelines to be located within roads and motorway corridors, and opportunities for stream crossings to include enhancement works.</p> <p>An update meeting was held with Ngati Manuhiri and Te Kawerau a Maki in November 2014. The significance of the Upper Harbour and Lucas Creek to Te Kawerau a Maki was restated. Opportunities for ecological restoration at stream crossings and at the proposed causeway widening were discussed. It was also suggested that a cultural art work could be installed on the widened causeway, acknowledging the history and significance of the area. Te Kawerau a Maki prepared an addendum to their initial CIA on the Northern Interceptor project in December 2014. Additional concerns raised in this addendum included works within the CMA (both at the Upper Waitemata Harbour and Te Wharau Creek) and the pipeline route through North Shore Memorial Park.</p>
Te Rūnanga o Ngāti Whatua	<p>Te Runanga o Ngati Whatua was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Te Rūnanga o Ngāti Whatua responded requesting that Watercare provide</p>

Mana Whenua	Involvement to Date
	them with the responses received from mana whenua engaged in the projects to date and would provide their confirmed position following this.
Ngāti Tamaoho	<p>Ngati Tamaoho was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Ngati Tamaoho responded confirming that they would defer to mana whenua already engaged in the projects.</p>
Ngāti Whatua o Kaipara	<p>Ngati Whatua o Kaipara was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update email was sent regarding the NH2 project in May 2014, advising which iwi were involved at that time, and offering further information or a meeting to discuss the project. No response was received.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. No response was received from Ngāti Whatua o Kaipara.</p>
Ngati Whanaunga	<p>Ngati Whanaunga was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update email was sent regarding the NH2 project in May 2014, advising which iwi were involved at that time, and offering further information or a meeting to discuss the project. No response was received.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. No response was received from Ngāti Whanaunga.</p> <p>Ngati Whanaunga registered their interest in the projects for the first time via the Kaitiaki Managers Projects List in February 2015. Updated information on the projects was provided to Ngati Whanaunga including another invitation to participate in further consultation, no further response was received.</p>
Te Uri o Hau	<p>Te Uri o Hau was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Te Uri o Hau responded confirming that the projects are outside their statutory area of interest.</p>
Waikato Tainui	<p>Waikato Tainui was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Waikato Tainui responded requesting that Watercare undertake a full assessment against the Waikato Tainui Environmental Plan to ensure consistency with it.</p>
Ngati Paoa Ngāti Rehua Ngatiwai Ki Aotea Ngāti Tamaterā Ngāti Te Ata Te Ahiwaru Te Patukirikiri	<p>Ngati Paoa, Ngāti Rehua Ngatiwai Ki Aotea, Ngāti Tamaterā, Ngāti Te Ata, Te Ahiwaru and Te Patukirikiri were initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p> <p>An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. No responses were received from Ngati Paoa, Ngāti Rehua Ngatiwai Ki Aotea, Ngāti Tamaterā, Ngāti Te Ata, Te Ahiwaru or Te Patukirikiri.</p>
Ngāti Wai	<p>Ngati Wai was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.</p>

Engagement with mana whenua is ongoing, and will continue through the project development and delivery phases.

7.4 Transport authorities

The entire project is located within or immediately adjacent to the existing SH18 motorway corridor, as described earlier in this report. Meetings with representatives of the New Zealand Transport Agency (NZTA) and Auckland Motorway Alliance (AMA) have taken place to discuss the proposed works.

7.4.1 NZTA and AMA

Discussions with NZTA and AMA (Auckland Motorway Alliance) commenced in late 2013, when approval in principle was given to attach the proposed new watermain on the underside of the northern Greenhithe Bridge. Further discussion has taken place during 2014 and is ongoing in 2015 regarding the proposed crossing under SH18 from Station Road and the proposed causeway widening. Key considerations for NZTA and AMA are the structural integrity of the Greenhithe Bridge, stability of the existing motorway and causeway, potential for settlement arising from pipe installation under the motorway formation, traffic management during construction, and permanent access requirements.

Given the locality and nature of the proposed works, close liaison with NZTA is essential for this project and will continue during project delivery and in the long term.

7.4.2 Auckland Transport

The existing cycleway along the northern edge of the motorway causeway was constructed by NZTA and is managed by Auckland Transport. Initial discussions have taken place with NZTA in relation to their long term plan for a cycleway along the full length of the SH18 motorway causeway between Westgate and Albany. Opportunities to enhance the existing cycleway as part of Watercare's proposed causeway widening works will continue to be discussed with NZTA and Auckland Transport.

Any works within the local road network require a Corridor Access Request approval from Auckland Transport. The only works associated with the GBWD and Causeway project that will require works within the local road network are construction of the proposed cross connection chamber adjacent to Station Street, Hobsonville Point and the potential closure of the Tauhinu Road off-ramp. The details of this work will be discussed with Auckland Transport during the detailed design and construction phases of the project.

7.5 Network utilities

Major utility services already located within the SH18 motorway causeway are a high pressure gas main and power cables operated by Vector. Initial discussions have taken place with Vector in relation to the proposed causeway widening works and the protocols and requirements for working in the vicinity of those critical assets.

Consultation will continue with Vector and Transpower as the design progresses. Other network utility companies will be contacted during the design process in order to confirm the locations of existing services or any future development plans in the vicinity of the proposed construction sites.

7.6 Other agencies

7.6.1 Heritage New Zealand

Although no known archaeological sites will be affected by the proposed works, Watercare is consulting with Heritage New Zealand in regard to the project and will be seeking an authority under Section 44(a) of the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA) to cover all works undertaken for the project as a precaution.

7.7 Immediately adjacent private landowners

7.7.1 Hobsonville Point

The proposed works are located adjacent to the land owned (or formerly owned) by the Hobsonville Land Company (on the south side of the motorway) and Summerset Holdings Limited (on the north side of the motorway). Consultation has taken place with these companies during development of the project to date. The parties are generally supportive of the proposed infrastructure development, but with a particular interest in the timing of works relative to other construction projects, and the management of effects during construction.

The land located on the northern side of the motorway between the Summerset Retirement Village and the motorway causeway is owned by M and A Evans. The proposed works are located in close proximity to that property and the proposed temporary access road for the causeway widening extends through the property. Watercare has met with Mr Evans and an understanding of the objectives and intentions of both parties has been developed. Watercare will continue to consult with Mr Evans to ensure these objectives are met.

Since early discussions on the project, sites have been sold and houses constructed along Squadron Drive, Station Street and the surrounding roads of the Hobsonville Point development. Consultation with these new landowners, and others in proximity to the proposed works in both Hobsonville Point and Greenhithe, will take place during further project development.

7.8 Public consultation events

Public consultation events were held at the following locations:

- Albany Junior High School, Appleby Road (March 26, 2015,)
- Hobsonville Point Primary School, De Havilland Road (March 30, 2015)
- North Shore Dog Club, Wainoni Park (March 31, 2015).

The public consultation events were advertised in local newspapers and a targeted mail-out was sent to residences in close proximity to the proposed works and to local community organisations and residents groups.

Matters raised at these events included:

- Queries around the proposed alignments (particularly through Greenhithe) and alternatives considered
- Concerns with regard to the stability of existing trees located near properties adjacent to Wainoni Park
- Concerns with regard to the removal of trees at 84 Laurel Oak Avenue
- Confirmation that the proposed pipelines are to be installed below ground
- Queries relating to the timing and duration of construction activities in residential areas
- Broader inquiries with regard to the wastewater network outside the scope of the proposed works

7.9 Key consultation outcomes

Generally, the parties consulted to date have been supportive of the overall project, acknowledging the need for new infrastructure to support Auckland's future growth and development.

The main outcome of the consultation process to date has been the changes in alignment and refinements made along the proposed route and at some key sites.

Identifying opportunities to achieve mutually beneficial outcomes with affected landowners and occupiers has also formed a key part of the consultation and will continue as the design is further developed.

7.9.1 Ongoing consultation

The ongoing consultation process prior to construction will incorporate:

- Targeted and wider community consultation during the statutory process (2015);

- Consultation with directly affected parties on matters of detail to be incorporated in final design (2015 – 2016);
- Consultation with directly affected parties prior to construction to develop the details of the construction methodology and construction management plans.

A detailed project communications plan will also be developed prior to construction. The communications plan will cover matters such as:

- The methods of consultation and liaison with key stakeholders, owners and occupiers of neighbouring properties and the wider community regarding the likely timing, duration and effects of construction works;
- Name and contact details for the nominated community liaison person and alternative contact details in the event of that person not being available (to ensure a contact person is available by telephone 24 hours per day seven days per week during the construction phase); and
- Procedures to record and respond to complaints.

The communications plan will be implemented during construction, and updated and revised as appropriate.

8. Statutory Assessment

The scope of the resource consents sought is set out in Section 4 of this AEE. This section assesses the GBWD and Causeway project against the relevant provisions of the Resource Management Act 1991 (RMA) and the relevant provisions of the following policy statements and plans prepared under the RMA:

- The New Zealand Coastal Policy Statement 2010 (NZCPS)
- Hauraki Gulf Marine Park Act (HGMPA)
- National Policy Statement for Freshwater Management 2014 (NPS:FW)
- The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (NES:Soil)
- Auckland Regional Policy Statement 1999 (RPS) and RPS provisions in Proposed Auckland Unitary Plan
- Auckland Council Regional Plan: Coastal 2004 (ACRP:C)
- Auckland Council Regional Plan: Sediment Control 2001 (ACRP:SC)
- Auckland Council Regional Plan: Air, Land and Water 2013 (ACRP:ALW)
- Auckland Council District Plan: Waitakere Section 2003 (ACDP:WS)
- Auckland Council District Plan: North Shore Section 2002 (ACDP:NS)
- Proposed Auckland Unitary Plan, notified 2013 (PAUP)

8.1 Resource Management Act 1991

8.1.1 Part 2 (Purpose and Principles – Sections 5, 6, 7 and 8)

Part 2 provides a common set of principles to be applied to the management of all resources.

8.1.1.1 Section 5 Assessment

The RMA has a single overarching purpose: to promote the sustainable management of natural and physical resources. Sustainable management is defined in Section 5(2). The GBWD and Causeway project supports the purpose of the RMA for the following reasons:

- The project provides critical water supply and wastewater services at a regional level to support both existing communities and anticipated population growth.
- The project optimises the opportunities provided through provision of both services (NI and GBWD) within the same construction programme where the alignments overlap, ensuring that the work is done efficiently and in a cost effective manner.
- As demonstrated in Section 6 of this AEE, the project can be undertaken in a manner that avoids or mitigates the adverse effects on the environment.
- The project provides a sustainable and cost effective solution to meet Watercare's statutory objectives.

8.1.1.2 Section 6 Assessment

In achieving the purpose of the RMA, matters of national importance shall be recognised and provided for, with the following matters being relevant to the project:

- a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development;*

As noted in the Technical Report I Landscape and Visual Assessment Volume 2, the project area is heavily influenced by the existing causeway, Greenhithe Bridge and SH18. Overall, natural character is highly modified, especially in the vicinity of the proposed works area. The works within the coastal environment

are necessary and appropriate to the coastal environment, as the infrastructure requirements of NI and GBWD rely on servicing across the upper Waitemata Harbour. Combining the two into a single project where their alignments overlap will minimise the length of time works occur within the CMA and coastal environment, and avoid duplicating any adverse effects of the two projects through a single integrated construction programme. Furthermore the overlapping of the GBWD and NI alignments results in limiting the effects on the coastal environment to a location which is already dominated by the existing causeway and where the natural character of the coastal environment has been assessed as being highly modified.

c) *The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;*

While the works will be in an area identified in the PAUP as a “significant ecological area” (which is applied to the rock revetment on the existing causeway, landward of mean high water springs), neither the Technical Report D Ecological Assessment nor Technical Report E Arboriculture in Volume 2 support such a status in their assessments. Relying on these reports as being thorough and focussed on the site itself, it would appear that consideration of the Project in the context of 7(c) is relevant with respect to habitats of indigenous fauna. The Technical Report D Ecology Assessment has identified that the mangrove habitat removal to facilitate the works at the western embayment will have an adverse effect on banded rail. The report also states that mangrove encroachment is resulting in the loss of habitat for foraging for a range of threatened and endangered bird species. Significant areas of the Upper Waitemata harbour both north and south of the Project area are identified in the ARP:C as being Coastal Protection Areas (either category 1 or 2). The Hobsonville Peninsula is identified as one of the two major roosts on the Waitemata Harbour and all of the area north of Herald Island is considered “the best example of the muddy, mangrove-lined inlets of the inner Waitemata Harbour”. The area of mangrove lost through the project does not have the same values attributed to it and nor will its removal have an adverse effect on those highly valued areas in the wider harbour area. Mitigation recommended in Technical Report D Ecological Assessment such as bird roosts and fencing to prevent dog access to banded rail habitat is supported. Accordingly it is considered that the Project has recognised and provided for the protection of significant habitats of indigenous flora and fauna.

d) *The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers;*

The project offers opportunities to enhance public access along the foreshore on the widened causeway. On completion of construction and resolution of the final ownership and management of the land, the facilities can be developed to provide for passive recreation along the full extent of the widened causeway. This opportunity will be explored once the ongoing management of the widened causeway is resolved.

During construction pedestrian access along the causeway may be restricted for health and safety reasons. However the cycleway along SH18 and the Greenhithe Bridge will be maintained.

e) *The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.*

The relationship of iwi to the coastal environment of the project area has been explored through consultation with mana whenua (as summarised in Section 7 of this AEE) and through the CIAs that have been prepared. Watercare is exploring ways of acknowledging the relationship of mana whenua through the development of the project.

8.1.1.3 Section 7 Assessment

Other matters to have particular regard to when managing the use, development and protection of natural and physical resources include:

b) a) Kaitiakitanga;

Watercare recognises the importance of iwi exercising their functions as kaitiaki over natural and physical resources. As noted above, Watercare has an enduring relationship with iwi as referred to in Section 7.3.3 of this AEE, and established relationships with individual mana whenua entities, whether or not they are active participants in the Watercare Mana Whenua Kaitiaki Forum. It is these relationships that enable iwi

to exercise their role as kaitiaki in the project area. Key matters raised by iwi through CIAs prepared will be addressed either through the construction process or (where appropriate) post construction.

c) The efficient use and development of natural and physical resources;

The works reflect an efficient use and development of natural and physical resources. The GBWD and NI works are coordinated within the project area to ensure that the construction effects are minimised and there is no duplication of adverse construction effects between the two projects, including to road users and cyclists, network utility operators who have utilities within the existing causeway, and to adjacent landowners. The combining of the two services within the widened causeway will minimise disruption to the coastal environment. Forward planning by Watercare will ensure that as population growth anticipated by the Auckland Plan puts greater demand on potable water supply and wastewater services, these services can be provided with minimal ongoing disruption as the systems are designed to accommodate planned growth into the future.

d) The maintenance and enhancement of amenity values;

e) Intrinsic values of ecosystems;

Maintenance and enhancement of the quality of the environment;

The amenity values of the immediate causeway area have been assessed as highly modified given the influence of SH18 and the Greenhithe Bridge. There is a reasonably high level of broader landscape amenity with the presence of the harbour and relatively continuous coastal vegetation. Amenity values in the area will be subject to some reduction through the construction process. In the longer term the finished causeway widening will provide an opportunity for an enhanced environment through the indicative landscape concept plan, public access opportunities and the integration with the existing causeway structure. The widened causeway will offer opportunities for enhanced open space, where currently there is just a walkway/cycleway. The technical reports do not identify any potential issues with the long term effects on ecology, subject to appropriate mitigation, nor the intrinsic values of the coastal environment in the project area. Maintenance of the quality of the environment includes maintenance of the existing NH1 watermain, and the project facilitates this by provision of an alternative supply pipeline to enable NH1 to be shut down for maintenance.

8.1.1.4 Section 8 Assessment

The principles of the Treaty of Waitangi shall be taken into account when managing the use, development, and protection of natural and physical resources. Watercare, as discussed above, recognises these principles through its enduring relationships with iwi. Ongoing consultation will ensure that outstanding matters will be addressed. For these reasons it is considered that the Project has, and will continue to, take into account the principles of the Treaty of Waitangi.

8.1.2 Section 104 – Consideration of Applications

8.1.2.1 Section 104(1)(a)

Section 6 of this AEE identifies the actual and potential effects on the environment of the project. The positive effects of the project, as identified in Section 6.1 of this AEE are considered to be significant on the social, cultural, economic and environmental wellbeing of the wider Auckland area. Having regard to the potential effects both during construction and operation it is concluded that overall, with mitigation, potential and actual adverse effects associated with construction will be minor and post construction effects **overall** will be less than minor.

8.1.2.2 Section 104(1)(b)

When considering the project under s104 (1)(b), the decision maker must have regard to the relevant provisions of the following statutory documents.

8.1.2.3 New Zealand Coastal Policy Statement (NZCPS) 2010

The project extends into the CMA in the location of the causeway widening/extension and attachment of a new watermain to the Greenhithe Bridge. Regard has been given to the NZCPS. The Project is considered to be consistent with relevant provisions of the NZCPS for the following reasons:

- The works will have a less than minor adverse effect on the wider coastal environment and a minor effect on the immediate coastal environment as a result of the proposed widening and extension of the causeway as concluded in Technical Report H Coastal Processes;
- Technical Report B Ecological Assessment does not identify any significant ecological effects that will result from the works, and over time adverse effects will be remedied through reinstatement of the disturbed marine environment adjoining the widened causeway (to a state that reflects the existing coastal margin) and through mitigation proposed;
- The natural character of the coastal environment will re-establish once construction works have finished, especially given that the proposed landscape treatment will generally reflect the current environment, albeit a wider causeway with the construction platform;
- Watercare has consulted with iwi, consistent with its obligations under the Treaty of Waitangi, and iwi have addressed issues relating to kaitiakitanga through a formal consultation process and the CIAs prepared for the project;
- The widened causeway provides an opportunity for enhanced public open space, greater opportunity for active and passive recreation, and high quality landscape treatment of the causeway works; and
- Functionally, widening and extension of the causeway is the most appropriate means to provide for the necessary expansion of both the bulk water supply and trunk wastewater network of the Auckland region in a manner that will accommodate expected population growth of the region in the north and east. It must be noted that the need to use existing infrastructure such as the water supply dams and the Rosedale WWTP efficiently and to service Auckland with both wastewater and potable water requires access across the Waitemata harbour at some point.

Notably, with respect to the relevant policies

- Policy 6 recognises the provision of infrastructure as being activities in the coastal environment that are important to the social, economic and cultural well-being of communities, including meeting the foreseeable needs of population growth;
- Policy 10 acknowledges that reclamations are considered appropriate where there is no practicable alternative method, where they are of significant regional benefit and where the purpose is to provide for the efficient operation of infrastructure;
- Policy 11 seeks to protect adverse effects on indigenous biodiversity through avoiding adverse effects on threatened or at risk taxa. The reduction of potential foraging for such species is not considered to put the protection of those species at risk;
- Policies 13, 14 and 15 seek to preserve, restore and protect the natural character of the coastal environment. Technical Report I Landscape and Visual Assessment summarised the natural character as “a highly modified environment that comprises a mixture of residential development, dominant road infrastructure and natural coastal landscape.” and that “the landscape attributes of the subject site are low due to the presence of SH18 and the level of change that is currently underway in neighbouring Hobsonville and off Squadron Drive. As a result, the overall landscape character is a mixture of highly modified land-based activities set within a natural coastal environment.” Neither the subject site nor the coastal area in the immediate vicinity of the works are identified in the PAUP as “Coastal Natural Character area”. The PAUP has been prepared to give effect to the NZCPS. Given the provisions of the PAUP and the summary in the Technical Report I Landscape and Visual Assessment, the proposal will not be inconsistent with the provisions of the NZCPS;

- Policies 18 and 19 with respect to public open space and walking access have been recognised in the Indicative Landscape Concept Plan appended to the Technical Report I Landscape and Visual Assessment. During construction access will be managed to ensure public safety, and on completion of the works the site will make provision for public access within an improved environment to that available now. The final details will require confirmation when the ongoing management of the site is settled.
- Policy 22 with respect to sediment and Policy 23 with respect to discharge of contaminants has been addressed in Technical Report A Earthworks and Sedimentation and Technical Report B Soil, Sediment and Groundwater Contamination. These matters can be adequately addressed during construction to ensure that the provisions of the NZCPS are respected.

8.1.2.4 Hauraki Gulf Marine Park Act (HGMPA)

The project has been assessed with regard to the provisions of the HGMPA. For the coastal environment of the Hauraki Gulf, Sections 7 and 8 of the HGMPA must be treated as a New Zealand coastal policy statement issued under the RMA. The project will not affect the wider Gulf area or the life supporting capacity of the Gulf (including the islands). The project has no adverse effect on the historic or physical characteristics of the Gulf, and no significant adverse effects on the natural resources of the Gulf.

8.1.2.5 National Policy Statement for Freshwater Management 2014 (NPS:FW)

The NPS:FW relates to the management of freshwater resources, providing national direction for the setting of water quality and quantity limits and targets. Given that the proposed works are being undertaken within the coastal environment and no freshwater environments are affected the NPS:FW is not considered relevant to this project.

8.1.2.6 National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011

As discussed in Technical Report B Soil, Sediment and Groundwater Contamination the works do not necessitate any consent under this NES. No further consideration of it is necessary under s104(1)(b).

8.1.2.7 Auckland Regional Policy Statement (ARPS)

The ARPS outlines the broad policy direction for the wider Auckland region. Of most relevance to this Project are objectives and policies relating to Regional Overview and Strategic Direction (Chapter 2), matters of significance to iwi (Chapter 3), and Coastal Environment (Chapter 7). Regard has been given to these relevant provisions and the Project is considered to be consistent with the strategic direction of the ARPS for the following reasons:

- The Project actively supports the regional growth policies of the Auckland region through the augmenting of the GBWD to support and allow maintenance of NH1, a vital water supply pipeline serving the growing populations within the metropolitan urban limits of the North Shore;
- The Project actively supports the provision of wastewater services through the provision of the NI pipeline within the causeway widening. NI (as demonstrated through the resource consents for the wider Project) will provide essential wastewater services to growing communities in the west and north-western parts of Auckland.
- The project can be constructed and operated in a manner that does not result in significant adverse effects on the environment, and is in a location that, when completed will provide an enhanced level of amenity and will not compromise any significant coastal landscapes or features.

As a result of ongoing consultation, iwi with interests in the project area have been able to engage with the project managers from Watercare, prepare cultural impact assessments, and offer means to ensure that they can reinforce their role as kaitiaki over the project area during and after construction. This demonstrates that there has been regard to, and that the project is consistent with, the objectives of Chapter 3.

Regard has also been had to Coastal Environment (Chapter 7) and the project is considered to be consistent with relevant policy directions for the following reasons:

- The location and design of the project will assimilate into the existing environment, as the proposed widening and extension of the causeway will reflect to a significant extent the current form of the causeway, albeit being approximately 15 metres wider;
- The location is not in an area of significant indigenous vegetation and effects on fauna can be mitigated to protect their habitat in the long term;
- The project is not located in an area of high natural character;
- The project does not compromise the long term recreational values of the area, and will enhance public access and recreational opportunities;
- The project consolidates the location as being a key corridor for regionally significant infrastructure, without resulting in significant cumulative adverse effects. Co-location of such infrastructure protects the wider coastal environment from further modification.

8.1.2.8 Proposed Auckland Unitary Plan – Regional Policy Statement

The project has had regard to and supports the RPS provisions of the PAUP as follows:

- The project provides necessary infrastructure to support population growth in a manner that optimises existing infrastructure (the Greenhithe Bridge) and the construction of the causeway widening to provide for capacity for both NI and the GBWD (B1.1)
- The works are considered to be in an appropriate location, especially given
 - the geographical need to cross the Upper Waitemata Harbour in order to provide infrastructure to service the west, north-western and northern parts of Auckland, including the utilisation of existing infrastructure including the Greenhithe Bridge
 - the location of the existing causeway and Greenhithe Bridge; and
 - the nature of the section of coastal environment being affected, being a highly modified environment with no outstanding vegetation or natural features (albeit identified as an SEA in the PAUP, but assessed in much greater detail in Technical Report D Ecology as not being of significant value). (B1.4)
- The project has provided for the Te Tiriti o Waitangi partnerships and participation in the process as facilitated through the consultation process (B5.1) and the preparation of CIAs (B5.2)
- The project is located appropriately and in a manner that coordinates two significant infrastructure projects into one (thus minimising the effect on the environment during construction), and integrates the proposed new infrastructure, with other existing infrastructure, without unduly restricting wider use of the coastal environment (B7.1, B.2 and B.3);
- The project avoids and mitigates significant adverse effects on the environment (B7.5).

8.1.2.9 Auckland Council Regional Plan: Coastal 2004 (ACRP:C)

The GBWD and Causeway extends into the CMA in the location of the causeway widening/extension and attachment of a new watermain to the Greenhithe Bridge. This area is a general management area in the ACRP:C. Regard has been given to the relevant provisions of the ACRP:C and it is considered that the project is consistent with the relevant objectives and policies for the reasons noted below:

- The project preserves the natural character of the wider coastal environment by consolidating the proposed new GBWD and NI infrastructure in an area of limited natural character, and one which is influenced by the Greenhithe Bridge and existing causeway (objective 3.3.1 and policies 3.4.1, 3.4.2, 3.4.3 and 3.4.4). Additionally the project is not considered “inappropriate” in the context of its regional significance;
- The project does not have any significant adverse effect on the dynamic functioning of the physical coastal processes, as demonstrated by the Coastal Processes Technical Report H (refer Volume 2) or the integrity, functioning and resilience of the immediate bird habitats as demonstrated in the Ecology Technical Report D (refer Volume 2) (objectives 5.3.1 and 5.3.2 and associated policies);

- Watercare recognises the significance of the coastal environment to iwi, and continues to actively engage with them (objective 6.3.1);
- The project will facilitate an improved passive recreational environment through appropriate landscape treatment of the widened and extended causeway (objective 7.3.1 and associated policies);
- The use of the CMA is appropriate in this location due to the existing provision for the GBWD on the existing bridge structure, the widening of the existing causeway (as opposed to an entirely new structure), and the limited adverse effects of the works, especially post construction (objectives 9.3.1, 9.3.2, 10.3.1 and associated policies);
- Temporary occupation of the seabed is necessary to facilitate construction of the widened and extended causeway. Post construction part of the widened causeway will be surveyed and will be above MHWS – meaning that it is no longer occupying the seabed;
- The widening and extension of the causeway is not considered to be inappropriate reclamation of the coastal environment, as it is required to facilitate regionally significant infrastructure and the adverse effects can be adequately mitigated (objectives 13.3.1 and 13.3.2);
- The discharges generated by the Project will not result in any adverse effect on water quality or quantity of discharges to the CMA, and discharges will be in a similar location to those existing.

The project is consistent with the relevant policies, as

- There is no CPA1 areas or cultural heritage sites to consider; and
- The Project offers the opportunity for improved public access and passive recreation as a result of the infrastructure works.

8.1.2.10 Auckland Council Regional Plan: Sediment Control 2001 (ACRP:SC)

The landward component of the proposed works will be within the Sediment Control Protection Area (SCPA), which includes the area 100m landward of the CMA. Overall, it is considered that the project is consistent with the objectives and policies of the ACRP:SC as all sediment generated by the works will be managed according to best practise to avoid elevated levels of sediment entering the harbour.

8.1.2.11 Auckland Council Regional Plan: Air, Land and Water 2013 (ACRP:ALW)

The Auckland Council Regional Plan: Air, Land and Water (ACRP:ALW) addresses issues relating to the diversion and discharge of stormwater, groundwater and the disturbance of contaminated soils outside of the CMA. These are all activities that will be undertaken in the construction of the project. Overall, it is considered that the project has had regard to and is consistent with the relevant objectives and policies of the ACRP:ALW for the reasons noted below:

- Given the conclusion of Technical Report B Soil, Sediment and Groundwater Contamination (Volume 2) that the effects would be less than minor and that no resource consent requirement is triggered, a comprehensive assessment of the objectives and policies is not considered necessary. However, mitigation such as the preparation of appropriate protocols as part of the construction management plan(s) will ensure that potential contaminants are appropriately managed.
- The diversion of groundwater through installation of services and construction techniques such as tunnelling is assessed as being less than minor with appropriate mitigation (such as the use of sheet piling). The project will ensure that the effects of the diversion of groundwater can be adequately mitigated which is consistent with objective 6.3.8 and policy 6.4.49 of the ACRP:ALW.
- The provision of swales to capture, treat and then discharge stormwater from new impervious surfaces will minimise the adverse effects through providing treatment and ensuring the rate of discharge will not result in erosion at the outfall. Management of stormwater in this way is considered the best practicable option, considering the site, the types of contaminants that might result from the use of the widened causeway and the options available to manage the stormwater runoff.

8.1.2.12 Auckland Council District Plan: Waitakere Section 2003 (ACDP:WS)

The area of the proposed works to the west of the Greenhithe Bridge (and on the landward side of MHWS) is within the jurisdiction of the Auckland Council District Plan (Waitakere Section) 2003 (ACDP: WS). Overall, it is considered that the GBWD and Causeway is consistent with the objectives and policies of the ACDP:WS for the reasons noted below:

- The works will be undertaken in a manner that enhances the natural character of the coastal environment by being undertaken in an area that is already modified by human activity, by enhancement of the finished works through provision of public access and planting of low vegetation and trees to reduce the prominence of the infrastructure elements (objective 7);
- As discussed in relation to the ARPS and the RPS elements of the PAUP above, interested mana whenua entities have been engaged during development of the project to date (refer Section 7.3 of this AEE) and have contributed to the understanding of the project in relation to mauri and kaitiaki (objective 8).

8.1.2.13 Auckland Council District Plan: North Shore Section 2002 (ACDP:NS)

The area of the proposed works to the east of the Greenhithe Bridge is within the jurisdiction of the Auckland Council District Plan (North Shore Section) 2002 (ACDP: NS). Overall, it is considered that the GBWD and Causeway is consistent with the objectives and policies of the ACDP:NS for the reasons noted below:

- Objective 6.4.1 seeks to manage growth and change which ...avoids or mitigates conflicts between land use and planned future regionally significant infrastructure. Utilisation of the existing infrastructure corridor avoids conflict with other population growth objectives, including providing for a high quality natural and built environment;
- The arboriculture technical assessment recommends replacement planting to mitigate the loss of vegetation and appropriate management systems to be put in place to protect vegetation that is to be retained; and
- The use of the existing infrastructure corridor also assists in minimising potential adverse effects on adjacent landowners. The construction effects will be managed through the implementation of a Construction Management Plan and best practice construction management methods (e.g. relating to noise, vibration, dust, traffic) to ensure there are no significant adverse effects on adjacent properties. Notably the works will provide for water supply to support the growth aspirations provided for in the ACDP:NS. Post construction the operation of the Project will be less than minor (objective 14.3.1).

8.1.2.14 Proposed Auckland Unitary Plan (PAUP)

The Proposed Auckland Unitary Plan (PAUP) was notified on 30 September 2013. Submissions have been received on the PAUP and the hearings process is underway. No decisions have yet been made in relation to the relevant objectives and policies of the PAUP and therefore these provisions carry limited legal weight. Overall, regard has been given to the PAUP provisions and it is considered that the GBWD and Causeway is consistent with the relevant objectives and policies of the PAUP for the reasons noted below:

- Tree removal is necessary to facilitate the works. Although not ecologically significant, the landscape and amenity value of trees in the project area is recognised and an indicative landscape concept plan has been prepared in part to mitigate the effects of the proposed tree removal (Volume 2, Appendix 3 of Technical Report I and Drawing Set Volume 3). This supports objective C4.1.3 and the related policies.
- Earthworks will be undertaken in accordance with best practise erosion and sediment control measures (refer Volume 2 Technical Report A). A detailed erosion and sediment control plan (ESCP) will be forwarded to Council prior to works commencing, implementing the most appropriate measures for each stage of the project and recognising the diversity of environments within which the works will be undertaken (e.g. causeway widening and extension in coastal environment, trenching and tunnelling within a road corridor). The measures identified and the ESCP will ensure that earthworks will be managed to ensure that as little sediment is discharged into the coastal environment as is practicable (objective C5.2.1 and .3). Post construction the site will be fully stabilised.

- The arboriculture technical report identifies appropriate management techniques for working within the dripline of vegetation to be retained.
- The stormwater treatment and quantity discharged from the current causeway will require the extension of the existing culverts. The modifications will not result in any significant changes upstream, or to volume or quality of stormwater. Post construction the project will not generate runoff that will contain any significant levels of contaminants (being from a public footpath). Overall the effects of the project on water quality have been assessed as being less than minor. This supports the general policy direction of the PAUP to ensure that water quality is protected from further degradation (objective C5.15.1.3 and associated policies). The works will be undertaken to best minimise potential adverse effects on the coastal marine environment (as demonstrated in the Ecology Technical Report D (Volume 2) (objective C5.15.1.4 and associated policies).
- Technical Report C – Groundwater addresses potential effects associated with diversion of groundwater during construction and potential settlement effects. The PAUP objectives relating to water quantity, allocation and use are not considered relevant to diversion of groundwater. However policy 18 addresses diversion of groundwater. Given that the effects of the project on groundwater are assessed as being minor, if not benign, from construction, on nearby groundwater takes and with respect to water quality, the project would not be consistent with C5.15.2.18.
- As assessed in the relevant technical reports (notably A – Earthworks and sedimentation, D - Ecology, H- Coastal and I - Landscape and Visual), the works can be undertaken to avoid or mitigate adverse effects on the coastal environment. The existing natural character is highly modified and will not change significantly given that the widening and extension of the causeway will reflect the existing causeway arrangement (albeit wider), public access and amenity values will be enhanced through a planting plan and passive recreation opportunities may be facilitated by the project. This is considered to be consistent with the relevant objectives and their associated policies relating to reclamation (C5.1.1-C5.5.3).
- The project requires the removal of approximately 2,200m² of mangrove habitat. These mangroves represent a very small area of habitat in the context of the Upper Waitemata Harbour. Objectives and policies (D5.1.6) relating to mangrove removal recognise the need to do so where it is necessary (and there is no practicable alternative) to facilitate the provision of infrastructure. Post construction, mangroves will reasonably be expected to colonise to the foot of the widened causeway. The project is considered to be consistent with objectives and relevant policies of D5.1.6.
- The project necessitates the diversion of coastal water during construction. The works are necessary to enable the construction of regionally significant water and wastewater infrastructure. This is consistent with objective C5.1.9 and policy C5.1.9.3(c).

Overall the project supports the relevant growth objectives contained in the ARPS, ARP:C, ACDP:WS and ACDP:NS. The Project is generally consistent with the requirement to adequately mitigate effects to ensure that, overall, the effect on the different components of the natural environment are minor.

8.1.2.15 Section 104(1)(c) Other Matters

8.1.3 The Auckland Plan

The Auckland Plan is a statutory document which guides Auckland's future over the next 30 years and addresses issues such as:

- Transport and housing shortages
- Giving children and young people a better start
- Creating more jobs
- Protecting the environment.

The Auckland Plan was adopted by the Auckland Council in March 2012.

Directives 12.1 and 12.2 relate to the efficient provision of infrastructure and integration of planning network utilities to provide for population growth. Given that the purpose of the project is to facilitate infrastructure to meet current and future demand, and that the project integrates the GBWD and NI to optimise construction efficiencies, it is considered that the project supports the relevant Auckland Plan directives.

8.1.4 Iwi Management Plan

Ngati Whatua o Orakei Maori Trust Board has produced an Iwi Management Plan for their role, including the upper Waitemata Harbour. The key issues, objectives and policies of that plan relevant to the Project are 7.1 Te Wai Ora a Tane and Mauri Moana (Waters and their Ecological Communities) and 7.2 Te Wao Nui a Tane (terrestrial biodiversity). The provision of the NI and GBWD and Causeway projects reinforces the reliance throughout the region on infrastructure that minimises to the greatest extent possible adverse effects on the environment that would result from poorly designed and inadequate wastewater infrastructure. This supports Ngati Whatua o Orakei objectives to maintain and restore the mauri of waimaori networks and moana, and avoiding the direct discharge of wastewater into the sea.

The indicative landscape concept plan shows the potential replanting relying on reuse of existing pohutukawa and new pohutukawa specimens. As discussed in Section 7, Watercare will assist Ngati Whatua o Orakei to achieve the objectives and policies within the Iwi Management Plan where practical within the context of the GBWD and Causeway project.

8.1.5 Section 104D

As indicated in Section 4 of this AEE, the causeway widening is a non-complying activity as a result of the reclamation being a non-complying activity in the ARP:C. It is noted that the causeway widening is a discretionary activity under the PAUP. Under section 104D of the RMA a resource consent for the Project may only be granted if either:

- The adverse effects of the activity on the environment will be minor; or
- The activity is not contrary to the objectives and policies of relevant plans and proposed plans.

As demonstrated in Section 6 of this AEE, the adverse effects of the project will be minor. As demonstrated in Section 8.1.2.9 and 8.1.2.14 above, the project is generally consistent with, and certainly not repugnant to the relevant objectives and policies of the relevant plans and proposed plans. The project can pass either gateway test and be considered under s104 accordingly.

8.1.6 Sections 105 and 107

Sections 105 and 107 include a number of provisions relevant to the consideration and granting of discharge permits.

With respect to the requirements under s105:

- The nature of the discharge remains what it is, the point of discharge shifts westward to allow for the construction of the widened causeway;
- As the environment is proven to be tolerant to the quality and quantity of the stormwater discharge in this area and the limited opportunities for discharge points within the Project area it is not considered necessary or practical to consider alternative points of discharge; and
- Given the public ownership of the causeway the imposition of a condition requiring an esplanade strip or reserve is considered unnecessary (s.105(2) RMA).

With respect to section 107 the Earthworks and Sedimentation Technical Report A (Volume 2) considers the effects of altering the existing structures to accommodate the widened causeway (i.e. shifting the point of discharge to the west) and the stormwater from the increased impervious surfaces forming access along the widened causeway to be less than minor. No issues relating to the matters raised in section 107(1)(c)-(g) have been raised in that or any other technical report. The granting of the discharge permit would be consistent with the purpose of the RMA.

9. Conclusion

The Greenhithe Bridge Watermain Duplication and Causeway project will facilitate necessary maintenance of the existing NH1 watermain, providing security of supply and resilience to the water supply network. The project will also incorporate sections of three Northern Interceptor pipelines and provide a platform for these pipelines to cross the Upper Waitemata Harbour. The project represents an efficient coordination of infrastructure necessary to serve the growing populations of the north, north-west and north-east of Auckland.

During construction, appropriate management plans and protocols will be developed and implemented to manage potential construction effects. Construction effects can be adequately managed to ensure that, overall, the effects on the environment are minor.

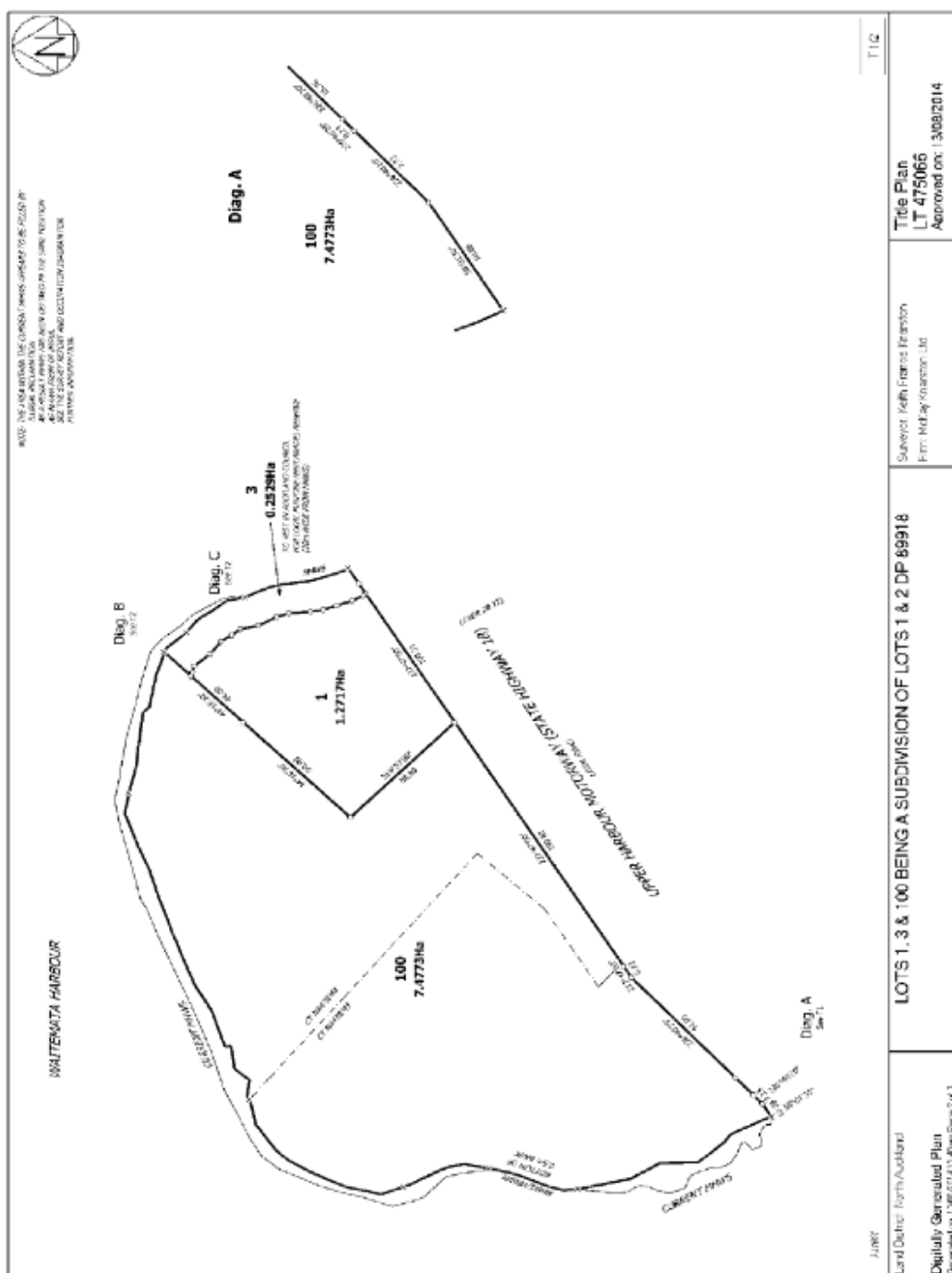
The completed works will be predominantly underground apart from manhole access lids located at ground level, and that part of the new watermain that will be attached to the underside of the Greenhithe Bridge structure. On completion of construction the effects of the operation of the new watermain will be positive. The provision of a landscaped area of open-space will provide visual mitigation for the effects of the widened causeway and will also provide new recreation and amenity opportunities linked to the coastal environment.

The proposed work is consistent with the purpose of the RMA in that it allows for the management of natural and physical resources in a way that enables people and communities to provide for their social, economic and cultural well-being and for their health and safety.

The proposed work is consistent overall with the objectives and policies of the relevant statutory documents as it is public infrastructure and can be constructed, operated and maintained in a manner which avoids, remedies or mitigates adverse effects.

Accordingly, it is considered that the consent applications warrant being granted so that the proposed work and the resulting network improvements can be implemented as planned.

Appendix A. Certificates of Title



Appendix B. Assessment of Alternatives Report