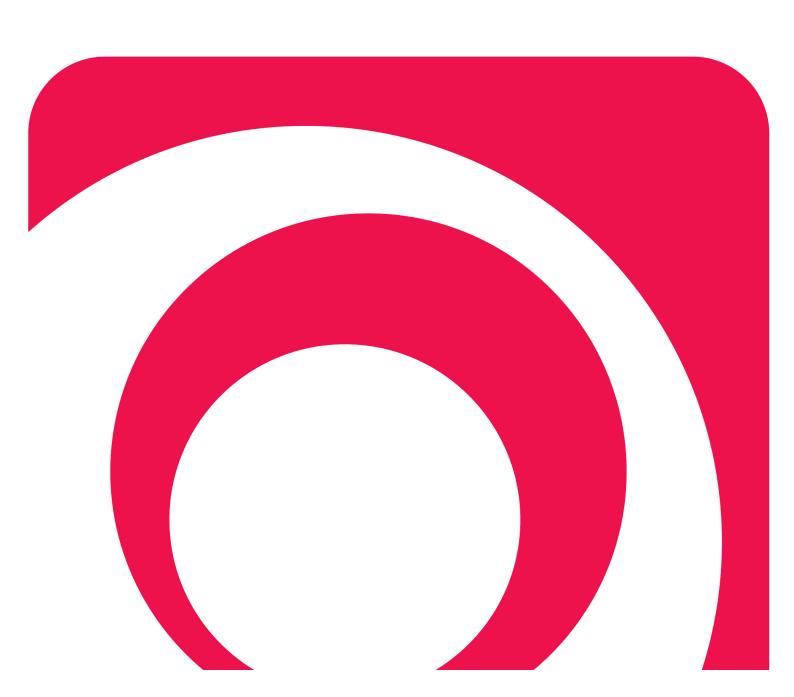


NORTHERN INTERCEPTOR PHASE 1 Assessment of Noise Effects Rp 001 2014519A

25 June 2015





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Project: **NORTHERN INTERCEPTOR PHASE 1**

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Report No.: Rp 001 2014519A

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EXECUTIVE SUMMARY

This report provides an assessment of construction noise effects from the proposed Northern Interceptor Phase 1 project for receivers located along the route detailed in the main AEE.

It contains a discussion of the pertinent noise criteria from the relevant district plans and regional coastal plan; outlines the noise effects assessment methodology; predicted noise levels and potential impacts from various activities associated with the Project.

The recommended Project noise criteria are based on those contained in NZS 6803: 1999, the Proposed Auckland Unitary Plan, and the Auckland Council Regional Plan Coastal. The Project aim is to achieve compliance with these criteria where practicable. The Project also acknowledges the requirement of Section 16 of the Resource Management Act that the best practicable option is adopted to ensure that noise emissions from Project works do not exceed a reasonable level. The assessment takes into account and discusses the practicability of mitigation and management measures.

Through the prediction of construction noise levels and the recommended mitigation and management measures, areas of risk have been identified where full compliance with the criteria may not be able to be achieved. These include aspects of short-term trenching work in close proximity to receivers, intertidal trenching early in the morning or late in the evening and night-time HDD rig operation.

Construction noise has been predicted using equivalent noise sources measured as part of previous projects and from information contained in NZS 6803: 199 and BS 5228-1: 2009. Tables are provided that show potential worst case noise levels from the construction activities proposed. These predictions are based on assumptions and estimates detailed in the draft construction methodology provided by the Project team. Realistically, there may be some variation in the actual methodology or equipment used to carry out the work. However, the Project Construction Noise and Vibration Management Plan ("CNVMP") will contain the procedures necessary for identifying and mitigating/managing any potential noise issues, as has historically occurred on various large infrastructure projects in Auckland.

General noise management and mitigation measures have been recommended to be implemented throughout the course of the Project as a best practice provision e.g. maintenance of equipment to a high level and the avoidance of unnecessary noise such as the use of horns and tonal reverse alarms. In addition, where there is a risk that the construction noise criteria may be exceeded, recommendations for specific noise mitigation and management measures are provided. These recommendations are site specific and involve additional measures such as the installation of temporary construction noise barriers or the timing of construction activities to avoid effects on receivers e.g. carrying out construction when most residents are at work or when businesses are closed.

The construction noise criteria are likely to be exceeded during some activities. While the intention is to meet the criteria as far as practicable, there will be times when construction cannot be undertaken in compliance with the noise criteria, and alternative management mitigation will need to be implemented. This may involve one-on-one discussions with affected stakeholders, and may, in some instances, result in the temporary relocation of residents.



Night-time trenching works may be carried out to minimise traffic delays on the road network at certain locations, for instance along John Glenn Avenue, William Pickering Drive and Piermark Drive. Night-time works in a business zone would be one example of the practicable mitigation of construction noise effects, as most if not all nearby businesses would be closed.

The effects of construction noise will require active noise management throughout the construction period to avoid, remedy or mitigate such effects. This would be undertaken through the implementation of the CNVMP, which will be formulated and updated as appropriate to reflect the actual activities occurring. The CNVMP forms the basis of all construction noise management and mitigation and contains detailed information regarding communication, training, maintenance, mitigation and other aspects of construction that affect the noise generation.

Overall, the construction of the Project is predicted to result in noise levels that are generally within the Project construction noise criteria, with some exceptions. While construction noise levels are higher than ongoing operational noise levels, it is commonly accepted that for any construction to occur, noise criteria must be less stringent, with the understanding that construction is a temporary activity with a finite duration.

It is considered that this Project can be constructed within reasonable noise criteria, provided that the best practicable option of mitigation is implemented throughout and contractors are committed to managing construction noise on an ongoing basis.



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1.0 INTRODUCTION

Watercare Services Limited ("Watercare") is proposing to build new pipelines and associated infrastructure to convey wastewater from north-western parts of Auckland to the Rosedale Wastewater Treatment Plant ("WWTP") in Albany. This project is known as the "Northern Interceptor". Construction of the Northern Interceptor is intended to be staged, with the timing of various stages depending on the rate of population growth.

Marshall Day Acoustics ("MDA") has been commissioned by Watercare to assess the potential noise effects related to the construction, operation and maintenance of the proposed Northern Interceptor Phase 1 ("the Project"). Construction noise is considered to be the principle source of noise and therefore potential effects.

The proposed work requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input for the *Northern Interceptor Phase 1 – Assessment of Effects on the Environment* report ("the main AEE") prepared by MWH New Zealand Limited, which supports the resource consent application.

This report provides the following:

- A brief overview of the proposed works (Section 2)
- A description of the environmental baseline for the particular receiving environments potentially affected by the Project (Section 4.0, Section 5.4 and Appendix D)
- A description of specific aspects of the Project in relation to noise (Appendix F)
- A brief outline of the relevant noise performance standards (Section 3.0)
- An assessment of the potential noise effects on the environment (construction, operation and maintenance), based on the concept design and site layout drawings detailed in the AEE documentation¹ and having reference to the statutory framework and any other environmental factors considered relevant. This includes the identification of activities that could result in adverse effects and, in turn, identifying design refinements or construction methodologies that could avoid, remedy or mitigate such effects (Section 5)
- Recommended mitigation and management measures (Section 5.5)

A Glossary of technical acoustical terms is contained in Appendix A.

2.0 PROJECT DESCRIPTION

2.1 Proposed Construction Works

The purpose of the Project is to transfer wastewater flows from the Hobsonville PS to the Rosedale WWTP. The Project includes an upgrade of the existing Hobsonville PS and the establishment of a new wastewater pipeline between it and the Rosedale WWTP.

The main components of the Project include:

Hobsonville PS and State Highway 18 ("SH18") crossing

¹ For technical drawings refer to Volume 3 of the Main AEE



- SH18 to Causeway
- Upper Waitemata Harbour crossing (by marine trenching or HDD)
- Rahui Road to Greenhithe Road
- Greenhithe Road to South Wainoni Park
- Wainoni Park (South and North)
- Te Wharau Creek crossing
- North Shore Memorial Park
- North Shore Memorial Park to North Shore Golf Club
- North Shore Golf Club to Albany Highway
- Albany Highway to William Pickering Drive
- Piermark Road to Bush Road
- Rosedale Park to Rosedale WWTP (including Alexandra Stream crossing)

These components are discussed in more detail below.

Based on the preliminary design to date, the proposed nominal diameters ("**DN**") and materials associated with the pipeline are:

- 710mm DN polyethelene ("PE") pipeline in land sections; and
- Twin 550mm DN PE pipelines at the crossings of the Waitemata Harbour, Te Wharau Creek and Alexandra Stream

All dimensions, areas and volumes provided 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 later in this report.

Construction of the Project is currently scheduled to start in 2017, and will be around three years in total duration. The approximate duration of each of the component work phases is set out in Section 5.0 and Appendix F.

Once a contractor is appointed, and prior to the start of the main construction programme, a construction management plan ("CMP") or plans will be prepared which set out the detail of the proposed construction methodology and describe the mitigation measures to be taken to minimise potential adverse effects and ensure compliance with consent conditions where practicable. The CMP will address construction noise and vibration via the CNVMP.

Management plans addressing specific topics listed above will be incorporated in the main CMP for the Project or prepared as standalone plans as appropriate. The vast majority of the proposed route is conventional construction and it is expected to occur within normal working hours – that is, 7.00am to 6.00pm Monday to Saturday. However, there may be occasions where it is necessary to undertake construction activities outside of normal hours, for example, where it is necessary to complete an activity that has commenced, to tie into the existing network, delivery of large plant or machinery, emergency works, or to tie in with tidal cycles for works in the Coastal Marine Area ("CMA").



At some specific sites, the proposed construction methods may require 24 hour operations. These sites are the proposed crossings of the Waitemata Harbour, Te Wharau Creek and Alexandra Stream, and possibly some identified road crossings in heavily trafficked areas. For works outside of normal working hours, appropriate measures will be implemented to ensure construction noise and vibration standards are met where practicable. These measures will be set out in the CNVMP for the Project.

A number of components of the Project have multiple methodologies available for construction. Where this is the case, potential options are described. The proposed methodology will be finalised once a contractor has been appointed. At that time, a detailed CMP will be prepared (the CMP will contain a section covering the CNVMP) 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 this report is sufficiently broad to address effects from different construction methodologies.

Reinstatement at all sites following construction will generally involve replacing what was at the site prior to construction in a like-for-like manner where appropriate and practicable, or as otherwise agreed with the landowner. At most sites this is likely to involve a combination of re-grassing or repaving, replanting, and replacement of facilities that have been removed (e.g. footpaths, street and park furniture). Construction access roads not required for maintenance access will also be removed. Reinstatement within the road corridor will be as agreed with Auckland Transport.

An overview of the proposed route is provided in the figure in Appendix B.

Watercare is proposing some widening along the existing SH18 motorway causeway near Hobsonville to provide for proposed water and wastewater infrastructure, including a section of the Northern Interceptor Phase 1 pipeline. That work forms part of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway ("GBWD&C") project. That project is part of a separate resource consent package, and is described in a report titled Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment, prepared by Aecom New Zealand.

2.2 Description of Operational Activities

MDA has identified the sources of potential Phase 1 operation noise as the air, line and scour valves (referred to as "minor above-ground structures") at various locations along the pipeline. It is MDA's experience that the operation of these valves would not give rise to any significant levels of noise breaking out from inside the concrete enclosures in which they are housed. In normal operation these valves occasionally bleed a small amount of air which would sound like a 'hiss' or a 'splutter'. Another source of noise would be the arrival and departure of maintenance crews i.e. light vehicle noise, which would happen infrequently and would result in negligible noise effects.

Infrequent truck deliveries of chemicals would also occur at Hobsonville PS. Chemicals would be pumped into holding tanks at the proposed chemical storage and dosing facility. It is recommended that this activity is confined to daytime only and should be screened/enclosed to ensure compliance with District Plan noise limits.

Based on the above, MDA considers the noise and potential noise impacts from the operational aspect of Phase 1 to be slight, and have not been considered further.



3.0 NOISE PERFORMANCE STANDARDS

3.1 Resource Management Act

Under the provisions of the RMA there is a duty to adopt the best practicable option to ensure that the noise from any development does not exceed a reasonable level. Specifically, Sections 16 and 17 reference noise effects as follows.

Section 16 states that "every occupier of land (including any coastal marine area), and every person carrying out an activity, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level".

Section 17 states that "every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity, whether or not the activity is in accordance with a rule in a plan, a resource consent or relevant sections of the RMA".

3.2 District Plans

The full extent of the Project is located within the Auckland Council District. The relevant operative and proposed district plans are as follows:

- The Auckland Council District Plan Operative Waitakere Section (2003) (the "Waitakere DP")
- the Auckland Council District Plan Operative North Shore Section (2002) (the "North Shore DP")
- In addition, the Auckland Regional Plan: Coastal applies to trenching activities on the Causeway and Greenhithe foreshores, crossing of the Waitemata Harbour, and drilling activities under Te Wharau Creek as they are located within the CMA
- The Proposed Auckland Unitary Plan ("PAUP")

The following generally describes the activities that will occur within each district and summarises the relevant noise criteria from each district plan. The full criteria as set out in each district plan are contained in Appendix C.

3.2.1 Waitakere DP

Waitakere District sites

There are several significant Project sites in the Waitakere district where construction noise will occur and therefore require assessment.

- Hobsonville PS: The site is located at 2A Buckley Avenue. Residential receivers are located on adjacent areas of land as part of the Hobsonville Point development
- Rising main conduit crossing under the SH18. Construction pits would be excavated on
 either side of the motorway in the vicinity of the Hobsonville PS site. Sensitive receivers
 are located within the Hobsonville Point development and Summerset Village Monterey
 Park
- Causeway widening site: The site will be located 600 metres along the causeway from the western end on the eastbound side of SH18. Residential receivers are located some distance to the south within the Hobsonville Point development



Waitakere DP Noise Rules

With regard to construction noise, Rule 1.1 specifies that noise from construction, maintenance or demolition that occurs in a Human Environment shall comply with the limits contained in NZS 6803P: 1984².

The limits from NZS 6803P: 1984 are set out in Appendix C.

3.2.2 North Shore DP

North Shore District sites

There are various construction sites and activities in the North Shore district that have been identified as potentially resulting in noise impacts. The location and activity as well as sensitive receiver locations are identified below:

- Rahui Road work site: would be located on public land adjacent to the Tauhinu Sea
 Scouts clubroom with nearby residences on Rahui Road overlooking the site
- Open cut trenching works along Traffic Road (including paper road section), Rame Road, Greenhithe Road and through Wainoni Park. The works would occur within the road or on public land (the Park) however would pass by residential, educational, recreational sporting facilities and commercial properties
- The proposed Wainoni Park HDD site and North Shore Memorial Park ("**NSMP**") HDD site: these sites are located on public land. Residential receivers are located adjacent along with the New Zealand Riding for the Disabled Association
- Open cut trenching works through NSMP, and along Schnapper Rock Road, Newbury Place, and Witton Place. Residential receivers are located adjacent along with Schnapper Rock Crematorium
- Pipe bridge between Witton Place and Laurel Oak Drive and open cut trenching through to North Shore Golf Course ("NSGC"): Adjacent receivers are all residential
- Open cut trenching works would pass through NSGC, in Appleby Road and a small section of Albany Highway, before passing through Clear Reserve (public space), then through Rosedale business park via John Glenn Avenue, William Pickering Drive, Piermark Drive and Bush Road. Nearby sensitive receivers along the proposed route are residential, sports recreation, educational and commercial
- Rosedale Park HDD sites: these sites are located on commercial and public land.
 Receivers adjacent to the sites are commercial, sports recreation
- Open cut trenching works would comprise the remainder of pipeline works and would pass through Rosedale Park (public space) and into the Rosedale WWTP.

North Shore DP Noise Rules

Rule 10.5 (i) states:

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² New Zealand Standard NZS 6803P:1984 "The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work"



"Any construction, maintenance and demolition noise shall comply with the provisions of NZS 6803 P 1984 'The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work".

3.2.3 Auckland Regional Plan: Coastal

The Operative Auckland Regional Plan: Coastal ("ARP:C") would apply to trenching activities on the Causeway and Greenhithe foreshores, Waitemata Harbour Crossing, and HDD activities under Te Wharau Creek.

Rule 35.5.5 (b) specifies noise limits for construction activity of 15 days or more in duration. In summary the relevant limits are:

Monday to Friday 0630 – 2230 75 dB L_{A10} or 90 dB L_{Amax}

Saturday 0700 – 2300 80 dB L_{A10} or 90 dB L_{Amax}

Sunday 0900 – 1900 65dB L_{A10} or 85 dB L_{Amax}

At all other times (night-time) 55 dB L_{A10} or 75 dB L_{Amax}

The full text of rule 35.5.5 (b) is contained in Appendix C.

3.2.4 Proposed Auckland Unitary Plan

Part 3 Chapter H Rule 6.2.1.4.1 of the PAUP specifies the use of NZS 6803: 1999 (the "Construction Noise Standard") in assessing construction noise.

Part 3 Chapter I Rule 6.2.1.2 of the PAUP requires that underwater noise from construction and dredging must not exceed a noise level of 200 dB 1μ Pa when measured at 1 metre from the noise source.

3.3 Recommended Project Construction Noise Criteria

As can be seen from the summary of the construction noise criteria from the Waitakere and North Shore district plans, the use of NZS 6803P: 1984 is stipulated. This version of NZS 6803 is a 26-year old provisional Standard which was subsequently replaced in 1999 by the current version, NZS 6803: 1999.

In comparing the two versions of NZS 6803, there are no significant differences; compliance with the 1984 version of the Standard would typically mean that compliance with the 1999 Standard is achieved. The current version is the most up-to-date Standard, which integrates with the newest versions of associated Standards such as NZS 6801: 2008 and NZS 6802: 2008 , specifically including technical refinements such as the use of the ' $L_{Aeq(T)}$ ' parameter rather than ' L_{A10} '. The NZS 6803: 1999 Standard is widely acknowledged as being appropriate for construction noise management and is therefore recommended to be applied to this Project in place of the 1984 standard.

The duration of total Project works would be greater than 20 weeks and is therefore classified as 'long-term duration' according to the Construction Noise Standard³. The long-term noise criteria of the Construction Noise Standard, as set out in Appendix E, form the basis of the assessment of land-based construction activities in this report.

³ NZS 6803: 1999 Clause 7.2.1



In summary, land-based construction works should comply with 70 dB L_{Aeq} and 85 dB L_{Amax} during daytime hours.

This assessment adopts the ARP:C criteria for construction work in the CMA and the PAUP criterion for underwater construction noise.

Together, the recommended criteria are collectively referred to as the "**Project construction noise criteria**".

4.0 EXISTING AMBIENT NOISE ENVIRONMENT

Two noise surveys were carried out on 24 November 2014 and 4 March 2015, during which existing daytime ambient noise was measured, generally in accordance with the relevant standards, in the vicinity of construction sites and the nearest receiver locations. The measurement positions are marked MP1 – MP11 as indicated in Appendix D.

The weather at the time of the surveys was considered to be within the acceptable range for carrying out environmental noise surveys, as set out in NZS 6801:2008.

The predominant noise sources during the survey were noted and are detailed in the table in Appendix D, which also summarises the measurement results (ranging between 41-56 dB L_{Aeq} and 36-52 dB L_{A90}). The measured ambient noise levels are discussed further in the subsections of Section 5.4.

5.0 CONSTRUCTION NOISE ASSESSMENT

5.1 General Works Overview

General activities that would be common to most temporary construction sites include contractor's site establishment, removal of some scrub and trees, set up perimeter fencing, working areas, offices and storage containers. In addition, the connection to utilities, telecommunications, construction of hardstand areas and vehicle parking with compacted stone would occur.

The set up of HDD drill rig sites may involve some shallow trenching, anchor piling and excavation of the drill pit. Various other ancillary plant would also be set up, and may include a generator, hydraulic power pack, pumps, and drilling fluid recycling/mixing units. Truck deliveries and heavy crane lifts would be required during set up.

The construction sites would be utilised for periods of 2-6 months, except for Hobsonville PS, which is estimated to be 8-10 months.

General activities that would be common for open cut trenching would include saw cutting of the road surface at trench edges, insertion of trench shields or sheet piles and excavation of soil down to the required depth (this will vary along the route). Some spoil would be removed from site and some stockpiled next to the trench to be used for backfilling once the pipe is installed. The road surface would then be reinstated in the usual manner.

Trenching work is considered to be transitory in nature and would progress at a rate of approximately 20-30 metres per day.

Chamber construction would involve excavation of soil down to the required depth. Some spoil removal via truck would occur, however, some would be retained for backfilling. Either



precast concrete or cast in situ methods would be used for chamber construction, requiring the use of concrete trucks or heavy lift crane.

Construction traffic generation

In terms of construction traffic generation, pipe deliveries (open trenching works) would occur at a rate of no more than 2 per week for each operating section of excavation and be by semi-trailer. Excavation works would require approximately 12-18 truckloads of spoil removal per day.

Construction traffic associated with HDD operations is expected to generate about 20 movements per day (spoil removal and delivery of drilling mud). Additional movements would occur during the establishment/disestablishment of each drilling site.

With regard to sub-tidal trenching, there would be very little traffic generation once underway. For trenching in the inter-tidal zone, spoil removal would generate about 20 movements per day.

For micro-tunnelling activities beneath SH18, excavated material would be removed from the site and taken to cleanfill using semi-trailer trucks. In total, spoil removal and the delivery of plant, pipes and other materials will result in approximately 20 movements per day.

The careful management of heavy vehicle movements on site access roads will also be necessary. Trucks should not sit idling on the access roads adjacent to dwellings. All site roads should be kept in good condition and free from potholes and speed humps to prevent unnecessary noise from occuring. This would be specifically addressed in the Project CNVMP.

5.2 Construction Sequence and Methodology

The following summarises the key activities which would typically occur on the Project:

- Site establishment
- Excavation, tunnelling, drilling and trenching works and associated activities
- Materials lay down, pipe line laying and construction of minor above-ground structures
- Site demobilisation and reinstatement

A detailed construction program will be developed. It is anticipated that this would be prepared by the lead Contractor and incorporated into the Project CMP. As such, an outline construction methodology has been drafted and is included in Appendix F. This assessment uses the outline methodology to predict construction noise.

5.3 Construction Noise Prediction Methodology

Construction noise levels have been predicted for all significant activities anticipated to occur during the Project and have been predicted in general accordance with the algorithm detailed in ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613) as implemented in SoundPLAN® environmental sound modelling software.

The ISO 9613 standard considers a range of frequency dependent attenuation factors, including spherical divergence, atmospheric absorption, ground effect and acoustic



screening. It assumes meteorological conditions favourable to propagation from sources (downwind at wind speeds 1 -5 m/s in all directions), and as such, represents a slightly conservative approach.

The equipment sound power levels used in the modelling are given in Appendix G.

In accordance with the provisions of the Construction Noise Standard, construction noise has been predicted to and assessed at a distance of 1 metre from the façades most exposed to Project construction activities, and to 1.5 metres above the relevant floor level⁴.

Whilst the predictive model is based on the construction methodology outlined in this report, there is potential for the actual methodology used to differ in some aspects, such as type/size of equipment or construction technique e.g. different method of piling. Any deviation from the report methodology would be addressed in the CMP, specifically by the CNVMP to achieve the best practicable option for mitigation and reducing noise levels deemed reasonable by the Construction Noise Standard.

5.4 Assessment of Construction Noise Effects

An assessment of construction noise effects has been carried out for receivers close to Project works. The assessment considers the location of all significant noise generating equipment and activities associated with carrying out the required works. Only construction works close to receiver locations has been considered because this is where detrimental amenity effects would be experienced.

It should be noted that whilst the most affected receivers identified in this assessment are predicted to receive the highest construction noise levels, they would not necessarily be the only receivers that would receive noise from the Project. Receivers located further from noise sources and/or shielded by intervening structures would receive noise levels below the levels predicted for the most affected receivers, and in compliance with the Project construction noise criteria.

The following sub-sections detail the site and activity assessments carried out by MDA. Refer to Appendix F for further details in relation to key activities, typical equipment and estimated activity durations. Refer to Appendix H for a Table of Effects which details the worst affected dwellings, predicted activity noise levels without and with mitigation, and residual effects/compliance status. The intention of the table is to provide a tool with which to assess the effects of construction noise for relevant receivers, thereby enabling identification of affected parties to be consulted with.

5.4.1 Hobsonville Pump Station upgrade

Details of site and surrounding receivers

The pump station site including 2 Buckley Avenue and adjacent residential receivers are shown in Figure 1. The nearest dwelling facades are located approximately 45 metres to the south-west on Teal Way⁵. In time, it is envisaged that further dwellings would be constructed east of the drainage reserve (current address is 70 Buckley Avenue) and would be approximately 50 metres from the site at the closest point. More dwellings are located

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⁴ NZS 6803: 1999 Sections 5.2 and 6.2.1

⁵ Dwellings on Teal Way have now been constructed



approximately 85 metres eastward on Waiarohia Place. The land located immediately west of the proposed works is owned by Vector and will be used for non-residential purposes.

Construction is estimated to be of 12 months total duration and would occur during normal construction hours.



Figure 1: Hobsonville PS and nearest dwellings^{6 7}

⁶ Various figures in this report have been sourced from Auckland Council GIS Viewer under Creative Commons Public License

⁷ The vacant lots on Teal Way and Waiarohia Place shown in this image have since been developed into dwellings This document may not be reproduced in full or in part without the written consent of Marshall Day Acoustics Limited



The predominant noise source at this location is traffic on Buckley Avenue and SH18. Noise from the existing pump station is also audible, however, is considered secondary to traffic sources and is generally only audible during traffic lulls and at night-time. The ambient noise level near the nearest dwellings is 56 dB L_{Aeq} and 51 dB L_{A90} measured during the daytime.

Construction Noise Predictions

Construction noise levels have been predicted for the closest dwellings surrounding the construction site, with the range shown in the following table.

Table 1: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range		
	(70 dB L _{Aeq} Noise Limit)		
Teal Way dwellings	<30-64		
Waiarohia Place dwellings	<30-65		
70 Buckley Avenue new dwellings SE of site	<30-69		

The construction noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for the receivers assessed. Construction noise would be generally audible for dwellings surrounding the site, with site noise being more discernible to those dwellings with line-of-sight to Hobsonville PS. Some activities would be inaudible due to the masking effect of traffic noise on Buckley Avenue and SH18.

5.4.2 SH18 Crossing

Details of site and surrounding receivers

The SH18 Crossing site and adjacent residential receivers are shown in Figure 2. The site sits within the existing NZTA designation.

The nearest sensitive receivers on the southern side of SH18 are located on Teal Way (140 metres to southwest) and Waiarohia Place (110 metres to east) and on the northern side of SH18 are located at 30 Ockleston Landing (200 metres to northwest) and Summerset Village Monterey Park (110 metres to northeast).

Construction is estimated to be of 3-5 months total duration and is anticipated to occur during normal construction hours.



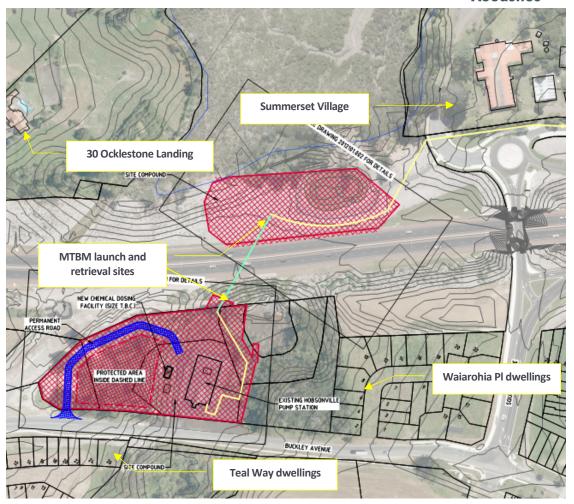


Figure 2: SH18 site and nearest dwellings

The site and adjacent receivers would have an ambient noise environment similar to that which exists at receivers adjacent to the Hobsonville PS site, given approximately equivalent setback distances from SH18.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings surrounding the construction site and are shown in the following table.



Table 2: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)		
30 Ockleston Landing	<30-52		
Waiarohia Place dwellings	40-58		
Buckley Avenue new dwellings SE of site	35-52		
Teal Way dwellings	33-51		
Summerset Village Monterey Park	33-57		

The construction noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 - 1800hrs) for the receivers assessed.

5.4.3 SH18 to Causeway Widening

Details of site and surrounding receivers

The pipeline path and adjacent residential receivers are shown on Figure 3. The works would occur within the existing motorway designation, albeit adjacent to residential site boundaries.

The nearest sensitive receivers to works are located to the north in Summerset Village Monterey Park. As at the date of this report, construction of a retirement village is underway, with the southern-most buildings associated with the development located approximately 10-30 metres from the works proposed.

Construction is estimated to be of 2-5 months total duration and is anticipated to occur during normal construction hours.



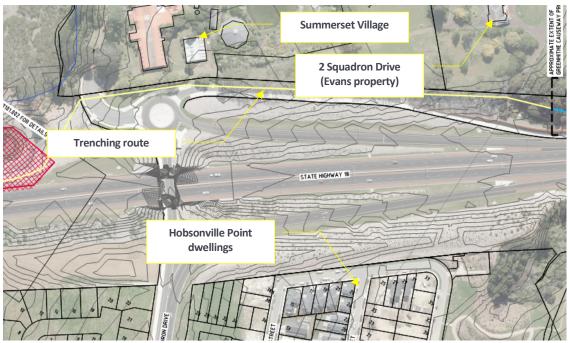


Figure 3: Pipeline route and nearest dwellings

The site and adjacent receivers (those closest to the motorway) would have an ambient noise environment similar to that which exists at receivers adjacent to the Hobsonville PS site, given approximately equivalent setback distances from SH18.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings to the construction site and are shown in the following table.

Table 3: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range		
	(70 dB L _{Aeq} Noise Limit)		
Summerset Village Monterey Park	60-86		
Hobsonville Point	40-58		
2 Squadron Drive (Evans property)	43-66		

The construction noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for receivers located in Hobsonville Point. Noise from trenching activities would be audible at some dwellings within the development with northwards facing aspects although the sound would have a different character to motorway noise. However, generally, the sound would be at a level considered to be non-intrusive.

Noise levels are predicted to comply with the construction noise criterion at 2 Squadron Drive. Construction works will be audible at the dwelling however noise levels are



considered to be acceptable given the proximity of SH18 and the short term nature of the works.

For Summerset Village receivers, site establishment activities such as the use of a concrete saw and jack hammer to break up the road surface are predicted to exceed the Project construction noise criterion by up to 16 decibels where they occur in close proximity to dwellings. As these activities would be short-term and transitory in nature, effects on nearby residents could be managed effectively through the CNVMP.

For receivers located adjacent to trenching works as it moves along the boundary of Summerset Village, noise levels from tracked crane movements, excavation and compaction are predicted to be at or exceed the Project construction noise criterion by 4-9 decibels where they occur within 15-20 metres. MDA understands that the rate of trenching is estimated to be in the order of 20-30 metres per day, as a result any one point of maximum noise exposure would be limited to less than a day, and any transitory effects could be managed through the CNVMP.

5.4.4 Harbour Crossing by Marine Trenching

Details of site and surrounding receivers

The proposed marine trenching envelope and surrounding receiving environment are shown in Figure 4 (striped area), with the remainder in the subtidal/transition zones of the Upper Waitemata Harbour. The point of greatest potential noise impact for residents would be in the intertidal zone of Greenhithe foreshore with the nearest receivers located 20-35 metres away.

MDA considers there to be low potential for residential noise impacts (including receivers on Herald Island and Hobsonville Point) from sub-tidal trenching works in the Upper Waitemata Harbour. Therefore, these locations have not been considered further. Inter-tidal trenching adjacent to the Greenhithe foreshore has been given further consideration below.

Marine trenching in the intertidal zone is estimated to be of 10-15 weeks duration out of a total of 3-5 months.



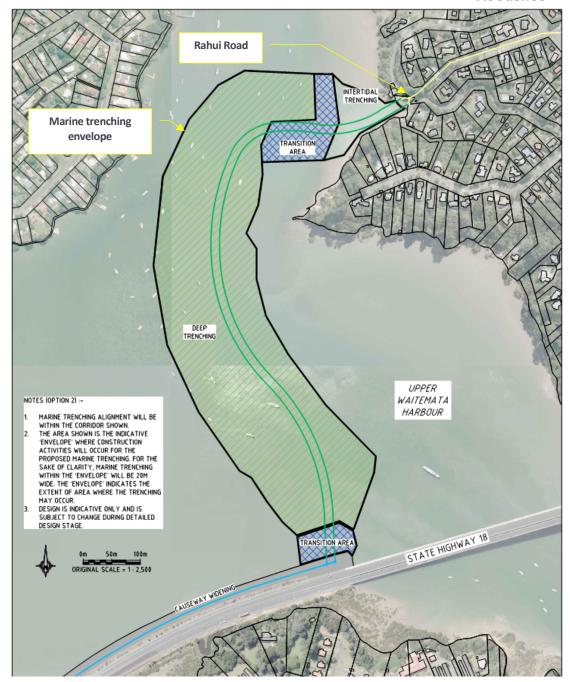


Figure 4: Marine trenching route and surrounding receiver environment

The ambient noise level near the nearest dwellings on Rahui Road Greenhithe is 46 dB L_{Aeq} and 38 dB L_{A90} measured during the daytime. The site and surrounding area do not receive significant traffic noise; with bird, insect and noise from the occasional passing boat characterising the ambient environment.



Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the Rahui Road construction site as well as the intertidal trenching zone on the Greenhithe foreshore and are shown in the following table.

Table 4: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)			
	Site Setup & Construction	Intertidal Trenching ⁸		
11 Rahui Road	48-50	58		
14A Rahui Road	47-49	57		
17 Rahui Road	53-56	66		
18 Rahui Road	48-50	57		
19 Rahui Road	54-57	70		
21 Rahui Road	49-51	61		
23 Rahui Road	46-48	58		

The noise levels for site setup and construction works given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for all of the nearest receivers assessed. Due to the low daytime background noise levels, noise from construction activities would be clearly audible, although would be variable in nature.

MDA notes that Rule 35.5.5 (b) of the ARP:C provides for a noise limit of 75 dB L_{A10} (refer to Section 3.2.3) between the hours of 0630-2230 Monday to Friday, and 80 dB L_{A10} Saturday between 0700-2300 hours for construction works carried out in coastal waters. MDA considers that there is potential for significant impacts where intertidal trenching is carried out early in the morning or late at night near the shoreline. As intertidal trenching may be somewhat dependent upon the prevailing tidal conditions, careful consideration would need to be given to when works would be carried out. Engagement with potentially affected receivers is recommended and the activity managed through the CNVMP.

It is recommended that all works in the CMA are carried out in as short a time as practicable so as to minimise the duration of effects.

⁸ Rule 35.5.5 (b) of the ARPC would apply to intertidal trenching works. Consequently, results in this column are presented as 'dB L_{A10} ' i.e. $L_{10} = L_{eq} + 2$ dB



Underwater Noise Compliance Assessment

Marine trenching⁹ in the Upper Waitemata Harbour can be undertaken in a number of ways. For the Project, the methods proposed include barge-mounted long-arm excavator, controlled flow excavation, and jetting sled excavation. This activity is estimated to last for a period of approximately 2 weeks.

These activities are assessed below and described further in Appendix I.

Long-arm Excavation

Underwater noise source levels for a range of anthropogenic activities are included in Appendix I 10 . The table shows that for dredging, underwater noise levels of between 168 – 186 dB re 1 μ Pa rms at 1m would be generated. As long-arm excavation does not involve the use of submerged noise sources 11 unlike other forms of dredging, noise generation would be at the lower end of the stated range and near 168 dB re 1 μ Pa rms at 1m.

Controlled Flow Excavation and Jetting Sled Excavation

Underwater noise source levels for these excavation types are not widely available. Source noise levels for high-pressure water jet lances have been measured at up to 171 dB re 1μ Pa rms at $1m^{12}$. MDA considers that controlled flow and jet sled excavation could generate noise levels similar to this, although would contain significanty greater low frequency content due to being of larger size. The level of underwater noise is therefore considered to be comparable to that generated by the tender boat.

Based on the above, the levels of underwater noise generated by the various proposed marine trenching methods are expected to comply with the PAUP criterion of 200 dB $1\mu Pa$ at 1m from the noise source.

The zone of influence on marine life would be small and would result in temporary behavioural response changes "the startle response" only when in close proximity to works and would not result in permanent physiological damage. The process of trenching is dynamic and would remain in one location for short periods of time only. As such, any underwater noise effects are considered to be slight.

5.4.5 Upper Waitemata Harbour Crossing by HDD: Causeway Widening Site

Details of site and surrounding receivers

The site and adjacent residential receivers are shown in Figure 5. The construction site would be set up on the section of widened Causeway established as part of the GBWD&C

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⁹ For the purpose of this assessment marine trenching is considered to be a form of dredging. However, the PAUP and the ARP:C defines dredging as excavation of material from the seabed and removal from the site that results in a change in seabed level. For the Project, seabed material will only be temporarily displaced a relatively small distance.

¹⁰ Refer www.ospar.org for information on the OSPAR commission

 $^{^{11}}$ With the exception of tug boat propeller noise which would be of similar noise level and character to a ferry (circa 160 to 180 dB re 1 micropascal)

¹² Molvaer Ol, Gjestland T (1981) *Hearing damage risk to divers operating noisy tools under water* Scandanavian Journal of Work, Environment and Health 7(4) 263-270



project. The nearest sensitive receivers are located approximately 150 metres to the south, within the Hobsonville Point development.

Construction is estimated to be of 4-6 months total duration and is anticipated to occur during normal construction hours.

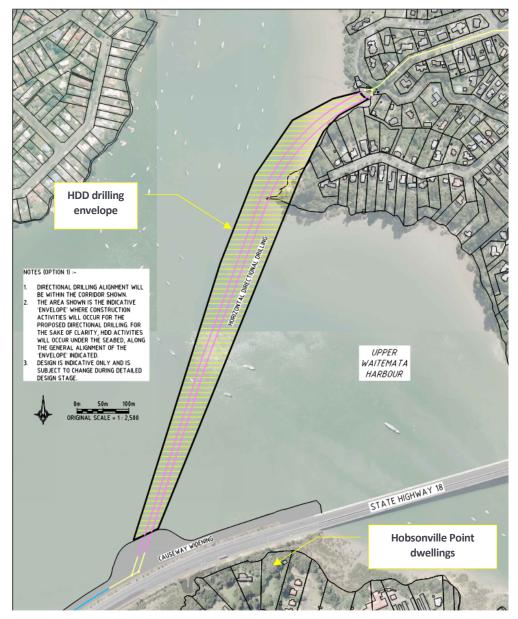


Figure 5: Causeway widening site location and adjacent receivers¹³

Existing Ambient Noise Environment

The site and adjacent receivers would have an ambient noise environment similar to that which exists at receivers adjacent to Hobsonville PS, given approximately equivalent setback distances from SH18.

¹³ Most of the Hobsonville Point dwellings shown in Figure 5 have been removed as part of the re-development. The aerial is useful in that it indicates the relative locations of new dwellings to works once redevelopment is completed.



Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table. It has been assumed that all plant such as the HDD drill rig, containerised generator, hydraulic power packs, pumps and recycling units, and tracked crane would be operating continuously and simultaneously. The predicted levels are therefore considered to be worst case.

Table 5: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)			
	Site Setup & Construction	Drilling		
Hobsonville Point	46-59	57		
2 Squadron Drive (Evans property)	32-46	43		

The noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for receivers located in Hobsonville Point without any specific mitigation measures required. Due to the location of the site being adjacent to SH18, construction noise would be generally masked by traffic noise, although would be audible at times at some receiver locations. Perceptibility would be dependent upon the time of day and corresponding volume of traffic on SH18.

As a second pipeline would be drilled adjacent to the first, the same HDD rig would be relocated approximately 10-20 metres east or west. Similar noise levels from drilling operations are anticipated to occur.

Once HDD drilling commences it must continue until the pipeline is complete. This will necessitate 24/7 drilling operations over an expected period of 1 week for each pipestring and another separate week for pipe pull-through. For night-time HDD operations, noise from unsilenced plant is cumulatively predicted to exceed the night-time noise criterion of 45 dB L_{Aeq} and would require mitigation. Mitigation measures could consist of using a super-silenced generator, enclosing the hydraulic power packs and mud pumps, and erecting a noise barrier between the site and nearest receivers. Even with the noise mitigation measures implemented, night-time noise levels are predicted to exceed the night-time noise criterion by 4 decibels.

In assessing the effects of noise from the Project, consideration is to be given to the existing ambient noise level in the immediate area and whether this affects the relevance of the applicable noise criteria. With regard to the night-time noise criterion, it is noted that the average night-time ambient noise level near the nearest receivers is 49 dB L_{Aeq} and 43 dB L_{A90}^{14} , with the principal noise source being vehicles on SH18. As the average ambient environment exceeds the noise criterion by 4 decibels, adoption of a "background plus"

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 $^{^{14}}$ Based on long-term noise logging carried out in the vicinity between 24 November and 3 December 2014



approach to setting a suitable criterion, in accordance with Clause 7.2.6 of the Construction Noise Standard, is warranted in this instance.

On this basis, MDA considers that a night-time noise criterion of 53 dB L_{Aeq}^{15} applied only to night-time drilling operations at the causeway widening site, would offer a suitable degree of residential amenity protection to Hobsonville Point residents, whilst still allowing crucial Project construction works to proceed without undue time constraints.

It is considered that night-time drilling noise levels of up to 53 dB L_{Aeq} are acceptable in this instance, where a high level of community engagement occurs. The activity would need to be managed through the CNVMP. The slight relaxation of the night-time noise criterion specific for this activity would enable the works to be completed in as short a time as possible, thereby minimising the duration of noise effects.

5.4.6 Upper Waitemata Harbour Crossing By HDD: Rahui Road site

Details of site and surrounding receivers

The Rahui Road construction site and adjacent residential receivers are shown in Figure 6. It is noted that some of the adjacent receivers are elevated above the site. The site would be used as an HDD site, initially, with the HDD rig relocated to the site from the causeway widening site in order to carry out the pipestring pull.

Limited day-to-day operations would occur at the site, except during pipestring pulls. Therefore, the total duration of site use would be appreciably less than for the causeway widening site.

Construction is estimated to be of 4-6¹⁶ months total duration and is anticipated to occur during normal construction hours except for drilling and pipestring pulls, which would occur continuously over two separate 1-week periods for each pipestring.

 $^{^{15}}$ Night-time criterion calculated based on background noise level + 10dB i.e. 43dB + 10dB = 53 dB L_{Aeq}

¹⁶ Operated concurrently with Causeway widening site



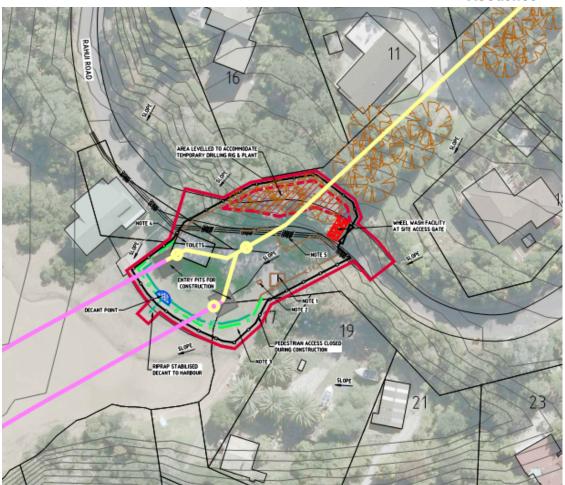


Figure 6: Rahui Road site location and adjacent receivers

The ambient noise level near the nearest dwellings is 46 dB L_{Aeq} and 38 dB L_{A90} measured during the daytime. The surrounding environment does not receive significant traffic noise; with bird, insect and noise from the occasional passing boat characterising the ambient environment.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table.

Table 6: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)			
	Site Setup & Construction	Pipestring Pull		
11 Rahui Road	48-50	63		
14A Rahui Road	47-49	58		
17 Rahui Road	53-56	64		



Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)			
	Site Setup & Construction	Pipestring Pull		
18 Rahui Road	48-50	63		
19 Rahui Road	54-57	65		
21 Rahui Road	49-51	61		
23 Rahui Road	46-48	59		

The construction noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for all of the nearest receivers assessed. Due to the low daytime background noise levels, noise from construction activities would be clearly audible, although would be variable in nature. MDA therefore considers that a high level of community engagement will be required, especially for activities such as the pipestring pull.

Where the HDD drill rig is operated during the night-time period, cumulative noise from unsilenced plant is predicted to exceed the night-time noise criterion of 45 dB L_{Aeq} by up to 20 decibels and would require mitigation and management measures. Mitigation measures could consist of using super-silenced generators, enclosing the hydraulic power packs and mud/slurry pumps. Noise barriers would not be effective in this instance due to receivers being elevated above the site.

Even with the noise mitigation measures implemented, night-time noise levels are predicted to exceed the noise criterion by 6-12 decibels and would result in moderate to significant effects. Noise effects from this activity would need to be managed through the CNVMP and would require a high level of community engagement. An example of a management measure would be to offer temporary relocation of affected parties during the period of pipe pulls. A noise contour prediction for night-time operation (with mitigation measures implemented) is included in Appendix H.

5.4.7 Rahui Road to Wainoni Park North

Details of site and surrounding receivers

The pipeline path and adjacent residential receivers is shown in Figure 7. All trenching would occur in the road or public space of Wainoni Park.

Trenching works would proceed along the route at an estimated rate of 20-30 metres per day for up to 7-15 months, and receivers located along this section of the pipeline route would be sequentially exposed to construction noise of a short-term nature. Residential receivers are located along Rahui and Traffic Roads, the unformed section between these roads, and Greenhithe Roads. There are also some commercial premises and Greenhithe Primary School located along Greenhithe Road.

Once works reach Wainoni Park South, the pipeline follows Greenhithe Road eastwards until around 77 Greenhithe Road, where it turns northwards and enters Wainoni Park. The trenching works would pass approximately 10-20 metres from residential properties located along the Park's eastern boundary (Te Wharau Drive).



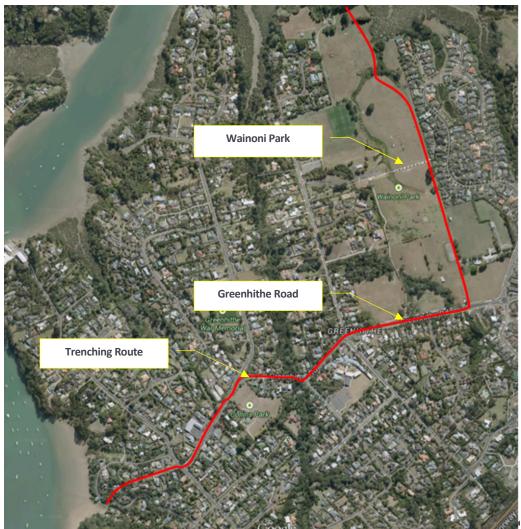


Figure 7: Trenching route along road designation and through Wainoni Park

MDA considers that the ambient noise environment along the route along Greenhithe Road is generally controlled by traffic noise. Ambient noise levels of 53 dB L_{Aeq} and 47 dB L_{A90} were measured adjacent to receiver locations along Greenhithe Road, including Greenhithe Primary School.

Construction Noise Predictions

Construction noise levels have been generally predicted for a range of receiver distances that would be encountered along this section of pipeline route, and are shown in the following table. It should be noted that the predicted levels do not take into account screening effect from buildings or other structures, therefore only apply to receivers that have line-of-sight to construction works. Where receivers along the route are located at similar distances, they would generally receive noise levels and effects which are similar. Receivers that do not have line-of-sight would receive noise levels significantly below those predicted in the table and generally compliant with the Project construction noise criterion.



Table 7: Predicted noise levels during normal construction hours

Activity	Plant	Plant	Noise Level (70dB L _{Aeq} noise limit)				
		L_{WA}	10m	20m	30m	40m	50m
Site Prep	Diamond Road Saw	112	84	78	75	72	70
	Compressor	106	78	72	69	66	64
	Jack Hammer	116	88	82	79	76	74
Trenching	Excavator	103	75	69	66	63	61
	Dewatering pumps	96	68	62	59	56	54
	Compactor	106	78	72	69	66	64
	Trucks	91	63	57	54	51	49
PE pipe string	Excavator	103	75	69	66	63	61
	Generator	103	75	69	66	63	61
	Tractor	91	63	57	54	51	49
Air valve construction	Excavator	103	-	69	66	63	61
	Hiab truck	91	-	57	54	51	49
	Mobile crane	99	-	65	62	59	57
	Concrete trucks and pumping	107	-	73	70	67	65
Scour valve	Excavator	103	-	-	66	63	61
construction	Dewatering pumps	96	-	-	59	56	54
	Compactor	106	-	-	69	66	64
Road surface	Excavator	103	75	69	66	63	61
reinstatement	Tipper truck	106	78	72	69	66	64
	Asphalt truck	108	80	74	71	68	66
	Vibrating roller	106	78	72	69	66	64
	Plate compactor	106	78	72	69	66	64



As can be seen from the noise levels in Table 7, trenching activities such as road surface cutting and breakup with jackhammer that occur 10-20 metres from dwelling façades are predicted to exceed the Project construction noise criterion. Trenching activities that occur close to the boundary with Te Wharau Drive properties may also exceed the limit. However, this would be dependent upon a number of factors, including proximity of dwellings to boundary and the height and condition of property fences.

It should be noted that the cutting and breakup of the road surface would be short-term duration works (only a few hours in any one location), with the majority of noise generating works consisting of excavation and removal of spoil, which have correspondingly lower noise levels.

This type of work is considered typical construction work and is carried out almost on a daily basis within the Auckland area and has been successfully mitigated and managed in many other construction projects.

An example of a practicable noise mitigation measure (a mobile noise screen) is shown in Appendix J, as recommended by the Construction Noise Standard¹⁷.

5.4.8 Te Wharau Creek Crossing: Wainoni Park HDD Site

Details of site and surrounding receivers

The construction site and adjacent residential receivers are shown in Figure 8. The site would be located toward the north-eastern end of Wainoni Park, close to Te Wharau Creek. The nearest receivers are located 180 metres to the southwest on Birchwood Grove and 220 metres to the southeast on Monkton Close.

Construction is estimated to be of 4-6¹⁸ months total duration with the majority of work anticipated to occur during normal construction hours. However, it should be noted that critical drilling activities will operate 24 hours per day for up to 4 weeks in total.

¹⁸ Operated concurrently with NSMP HDD Site

¹⁷ Appendix B NZS 6803: 1999



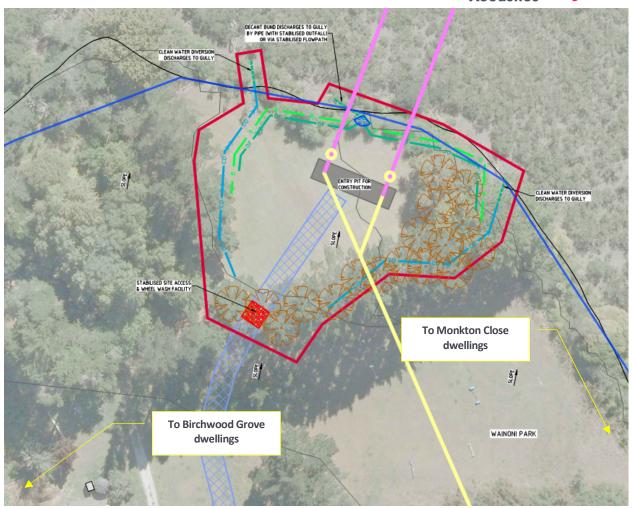


Figure 8: Site location and adjacent receivers

The ambient noise level near the nearest dwellings located on Monkton Close and Birchwood Grove is 47 dB L_{Aeq} and 40 dB L_{A90} measured during the daytime. The site and surrounding area do not receive significant traffic noise; with bird and insect noise characterising the ambient environment.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table. It has been assumed that all plant such as the HDD drill rig, generator, hydraulic power packs, pumps and recycling units, and tracked crane would be operating continuously and simultaneously. The predicted levels are therefore considered to be worst case.



Table 8: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)			
	Site Setup & Construction	Drilling		
Birchwood Grove dwellings	39-56	52		
Monkton Close dwellings	38-54	50		

The noise levels given in the table above are predicted to readily comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for all receivers assessed without any specific mitigation measures required.

As a second pipeline would be drilled adjacent to the first, the same HDD rig would be relocated approximately 10-20 metres east or west. Similar noise levels from drilling operations are anticipated to occur.

Where the HDD drill rig is operated during the night-time period, noise from unsilenced plant is cumulatively predicted to exceed the night-time noise criterion of 45 dB L_{Aeq} by 5-7 decibels and would require mitigation as discussed previously (refer Section 5.4.6).

With the noise mitigation measures implemented, night-time noise levels are predicted to comply with the night-time noise criterion. The activity would need to be managed through the CNVMP and engagement with the community prior to night-time works is recommended.

5.4.9 Te Wharau Creek Crossing: Memorial Park HDD Site

Details of site and surrounding receivers

The site and adjacent residential receivers are shown in Figure 9. The construction site would be located towards the south-western corner of NSMP. The nearest receivers are located approximately 100 metres to the southeast of the site on Kerema Way.

The site would receive the HDD drive from the Wainoni Park HDD site and would be used for pipe pull-through operations. Construction activities at the site are estimated to be of 4-6 months total duration and are anticipated to occur during normal construction hours. The exception is for drilling activities, which will operate 24 hours per day for up to 4 weeks in total.



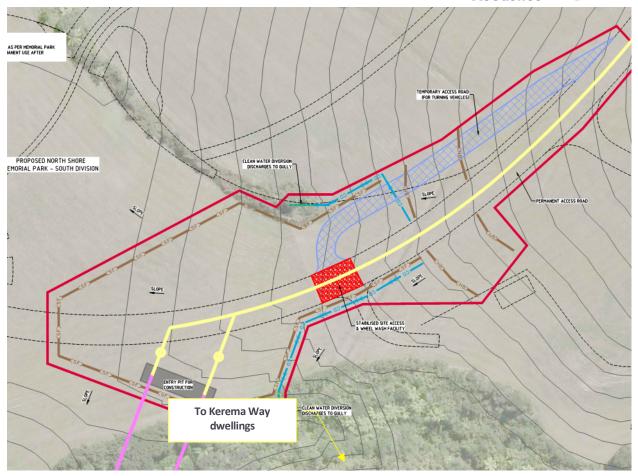


Figure 9: Site location and adjacent receivers

The ambient noise level near the nearest dwellings is 48 dB L_{Aeq} and 39 dB L_{A90} measured during the daytime. The site and surrounding area do not receive significant traffic noise; with bird, insect and residential construction noise characterising the ambient environment during the measurement period.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table.

Table 9: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)	
	Site Setup & Construction	Pipestring Pull
Kerema Way dwellings	44-52	48-57

The noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for receivers located on Kerema Way without any specific mitigation measures required.



As a second pipeline would be drilled adjacent to the first, the same HDD rig would be relocated approximately 15 metres away. Similar noise levels from the second pipestring pull are anticipated to occur.

Where the HDD rig is operated during the night-time period, noise from unsilenced plant is cumulatively predicted to exceed the night-time noise criterion of 45 dB L_{Aeq} by 3-12 decibels and would require mitigation as discussed previously.

With the noise mitigation measures implemented, night-time noise levels are predicted to comply with the night-time noise criterion or exceed by no more than 2 decibels. As the pipestring pull would be a short-term duration event it is considered that the effects could be managed through the CNVMP and would require community engagement.

5.4.10 NSMP to Witton Place

Details of site and surrounding receivers

The path of the open cut trenching and adjacent residential receivers are shown in Figure 10. Trenching would pass through NSMP before interacting with dwellings located on Schnapper Rock Road, Newbury Place, Aberley Road, and Witton Place. The trenching would pass in close proximity to 30, 32 and 34 Newbury Place and 222 and 224 Schnapper Rock Road.

Construction is estimated to be of 8 weeks total duration and would occur during normal construction hours.





Figure 10: Trenching route through NSMP and adjacent residential

Existing Ambient Noise Environment

The ambient noise level near the nearest dwellings is 41 dB L_{Aeq} and 36 dB L_{A90} measured during the daytime. The site and surrounding area do not receive significant traffic noise; with bird, insect and general residential activity characterising the ambient environment.

Construction Noise Predictions

Construction noise levels have been generally predicted for a range of receiver distances that would be encountered along the trenching route, and are shown in the following table. It should be noted that the predicted levels do not take into account screening effect from buildings or other structures, therefore only apply to receivers which have line-of-sight to construction works. Receivers that do not have line-of-sight would receive noise levels significantly below those predicted in the table and generally compliant with the Project construction noise criterion.



Table 10: Predicted noise levels during normal construction hours

Activity	Plant	Plant	Noise	Level (70dB	L _{Aeq} noise I	imit)
		L_WA	5m	10m	15m	20m
Site Prep	Diamond Road Saw	112	90	84	80	78
	Compressor	106	84	78	74	72
	Jack Hammer	116	94	88	84	82
Trenching	Excavator	103	81	75	71	69
	Dewatering pumps	96	74	68	64	62
	Compactor	106	84	78	74	72
	Trucks	91	69	63	59	57
PE pipe string	Excavator	103	81	75	71	69
	Generator	103	81	75	71	69
	Tractor	91	69	63	59	57
Air valve construction	Excavator	103	-	75	71	69
	Hiab truck	91	-	63	59	57
	Mobile crane	99	-	71	67	65
	Concrete trucks and pumping	107	-	79	75	73
Scour valve	Excavator	103	-	75	71	69
construction	Dewatering pumps	96	-	68	64	62
	Compactor	106	-	78	74	72
Road surface	Excavator	103	81	75	71	69
reinstatement	Tipper truck	106	84	78	74	72
	Asphalt truck	108	86	80	76	74
	Vibrating roller	106	84	78	74	72
	Plate compactor	106	84	78	74	72



As can be seen from the noise levels in Table 10, some trenching activities that occur 5-20 metres from dwelling façades are predicted to exceed the Project construction noise criterion.

As discussed in Section 5.4.7, trenching work in roads is considered typical construction work and is carried out almost on a daily basis within the Auckland area and has been successfully mitigated and managed in many other construction projects.

Management mitigation measures will be required where works pass close to some dwellings. It is recommended that noisy activities should be scheduled for weekdays only, where practicable, where they occur between Schnapper Rock Road and Newbury Place.

With regard to the sensitivity of NSMP, it is recommended that early and ongoing engagement with this stakeholder occurs to ensure that noise and general disruption is minimised as far as practicable. Night-time works may be a suitable management strategy for minimising (avoiding) effects on funeral parties and mourners. However, this would require consultation with the stakeholder.

Noise from trenching activities would be audible at other dwellings located further from works and/or screened by intervening houses. However, noise levels would be compliant with the Project construction noise criterion. Refer to Appendix H for a list of specific receivers that would be affected by the works.

5.4.11 Witton Place Pipe Bridge and Open Cut Trenching to NSGC

Details of site and surrounding receivers

The location of the proposed pipe bridge and adjacent residential receivers is shown in Figure 11. The pipe bridge would be constructed within 84 Laurel Oak Drive. The nearest receivers are located on Witton Place and Laurel Oak Drive, approximately 15 metres from site works (truck deliveries would pass within 10 metres of 9 and 17 Witton Place). At the northern end of the pipe bridge, open cut trenching would then proceed to the southern boundary of North Shore Golf Club.

Construction is estimated to be up to 5 months total duration and would occur during normal construction hours only.



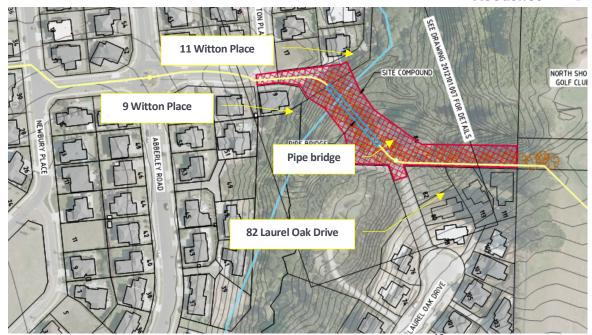


Figure 11: Location of proposed pipe bridge and adjacent dwellings 19

Existing Ambient Noise Environment

The ambient noise level near the nearest dwellings would be similar to those measured for Witton Place, i.e. 41 dB L_{Aeq} and 36 dB L_{A90} measured during the daytime. The site and surrounding area does not receive significant traffic noise; with bird, insect and general residential activity characterising the ambient environment.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table. Predictions have been made to the second floor of dwellings.

 $^{^{\}rm 19}$ The Laurel Oak Drive residences have been constructed since this photo was taken



Table 11: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)
9 Witton Place	58-73
11 Witton Place	60-77
17 Witton Place	57-75
76, 78 and 80 Laurel Oak Drive	49-69
82 Laurel Oak Drive	59-76
111 and 113 Laurel Oak Drive	59-66

The noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 - 1800hrs) for the majority of receivers. Minor exceedances of 3 decibels are predicted for 9 Witton Place during deliveries of equipment via truck.

Noise levels for 11 and 17 Witton Place and 82 Laurel Oak Drive are predicted to exceed the Project construction noise criterion by between 5-7 decibels. Activities which are predicted to exceed at the closest point to dwellings include 100 tonne mobile crane movements (which would be sporadic), bored piling using excavator mounted auger, delivery and pumping of concrete. The mitigation of these noise sources is considered to be problematic in this instance due to site topography and the fact that the dwellings are of two-storey construction. However, noise barriers located at the boundary of these receivers may be effective in reducing noise for ground floor receivers, particularly for 9, 11 and 17 Witton Place.

MDA recommends the use of the CNVMP to manage the effects from the activities predicted to exceed the Project construction noise criterion. The most effective management tool in this instance would entail communicating with affected dwellings and scheduling noisy activities to occur when occupants are not at home, e.g. at work. It is recommended that Saturday works in close proximity to dwellings should not occur.

5.4.12 NSGC to Albany Highway

Details of site and surrounding receivers

The pipeline route and adjacent residential receivers are shown in Figure 12. All trenching would occur within Open Space land or in the road. The nearest sensitive receivers to trenching works would be located on St Andrews Way²⁰ (approximately 15 metres distance); Appleby Road (approximately 10-40 metres distance, including Albany Junior High School); and dwellings on Albany Highway (approximately 15-30 metres distance). Scour and air valves would also be constructed in golf course grounds.

Construction is estimated to be of 3-5 months total duration and would occur during normal construction hours, albeit outside school term for works adjacent to Albany Junior High School.

²⁰ Dwellings on St Andrews Way are expected to be complete and occupied at works stage





Figure 12: Open cut trenching route and adjacent receivers

Existing Ambient Noise Environment

The ambient noise level near the nearest receivers is 54 dB L_{Aeq} and 52 dB L_{A90} but would be dependent upon proximity to Albany Highway. Traffic noise would be the controlling source of sound for receivers close to Albany Highway.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest receivers to trenching works and are shown in the following table. Other receivers located further from works and/or screened by intervening structures would receive significantly lower noise levels.

Table 12: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range		
	(70 dB L _{Aeq} Noise Limit)		
St Andrews Way dwellings (West facing)	66-89		
Albany Junior High School	57-80		
10, 12 and 18 Appleby Road	64-87		
ABC Childcare	58-81		
311C, 315A, 315B, 321 and 321A Albany Highway	64-87		
52 English Oak Drive	54-63		

Noise associated with the construction of minor above-ground structures is predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) work at the closest receiver (52 English Oak Drive).



Site establishment activities such as the use of a concrete saw and jack hammer to break up the road surface are predicted to exceed the Project construction noise criterion by up to 19 decibels where they occur 15 metres from dwellings, although these activities would be of short-term duration. The majority of noise generating works would consist of excavation, removal of spoil and the pipe laying which have predicted noise levels near 70-75 dB L_{Aeq} when in close proximity (worst-case location) to receivers.

As discussed in Section 5.4.7, trenching work in roads is considered typical construction work and is carried out almost on a daily basis within the Auckland area and has been successfully mitigated and managed in many other construction projects.

Potential noise effects from saw cutting the road surface and jack hammering could be avoided for sensitive receivers including ABC Daycare and Albany Junior High School by scheduling these activities to occur outside of school hours where it is practicable to do so and would be managed through the CNVMP. A similar methodology could be adopted for receivers on St. Andrews Way.

5.4.13 Rosedale Business Park to Bush Road

Details of site and surrounding receivers

The pipeline path and adjacent receivers are shown in Figure 13. All trenching works would occur on property with Business zoning or in the road.

Trenching works would proceed along the route at an estimated rate of 20-30 metres per day for up to 4-10 months. Receivers located along this section of the pipeline would be sequentially exposed to construction noise of a short-term nature.



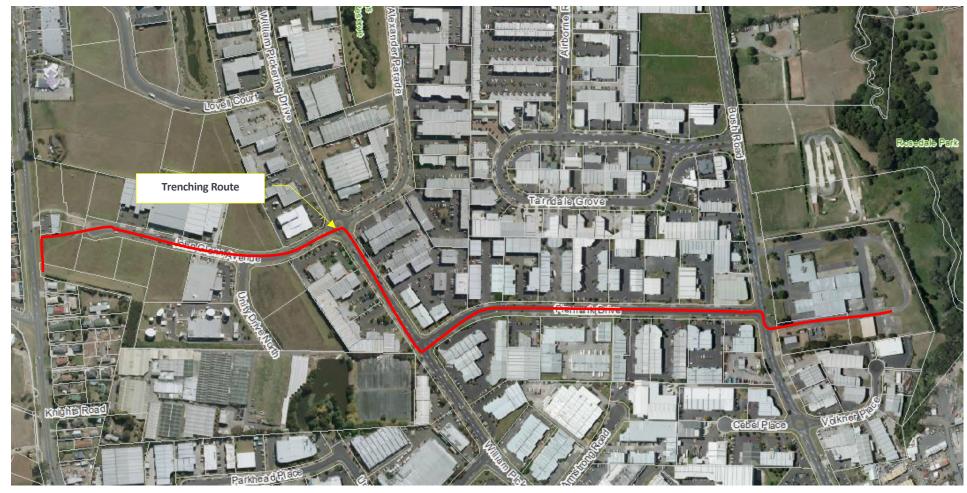


Figure 13: Open cut trenching route and adjacent receivers

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Existing Ambient Noise Environment

The ambient noise level near Unity Drive North is 48 dB L_{Aeq} and 44 dB L_{A90} measured during the daytime. Noise levels of 52 dB L_{Aeq} and 49 dB L_{A90} have been measured along Piermark Drive, with the controlling noise source considered to be traffic.

Construction Noise Predictions

Construction noise levels have been generally predicted for a range of receiver distances that would be encountered along the pipeline route, and are shown in the following table. It should be noted that the predicted levels would apply to all commercial premises along the route that are located approximately 15-25 metres from works. Where receivers along the route are located at similar distances, they would generally receive noise levels and effects which are similar. Receivers that do not have line-of-sight would receive noise levels significantly below those predicted in the table and would be readily compliant with the Project construction noise criterion.

Table 13: Predicted noise levels during normal construction hours

Activity	Plant	Plant	Noise Le	Noise Level (70dB L _{Aeq} noise limit)			
		L_WA	15m	20m	25m		
Site Prep	Diamond Road Saw	112	80	78	76		
	Compressor	106	74	72	70		
	Jack Hammer	116	84	82	80		
	Excavator	103	71	69	67		
	Chainsaw	102	70	68	66		
	Tipper trucks	106	74	72	70		
	Compactor	106	74	72	70		
Trenching	Excavator	103	71	69	67		
	Dewatering pumps	96	64	62	60		
	Compactor	106	74	72	67		
	Trucks	91	59	57	55		
PE pipe string	Excavator	103	71	69	67		
	Generator	103	71	69	67		
	Tractor	91	59	57	55		
Air valve	Excavator	103	71	69	67		
construction	Hiab truck	91	59	57	55		
	Mobile crane	99	67	65	63		
	Concrete trucks and pumping	107	75	73	71		
Scour valve	Excavator	103	71	69	67		
construction	Hiab truck	91	59	57	55		
	Mobile crane	99	67	65	61		
	Concrete trucks and pumping	107	75	73	71		
Road surface	Excavator	103	71	69	67		



Activity	Plant	Plant	Noise Level (70dB L _{Aeq} noise limit)		
		L_WA	15m	20m	25m
reinstatement	Tipper truck	106	74	72	70
	Asphalt truck	108	76	74	72
	Vibrating roller	106	74	72	70
	Plate compactor	106	74	72	70

As can be seen from the noise levels in Table 13, activities such as saw cutting and breakup of the road surface that occur 15-20 metres from commercial receiver façades are predicted to significantly exceed the daytime limit of the Project construction noise criterion.

With the exception of the cutting/breakup of road surface by saw and jack hammer, MDA considers that where works take place between 20-25 metres from a commercial receiver, construction noise effects are considered to be reasonable, where prior notice is given.

It is noted that the Construction Noise Standard allows a 5 decibel relaxation in the noise limit between 1800 and 0730 hours (noise limit is 75 dB L_{Aeq}) for commercial receivers. It is understood that trenching works through the business park may occur during the night-time so as to mitigate traffic congestion on Piermark Drive and William Pickering Drive. Night-time works would also practicably mitigate construction noise effects as most if not all nearby businesses would be closed.

5.4.14 Bush Road HDD Site

Details of site and surrounding receivers

The site and adjacent commercial receivers are shown in Figure 14. The construction site would be located at the back of the Kea Caravans site, located at 169 Bush Road. A swimming school (Hilton Brown Swim School) is located 45 metres southwards.

Construction is estimated to be up to 4²¹ months total duration with the majority of work anticipated to occur during normal construction hours. However, it should be noted that critical drilling activities will operate 24 hours per day for up to 4 weeks in total.

²¹ Operated concurrently with Rosedale Park HDD site





Figure 14: Site location and adjacent receivers

Existing Ambient Noise Environment

The ambient noise level near the nearest commercial is 52 dB L_{Aeq} and 49 dB L_{A90} measured during the daytime. The site and surrounding area receive significant traffic and other industrial noise.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest dwellings adjacent to the construction site and are shown in the following table. It has been assumed that all plant such as the HDD drill rig, generator, hydraulic power packs, pumps and recycling units, and tracked crane would be operating continuously and simultaneously, which would generally not be the case. The predicted levels are therefore considered to be worst case.

Table 14: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range (70 dB L _{Aeq} Noise Limit)				
	Site Setup & Construction	Drilling			
Kea Caravans	39-64	65			
Hilton Brown Swimming School	46-68	70			



The noise levels given in the table above are predicted to readily comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) for all receivers assessed without any specific mitigation measures required.

The predicted levels also comply with the night-time noise limit of 75 dB L_{Aeq} for commercial receivers, where drilling and pipe string pulls occur in this period.

5.4.15 Rosedale Park HDD Site

Details of site and surrounding receivers

The site and surrounding area are shown in Figure 15. The construction site would be located toward the southern end of Rosedale Park, on the eastern side of Alexandra Stream, approximately 225 metres from Paul Matthews Road. The nearest receivers would be located at the Rosedale Park (club house and sports fields approximately 60-200 metres away); and business zoned properties on Paul Matthews Road (130-250 metres away). Hilton Brown Swim School is located approximately 225 metres to the northwest.

The site would receive the HDD drive from the Bush Road HDD site and would be used for pipe pull-through operations. Construction activities at the site are estimated to be up to 4^{22} months total duration and are anticipated to occur during normal construction hours with the exception of drilling activities, which will operate 24 hours per day for up to 4 weeks in total.



Figure 15: Site location and adjacent receivers

²² Operated concurrently with Rosedale Park HDD launch site



Existing Ambient Noise Environment

The ambient noise level near the nearest commercial receivers is 52 dB L_{Aeq} and 49 dB L_{A90} measured during the daytime. The site and surrounding area receive significant traffic and other light-industrial noise.

Construction Noise Predictions

Construction noise levels have been generally predicted for the closest receivers and are shown in the following table.

Table 15: Predicted noise levels during normal construction hours

Receiver Location	Predicted Noise Level Range	e (70 dB L _{Aeq} Noise Limit)
	Site Setup & Construction	HDD pull-through
Hilton Brown Swim School	37-45	54
41, 45, 49 and 53 Paul Matthews Road (Commercial)	32-41	50
8 Paul Matthews Road (Commercial)	42-51	61
Rosedale Park		
- At Clubhouse	34-43	55
- Player on adj. sports field	48-55	67

The noise levels given in the table above are predicted to comply with the Project construction noise criterion for Monday to Saturday daytime (0730 – 1800hrs) work for all receivers assessed without any specific mitigation measures required.

The predicted levels also comply with the night-time noise limit of 75 dB L_{Aeq} for commercial receivers, where drilling and pipe string pulls occur in this period.

5.4.16 Rosedale Park to Rosedale WWTP

Open cut trenching works would travel through Rosedale Park with no sensitive receivers located nearby. Park patrons 50 metres or more from works would experience noise levels in the range 50-65 dB L_{Aeq} at most, and would generally be similar to the ambient environment in the area, interspersed with periods of more noticeable noise. The predicted noise levels comply with the Project construction noise criterion.

5.5 Mitigation and Management of Construction Noise

Potential management and mitigation measures are discussed below.

5.5.1 Communication and Consultation

The most important tool for managing construction noise is consultation and communication. For this Project, the recommended daytime criterion is predicted to



generally be achieved at dwellings which are located 20 metres or more distance from general trenching works. For short-term activities such as saw cutting and asphalt breakup this distance increases, although, is dependent upon intervening screening.

Any residents affected by noise levels higher than the recommended Project noise criteria would need to be consulted with in relation to the proposed works, including timing. Communication should occur with the stakeholders prior to works being carried out, by means of letter drop or face-to-face contact.

5.5.2 Timing of activities

It is noted that general construction hours span two time periods in the Project construction noise criterion, namely 0630-0730 hrs and 0730-1800 hrs. Of these periods, the 0630-0730 hours period, often termed the 'morning shoulder', has a significantly lower noise limit than the daytime period. Therefore, a potential risk exists for construction activities to exceed the morning shoulder criterion by a significant margin, unless early morning site activities are appropriately managed. Two examples would be where trucks with engines running queue up outside the site gates prior to site opening, and also crane lift of heavy items delivered by truck during this period.

The management of these issues could take the form of preventing trucks from queuing/idling outside the construction site gates, prohibiting the use of tonal reverse beepers and scheduling heavy deliveries to occur after 0730 hrs.

5.5.3 Noise Barriers

In general, placing solid barriers, such as sheets of plywood, between dwellings and the construction activities can reduce noise levels by up to 10 decibels. However, the second floor of a two-storey dwelling would not be protected due to its elevated nature. This would also be the case for dwellings naturally elevated above construction sites.

5.5.4 Avoidance of Unnecessary Noise

At many construction sites it can be observed that some construction practices unnecessarily increase noise levels. Those include the sounding of horns when a truck is fully laden, the air break release of trucks and the utilisation of audible, often tonal, reversing alarms.

Those issues can be avoided or noise levels reduced by means of changed construction site management; fitting of mufflers to trucks; maintenance of equipment to a high level and the replacement of audible reversing alarms with visual or lower noise broadband audible reversing alarms. It is considered that where these measures are implemented they would form a part of best practice management and mitigation of construction noise.

Other unnecessary noise may include shouting, loose tail gates and noise from radios played loudly. All of these can be avoided with good site management and are generally addressed I any management plan.



5.5.5 Construction Noise and Vibration Management Plan

It is common practice for infrastructure projects of significant size to have a CNVMP as part of the CMP which contains information on site management, mitigation, communication, complaints procedures and similar issues.

The contents of a CNVMP are set out in NZS6803:1999 Section 8 and Annex E. These requirements are summarised in Appendix K of this report.

The CNVMP will contain, but not be limited to:

- A summary of the project noise criteria
- A summary of construction noise assessments/predictions
- General construction practices, management and mitigation
- Noise management and mitigation measures specific to activities and/or receiving environments
- Monitoring and reporting requirements
- Procedures for handling complaints
- Procedures for review of the CNVMP throughout the project

A CNVMP will be implemented on site for each specific area of work and some specific activities where exceedance of the relevant criteria is likely, and will be kept up to date regarding actual timing/equipment use and methodologies, should these change throughout the construction process.

6.0 CONCLUSIONS

An assessment of noise effects for the proposed Northern Interceptor Phase 1 project has been carried out. Construction noise is considered the principle source of noise and therefore potential noise effects.

The construction noise criteria from the relevant district plans within which the Project would operate have been reviewed and it is concluded that New Zealand Standard NZS 6803: 1999 "Acoustics – Construction Noise" is the most appropriate standard for the assessment and management of day-to-day construction noise effects. Where the noise criteria of this standard are predicted to be exceeded, noise management and mitigation measures will be required.

This assessment adopts the ARP:C criteria for construction work in the CMA and the PAUP criterion for underwater construction noise.

Noise from the proposed construction activities described in Appendix F has been considered and noise levels have been predicted at dwellings adjacent to the works, as well as at nominal setback distances that will be encountered across the Project. Several construction activities have been identified as being likely to generate noise levels in excess of the daytime noise criterion of 70 dB L_{Aeq} . Construction activities occurring at night, including HDD drilling and PE pipe string pulls are predicted to generate noise levels in



excess of the night-time noise criterion of 45 dB L_{Aeq} and would require noise mitigation, management via the CNMVP and a high level of community engagement.

This assessment contains detailed summary tables of the activities likely to exceed the Project construction noise criteria and at which locations.

For the activities identified as potentially exceeding the Project construction noise criteria, active noise mitigation and/or management measures are recommended to be undertaken to avoid, remedy or mitigate adverse effects as far as practicable. The specifics of the required measures would be detailed in the Project CNVMP, which would be formulated and submitted to Council for approval prior to construction commencement.

It is considered that the best practicable option (for noise) for this Project is to ensure that construction noise effects are managed with the aim of meeting the Project construction noise criteria set out in Section 3.3 and Appendix E of this report and any exceedances are addressed through noise management and mitigation.



APPENDIX A GLOSSARY OF TERMINOLOGY

dB Decibel. The unit of sound level.

Expressed as a logarithmic ratio of sound pressure P relative to a

reference pressure of Pr=20 μ Pa i.e. dB = 20 x log(P/Pr)

dBA The unit of sound level, which has its frequency characteristics

modified by a filter (A-weighted) to approximate the frequency

bias of the human ear.

L_{Aeq (t)} The equivalent continuous (time-averaged) A-weighted sound

level. This is commonly referred to as the average noise level.

The suffix "t" represents the period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.

L_{A10 (t)} The A-weighted noise level equalled or exceeded for 10% of the

measurement period. This is commonly referred to as the average

maximum noise level.

L_{A90 (t)} The A-weighted noise level equalled or exceeded for 90% of the

measurement period. This is commonly referred to as the

background noise level.

L_{Amax} The A-weighted maximum noise level. The highest noise level that

occurs during the measurement period.

SWL or L_w Sound Power Level

A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total

sound power radiated by a sound source.

Noise A sound that is unwanted by, or distracting to, the receiver.

Ambient The ambient noise level is the noise level measured in the absence

of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to

the addition of a new noise source.

NZS 6803P:1984 New Zealand Standard NZS 6803P:1984 "The Measurement and

Assessment of Noise from Construction, Maintenance and

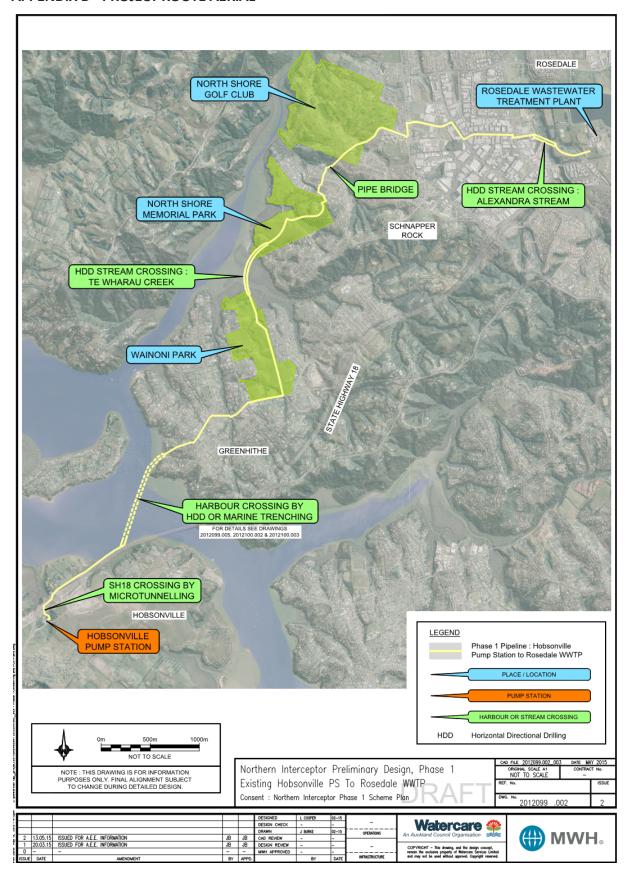
Demolition Work"

NZS 6803:1999 New Zealand Standard NZS 6803: 1999 "Acoustics - Construction

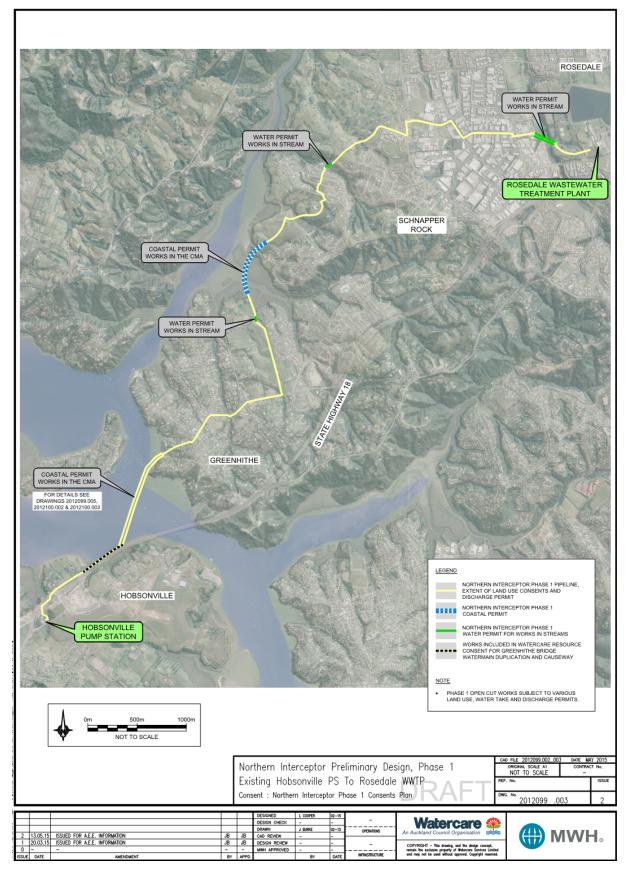
Noise"



APPENDIX B PROJECT ROUTE AERIAL









APPENDIX C DISTRICT PLAN NOISE RULES

Operative Waitakere DP

Rule 1.1

NZS6803P: 1984 Construction Noise Limits

Table 1

RECOMMENDED UPPER LIMITS FOR LEVELS OF CONSTRUCTION WORK NOISE RECEIVED IN RESIDENTIAL AREAS

77 1		Noise level (dBA)									
Time period	Weekdays			Saturdays		Sundays and Public holiday					
	L.,	L., 1	max .	L.o L.o, Lmax		Lio Los Lma		L _{max} .			
0630-0730	60	45	70	**	**	**	**	**	**		
0730-1800	75	60	90	75	60	90	**	**	**		
1800-2000	70	55	85	**	**	**	**	**	**		
2000-0630	**	**	**	**	**	**	**	**	**		

Operative North Shore DP

Rule 10.5 (i)

 Any construction, maintenance and demolition noise shall comply with the provisions of NZS 6803 P 1984 'The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work'.

Operative Auckland Regional Plan: Coastal

Rule 35.5.5 (b)

b Construction noise of 15 days or more in duration shall not exceed the following levels when measured 1 metre from the façade of any occupied or inhabited adjacent building, for any 30 minute period in accordance with Section 3.2.1 of NZS 6803P: 1984;

	L ₁₀	L _{max}
Monday to Friday 6.30am to 10.30pm	75 dBA	90 dBA
Saturday 7.00am to 11.00pm	80 dBA	90 dBA
Sunday 9.00am to 7.00pm	65 dBA	85 dBA
At all other times (night times)	60 dBA	75 dBA
At all other times (night time in any area where an operative District Plan provides for residential activity as the principal activity)	55 dBA	75 dBA

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PAUP

Rule 6.2.1.4.1

PART 3 - REGIONAL AND DISTRICT RULES» Chapter H: Auckland-wide rules» 6 General» 6.2 Noise and vibration» 1. Land use controls» 1.4 Construction noise

Construction noise - all zones except City Centre and Metropolitan Centre zones

Noise from construction and demolition activities in all zones except in the City Centre and Metropolitan Centre zones must meet the requirements of Tables 2 and 3 of New Zealand Standard on Acoustics – Construction Noise (NZS 6803: 1999). The measurement and assessment of construction noise must be in accordance with New Zealand Standard on Acoustics – Construction Noise (NZS 6803: 1999) and the requirements of annex A of New Zealand Standard on Acoustics – Construction Noise (NZS 6803: 1999) must be used if it is necessary to assess the measured Leq levels in high background noise areas.

Rule 6.2.1

The Proposed Auckland Unitary Plan (notified 30 September 2013)

PART 3 - REGIONAL AND DISTRICT RULES»Chapter I: Zone rules»6 Coastal - General Coastal Marine zone»2. Land and water use controls»

2.1 Noise

- 1. Interface with other zones:
 - a. activities in the CMA must not exceed the levels specified in clause 1.2.1 of the Auckland-wide Noise and vibration rules.
- Underwater noise from construction, dredging, mineral exploration and extraction (including seismic surveying):
 - underwater activity must not exceed a noise level of 200 dB re 1µPa measured at 1m from the noise source.
 - b. the noise limit above does not apply to:
 - the operational requirements of vessels (including cargo vessels, tugs, passenger liners, naval vessels and commercial fishing vessels)
 - use of sonar
 - temporary activities other than construction works (refer to the Auckland-wide Temporary activities rules).



APPENDIX D AMBIENT NOISE MEASUREMENT LOCATIONS AND RESULTS



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-	Magazina	· · · · · · · · · · · · · · · · · · ·	Maga	Measured Level (dBA) ¹			
Measurement	Measure	ement	ivieas	urea L	evei (a	ВА)	- Description of
Position ⁽³⁾	Date Start/Finish	Duration (min:sec)	L _{Amax}	L _{A10}	\mathbf{L}_{Aeq}	L _{A90}	Sound Sources ⁽²⁾
MP1	12:27 / 12:39	10:00	69	58	56	51	Upper Harbour Highway traffic, Buckley Ave traffic, construction noise, HPS audible during Iulls in traffic
MP2	12:56 / 13:01	5:00	59	50	46	38	Birds, wind in trees, boat engine
MP3	13:11 / 13:24	5:00	68	55	53	47	Greenhithe Rd traffic, construction noise, children playing at school, birds, wind in trees. NB Nearby traffic on Greenhithe excluded
MP4	13:28 / 13:34	5:00	60	49	46	40	Birds, wind in trees
MP5	13:43 / 13:48	5:00	61	50	47	40	Birds, wind in trees
MP6	14:07 / 14:13	5:00	65	51	48	39	Construction noise (pipe scaffolding), birds, frogs, wind in trees
MP7	14:24 / 14:29	5:00	64	43	41	36	<u>Birds</u> , distant cars
MP8	14:34 / 14:40	5:00	61	47	44	40	Electric power tool in distance, gusty wind
MP9	14:57 / 15:06	5:00	62	50	48	44	INMARSAT site "hum", traffic on road network, construction noise
MP10	12:05 / 12:14	5:00	62	56	54	52	<u>Distant traffic on Albany Highway,</u> insect noise
MP11	15:13 / 15:18	5:00	62	54	52	49	Bush Rd traffic, birds, Vector substation "hum", general industrial/commercial noise

Notes to Table 1:

- (1) An explanation of technical terms is provided in Appendix A
- (2) Underlined noise source is dominant
- (3) Measurement positions are shown on Figure x.1 on following page



APPENDIX E CONSTRUCTION NOISE LIMITS

NZS 6803: 1999 "Acoustics – Construction Noise" sets out the following noise limits

"Residential zones and dwellings in rural areas:

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration	of work				
		Typical duration (dBA)		Short-term duration (dBA)		Long-ten duration (dBA)	
		L_{eq}	L _{max}	L_{eq}	L _{max}	L_{eq}	L _{max}
Weekdays	0630-0730	60	<i>75</i>	65	75	55	<i>75</i>
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	<i>75</i>	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	<i>7</i> 5	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays	0630-0730	45	<i>75</i>	45	75	45	75
and public	0730-1800	55	85	55	85	55	85
holidays	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	<i>75</i>

Industrial or commercial areas:

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

Time period	Duration of work					
	Typical duration	Short-term duration	Long-term duration			
	L _{eq} (dBA)	L _{eq} (dBA)	L _{eq} (dBA)			
0730-1800	75	80	70			
1800-0730	80	85	75"			



Notes in the standards to the tables above:

7.2.5

The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.

7.2.6

One major factor which should be considered is whether there is a relatively high background sound level (L_{90}) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a "background plus" approach).

7.2.7

Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dBA. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed."

Discussion

The Construction Noise Standard provides for noise criteria that are higher than criteria for ongoing operational noise levels. This is because it is commonly accepted that for any construction to occur, noise criteria must be less stringent, with the understanding that construction is a temporary activity with a finite duration. The Standard states in the Foreword:

The generally acceptable level of intrusive noise in the community is assessed under the provisions of NZS6802:1999. However, construction noise is outside the scope of NZS6802:1999 because it usually cannot be kept within the specified limits. Although this may mean that the noise is undesirable, it is not necessarily unreasonable when all the relevant factors are taken into consideration. Construction noise is an inherent part of the progress of society.

As noise from construction projects is generally of limited duration, people and communities will usually tolerate a higher noise level provided it is no louder than necessary, and occurs within appropriate hours of the day.

It is considered that the Northern Interceptor can be constructed within reasonable noise criteria, provided that the best practicable option of mitigation is implemented throughout and contractors are committed to managing construction noise on an ongoing basis. It is noted that ambient noise levels in the areas under consideration range from $41-56\ L_{Aeq}$ during the daytime. Therefore, even when achieving compliance with the daytime construction noise criteria, there will be appreciable increases in overall noise level during the construction phase at some locations. This is, as recognised by the Construction Noise Standard, an expected and inevitable result of large construction projects near receivers.

Construction would occur in close proximity to some receivers and in some instances, noise emissions have the potential to exceed the Construction Noise Standard. It is generally noted that for most large-scale construction projects, exceedances of construction noise limits occur from time-to-time. Provided all reasonable mitigation steps are taken, the exceedance is of limited duration, and the community is consulted prior to commencement, noise may not be unreasonable.

The reasonableness or otherwise of noise from a construction activity exceeding the criteria may vary from site-to-site and activity-to-activity. The impact of any exceedance will be dependent upon the circumstances in which it occurs. For instance, where the daytime noise criterion is exceeded for several days, but



neighbouring residents are not at home, no one would be affected and therefore mitigation may not be required beyond communication with residents.

In the event that night-time works occur for one or two nights, this may be acceptable provided that residents have been informed and a clear period provided. However, should night-time works be ongoing for several consecutive nights, and at a noise level that affects residents' ability to sleep, then alternatives should be found, such as temporary relocation. This would be determined on a case-by-case basis throughout the construction process when construction equipment, methodologies and timing have been ascertained. Any such measures would be found in the project CNVMP that provides detail as to the methodology for proactively avoiding, or responding to noise issues.



APPENDIX F SITE AND CONSTRUCTION METHODOLOGY OVERVIEW^{23 24}

Existing Hobsonville pump station (2A Buckley Avenue)

The property located at 2 Buckley Avenue would be acquired. For Phase 1 of the Project the new site would be used for materials lay down and the construction of peripheral structures. Some earthworks would be required to level the site and would entail the use of an excavator and tipper trucks.

The existing pump station located at 2A Buckley Avenue would be upgraded with the installation of new pumps and associated pipes, valves, and other ancillary plant inside the existing structure. Truck deliveries and heavy crane lifts would occur. Extensive piping and ducting would be required within the site and would require excavation. Excavations would require structural support that may be by sheet piling. Dewatering pumps would operate also. Site access roads would be improved.

Key Activities		Typical Equipment	Approx Duration
Site Establishment	•	6-30 excavators	2-8 weeks
	•	20-30T tipper trucks	
	•	20T mobile crane	
	•	Truck deliveries	
Pump station upgrade	•	50T tracked crane	12-20 weeks
	•	Containerised generator	
	•	Compressors	
	•	Truck deliveries	
Switch room upgrade	•	As above	10-16 weeks
Construction of chemical storage/dosing facility	•	As above	12-16 weeks
Pipework and connections	•	12-30T excavators	Will run intermittently,
	•	20T tipper trucks	concurrent with other
	•	50T tracked crane	activities
	•	Containerised generators	
	•	Pumps	
	•	Vibro-hammer piling	
	•	Plate compactor	
	•	12m truck deliveries	
	•	Concrete trucks and pumping	
Site remediation	•	12T excavator	6-12 weeks
	•	20T tipper trucks	
	•	Asphalting	
	•	Vibrating/static roller	
	•	Plate compactor	
	•	Compressors	
	•	12m truck deliveries	
	•	Concrete trucks and pumping	
Expected Duration			8-10 months

 $^{^{23}}$ The relevant drawings for each site are contained in Volume 3 of the AEE

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²⁴ Some activities in these tables would run concurrently thereby minimising the duration of effects



SH18 Crossing

A new rising main would be constructed in a concrete conduit under SH18 using a micro-tunnel boring machine ("MTBM"). Two pits would be excavated to support MTBM works, one on either side of SH18. Concrete pipes would be 'jacked' into place and the polyethylene ("PE") pipe liner pulled through via winch.

The temporary access shafts would be constructed using a long-arm excavator, mobile crane and spoil would be removed by truck. The shaft sides would be supported by soldier pile or similar therefore some impact piling would be required.

The MTBM would operate from the south side of the motorway therefore this site would require a generator, hydraulic power pack, pumps, a crane, ventilation fans and dewatering pumps. Concrete pumps and concrete trucks would also operate at the site. Similar equipment would operate at the site located on the northern side of the motorway although would be used for MTBM retrieval.

Key Activities	Typical Equipment	Approx Duration
Jacking shaft construction and	20T long-arm excavator	4-8 weeks
ops	50T mobile crane	
	 Containerised drilling mud reservoir 	
	 Containerised generator 	
	 MTBM and jacks 	
	 Ventilation fans 	
	 Concrete trucks and pumping 	
Receival shaft construction	20T long-arm excavator	4-8 weeks
and ops	Pile drilling rig	
	• 50T mobile crane	
	 Ventilation fans 	
	 Dewatering pumps 	
Slip-lining trench excavation	 20T excavator 	1-2 weeks
and ops	 Dewatering pumps 	
	 Compactor 	
Polyethylene (PE) pipe string	20T excavator	1-2 weeks
welding	 Fusion welder 	
	 Generator 	
	100T winch	
Installation of pipes, grouting,	20T long-arm excavator	2-4 weeks
backfilling	100T winch	
	Grout pump	
	• 50T mobile crane	
	 Dewatering pump 	
	Compactor	
Expected Duration		3-5 months



SH18 to Causeway Widening

A trench would be excavated adjacent to SH18 at the northern end of Squadron Drive and would run parallel to the motorway designation boundary onto the widened causeway, where it would connect with the section of pipe installed as part of the GBWD&C project. PE pipe would be laid and a minor above-ground structure constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	20T excavator	1-2 weeks
	 Tipper trucks 	
	Compactor/road roller	
Saw cutting of existing road	Diamond road saw	1 week
surfaces, removal of kerbs	 Compressor 	
	 Jack hammer 	
Trench excavation, support,	20T excavator	20-30 metres per day
removal of spoil, deliveries	• 50T mobile crane	
	 Dewatering pumps 	
	 Compactor 	
	 Trucks 	
PE pipe string welding	• 20T excavator	4-6 weeks
	 Fusion welder 	
	 Generator 	
Air valve chamber	• 20T excavator	4-8 weeks
construction	 12m Hiab truck 	
	 20t mobile crane 	
	 Concrete trucks and pumping 	
PE pipe install, backfilling,	 20T long-arm excavator 	2-4 weeks
reinstatement	 50T mobile crane 	
	 Dewatering pumps 	
	 Compactor 	
Expected Duration		2-5 months



Upper Waitemata Harbour Crossing;

The Project requires the crossing of the Upper Waitemata Harbour. This will involve the establishment of two 550mm DN pipelines crossing the harbour from a point at the construction platform on the widened causeway to a site on Rahui Road.

The preferred construction methodology and exact alignment of the pipelines across the harbour will be confirmed once a contractor is appointed. Accordingly, two resource consents are being sought for a corridor within which the final pipe alignment will be located and are as follows:

- 1. Option 1: Horizontal Directional Drilling
- 2. Option 2: Marine Trenching

Horizontal Directional Drilling

A drill rig, supporting equipment and works area will be established at the proposed construction platform on the widened causeway. An exit pit and works area will also be established at the Rahui Road site. The drill rig will be used to drill and ream a hole slightly larger than the pipe diameter from the construction platform to Rahui Road. The pipestring will be pulled through the hole from the Rahui Road side using the same or another drill rig. The estimated period for heavy equipment located at Rahui Road is no more than 4 weeks per pipe pull. This process will be repeated for the second crossing. All drilling fluid injection, treatment and recycling would be performed at the widened causeway site.

Key Activities	Typical Equipment	Approx Duration
Fencing	6T excavator	4 weeks
	 20T tipper truck 	
	 Post borer 	
	 8m rigid Hiab truck 	
	 Chain saws 	
Site Establishment	 12m Hiab truck 	2-4 weeks
(each site)	 20T mobile crane 	
	 Mini road roller 	
	 Mini excavator 	
HDD Pit 1	• 250-500T HDD rig	2-4 weeks + 2 week
	 100T mobile crane 	relocation for second
	 Continuous flight auger rig 	pipe
	 Mud separator units/storage 	
	 Containerised generator 	
PE pipe string welding	20T excavator	6-10 weeks
	 Fusion welder 	
	 Generator 	
	 Tractor/bulldozer 	
	 100T mobile crane 	
Air valve/Line valve	20T excavator	4-6 weeks per
chamber construction	• 12m Hiab truck	chamber (2)
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Expected Duration		4-6 months



Marine Trenching

It is anticipated that marine trenching will be undertaken in three main components, those being works on land, inter-tidal zone trenching/pipe-laying, and trenching/pipe laying in the harbour.

A construction site would be set up on the widened causeway²⁵ on the northern side of SH18. Marine trenching would be carried out, laying dual pipelines in a trench over to the Rahui Road site, Greenhithe. A construction site would be established on the Greenhithe shoreline on Rahui Road.

Key Activities	Typical Equipment	Approx Duration
Fencing	6T excavator	4 weeks
	 20T tipper truck 	
	 Post borer 	
	8m rigid Hiab truck	
	 Chain saws 	
Site Establishment	12m Hiab truck	2-4 weeks
(each site)	20T mobile crane	
	Mini road roller	
	Mini excavator	
Trenching/pipe-laying in	30T excavator	10-15 weeks
Intertidal zones	 30T tipper trucks 	
	Crane barge	
	 Dive boats/tug 	
	 Compressor 	
Trenching/pipe-laying in	Crane barge	2 weeks
subtidal zone	 Jet sled or controlled flow 	
	excavation plant	
	 Dive boats/tug 	
	 Generator 	
Air valve/Line valve	• 20T excavator	4-6 weeks per
chamber construction	12m Hiab truck	chamber (2)
	20T mobile crane	
	 Concrete trucks and pumping 	
Expected Duration		3-5 months

²⁵ Reclamation works carried out as part of the GBWD&C project



Trenching along Rahui and Traffic Roads

A trench would be excavated along these roads. PE pipe would be laid and the trench backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	8-20T excavators	1-2 weeks
	 20T tipper trucks 	
	Compactor/road roller	
Saw cutting of existing road	Diamond road saw	1 week
surfaces, removal of kerbs	 Compressor 	
	Jack hammer	
Trench excavation, support,	20T excavator	2-4 weeks
removal of spoil, deliveries	 Dewatering pumps 	
	 Compactor 	
	 Trucks 	
PE pipe string welding	20T excavator	2-4 weeks
	Fusion welder	
	 Generator 	
	Tractor	
PE pipe install, backfilling,	 20T long-arm excavator 	2-4 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Road surface reinstatement	• 12T excavator	1-2 weeks
	 20T tipper trucks 	
	 Asphalt truck 	
	 Vibrating/static roller 	
	 Plate compactor 	
Expected Duration		2-5 months



Trenching along Greenhithe Road

A trench would be excavated along this road. PE pipe would be laid and a minor above-ground structure constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Saw cutting of existing road	Diamond road saw	10-20 week
surfaces, removal of kerbs	 Compressor 	
	Jack hammer	
Trench excavation, support,	20T excavator	10-20 weeks
removal of spoil, deliveries	 Dewatering pumps 	
	 Compactor 	
	 Trucks 	
PE pipe string welding	• 20T excavator	10-20 weeks
	 Fusion welder 	
	 Generator 	
	Tractor	
PE pipe install, backfilling,	 20T long-arm excavator 	10-20 weeks
reinstatement	 12m Hiab truck 	
	 20T mobile crane 	
	 Concrete trucks and pumps 	
Air valve chamber	• 20T excavator	4-8 weeks
construction	 12m Hiab truck 	
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Road surface reinstatement	• 12T excavator	10-20 weeks
	 20T tipper trucks 	
	Asphalt truck	
	 Vibrating/static roller 	
	 Plate compactor 	
Expected Duration		2-5 months



Trenching through Wainoni Park

A trench would be excavated through Wainoni Park from south to north, entering the park at approximately 77 Greenhithe Road. PE pipe would be laid and minor above-ground structures constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	8-20T excavators	2-5 weeks
	• 20T tipper trucks	
	 Compactor/road roller 	
Trench excavation, support,	• 20T excavator	10-16 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	• Trucks	
PE pipe string welding	20T excavator	10-16 weeks
	• Fusion welder	
	Generator	
	• Tractor	
PE pipe install, backfilling,	20T long-arm excavator	10-16 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Air valve chamber	• 20T excavator	4-8 weeks
construction	• 12m Hiab truck	
	20T mobile crane	
	 Concrete trucks and pumping 	
Scour valve chamber	20T excavator	4-8 weeks
construction and connections	• 12m Hiab truck	
	20T mobile crane	
	 Concrete trucks and pumping 	
Surface reinstatement and	20T tipper trucks	2-4 weeks
reseeding	Light vehicles	
Expected Duration		3-5 months



Te Wharau Creek Crossing by HDD

Two construction sites would be established; one at the northern end of Wainoni Park and the other in the south-western corner of North Shore Memorial Park. The HDD would drive in a north-east direction. The pipe 'strings' would be welded together on the NSMP site and the HDD rig would perform drilling and pull-through from the Wainoni Park North site. All drilling fluid injection, treatment and recycling would be performed at this site.

Key Activities		Typical Equipment	Approx Duration
Fencing	•	6T excavator	1-2 weeks
	•	Post borer	
	•	8m rigid Hiab truck	
Site Establishment (each site)	•	12m Hiab truck	1-2 weeks
	•	20T mobile crane	
	•	Mini road roller	
	•	Mini excavator	
NSMP HDD site	•	250-500T HDD rig	2-4 weeks + 2 week relocation
	•	100T mobile crane	for second pipe
	•	Continuous flight auger rig	
	•	Mud separator units/storage	
	•	Containerised generator	
PE pipe string welding	•	20T excavator	4-6 weeks
	•	Fusion welder	
	•	Generator	
	•	Tractor/bulldozer	
	•	100T mobile crane	
Line valve chamber	•	20T excavator	4-6 weeks per chamber (2)
construction	•	12m Hiab truck	
	•	20T mobile crane	
	•	Concrete trucks and pumping	
Expected Duration		·	4-6 months



Trenching through NSMP

A trench would be excavated, starting in the south-western corner of NSMP. Trenching would follow the alignment of the proposed access road and move in a north-easterly direction up to Schnapper Rock Road. PE pipe would be laid and minor above-ground structures constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	20T excavator	2-5 weeks
	 Tipper trucks 	
	 Compactor/road roller 	
Trench excavation, support,	20T excavator	8-14 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	 Trucks 	
PE pipe string welding	20T excavator	8-14 weeks
	 Fusion welder 	
	 Generator 	
	• Tractor	
PE pipe install, backfilling,	20T long-arm excavator	8-14 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Air valve chamber	• 20T excavator	4-8 weeks
construction (2)	 12m Hiab truck 	
	• 20T mobile crane	
	 Concrete trucks and pumping 	
Surface reinstatement and	20T tipper trucks	2-4 weeks
reseeding	 Asphalt truck 	
	 Vibrating/static roller 	
	 Plate compactor 	
Expected Duration		2-5 months



Trenching from NSMP to Witton Place

Trenching works would travel northwest along Schnapper Rock Road then turn north and follow a public footpath between 30 and 32 Newbury Place, along the length of Witton Place, down the footpath between 9 and 17 Witton Place, and into the bush reserve behind. PE pipe would be laid and minor above-ground structures constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Saw cutting of existing road	Diamond road saw	3-5 weeks
surfaces, removal of kerbs	 Compressor 	
	Jack hammer	
Trench excavation, support,	20T excavator	3-5 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	 Trucks 	
PE pipe string welding	20T excavator	3-5 weeks
	 Fusion welder 	
	 Generator 	
	• Tractor	
PE pipe install, backfilling,	20T long-arm excavator	3-5 weeks
einstatement	 Dewatering pumps 	
	 Compactor 	
Air valve chamber	 20T excavator 	4-8 weeks
construction	• 12m Hiab truck	
	20T mobile crane	
	 Concrete trucks and pumping 	
Scour valve chamber	 20T excavator 	4-8 weeks
construction and connections	• 12m Hiab truck	
	• 20T mobile crane	
	 Concrete trucks and pumping 	
Road surface reinstatement	• 12T excavator	1-2 weeks
	 20T tipper trucks 	
	Asphalt truck	
	 Vibrating/static roller 	
	Plate compactor	
Expected Duration		2 months



Pipe Bridge and trenching between Witton Place and North Shore Golf Course

A pipe bridge would be constructed within the bush reserve adjacent to Witton Place with the landing behind the dwelling located at 82 Laurel Oak Drive. From there trenching would take over and the route would pass through the North Shore Golf Course grounds. PE pipe would be laid and a minor above-ground structure constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	6-20T excavator	2-6 weeks
	• 20T tipper trucks	
	 Compactor/road roller 	
	Chain saws	
Trench excavation, support,	• 20T excavator	4-8 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	• Trucks	
PE pipe string welding	• 20T excavator	4-8 weeks
	 Fusion welder 	
	 Generator 	
	• Tractor	
PE pipe install, backfilling,	 20T long-arm excavator 	4-8 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Pipe bridge construction	• 20T excavator	10-20 weeks
	 Continuous flight auger piling 	
	• 100T mobile crane	
	 Truck deliveries 	
	 Concrete trucks and pumping 	
Scour valve chamber	• 20T excavator	4-8 weeks
construction and connections	• 12m Hiab truck	
	• 20T mobile crane	
	 Concrete trucks and pumping 	
Surface reinstatement and	20T tipper trucks	2-4 weeks
reseeding	Light vehicles	
Expected Duration		4-5 months



Trenching through North Shore Golf Course

Trenching works would pass through the North Shore Golf Course grounds heading in a north-easterly direction and then along the boundary with the dwellings located on St. Andrews Way. PE pipe would be laid and minor above-ground structures constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	20T excavator	2-5 weeks
	 Tipper trucks 	
	 Compactor/road roller 	
Saw cutting of existing road	 Diamond road saw 	3-5 weeks
surfaces, removal of kerbs	 Compressor 	
	Jack hammer	
Trench excavation, support,	20T excavator	7-14 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	 Trucks 	
PE pipe string welding	• 20T excavator	7-14 weeks
	 Fusion welder 	
	 Generator 	
	Tractor	
PE pipe install, backfilling,	 20T long-arm excavator 	7-14 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Air valve chamber	 20T excavator 	4-8 weeks
construction	• 12m Hiab truck	
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Scour valve chamber	 20T excavator 	4-8 weeks
construction and connections	• 12m Hiab truck	
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Road surface reinstatement	 12T excavator 	7-12 weeks
	 20T tipper trucks 	
	Asphalt truck	
	 Vibrating/static roller 	
	 Plate compactor 	
Surface reinstatement and	20T tipper trucks	2-4 weeks
reseeding	 Light vehicles 	
Expected Duration		3-5 months



Trenching between Albany Highway and William Pickering Drive

Trenching will occur along Appleby Road and through the intersection of Albany Highway; the route then heads northwards along the highway then turns eastwards onto John Glenn Avenue until it intersects with William Pickering Drive. The route then heads south before turining onto Piermark Drive.

Key Activities	Typical Equipment	Approx Duration
Site establishment	20T excavator	1-2 weeks
	 20T tipper trucks 	
	 Compactor/road roller 	
	 Chain saws 	
Saw cutting of existing road	Diamond road saw	1-2 weeks
surfaces, removal of kerbs	 Compressor 	
	 Jack hammer 	
Trench excavation, support,	20T excavator	2-4 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	 Trucks 	
PE pipe string welding	• 20T excavator	2-4 weeks
	 Fusion welder 	
	 Generator 	
	 Tractor 	
PE pipe install, backfilling,	20T long-arm excavator	2-4 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Scour valve chamber	20T excavator	4-8 weeks
construction and connections	12m Hiab truck	
	20T mobile crane	
	 Concrete trucks and pumping 	
Expected Duration		2-5 months



Trenching along Piermark Drive and across Bush Road

Trenching works would follow Piermark Drive to the intersection with Bush Road, and then pass between 169 and 179 Bush Road before stopping on the eastern side of 169 Bush Road (occupied by Kea Caravans). PE pipe would be laid and a minor above-ground structure constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Saw cutting of existing road	Diamond road saw	6-12 weeks
surfaces, removal of kerbs	 Compressor 	
	Jack hammer	
Trench excavation, support,	20T excavator	6-12 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	 Trucks 	
PE pipe string welding	20T excavator	6-12 weeks
	 Fusion welder 	
	 Generator 	
	 Tractor 	
PE pipe install, backfilling,	• 20T excavator	6-12 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Air valve chamber	• 20T excavator	4-8 weeks
construction	 12m Hiab truck 	
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Road surface reinstatement	 20T tipper trucks 	10-20 weeks
	 Asphalt truck 	
	 Vibrating/static roller 	
	 Plate compactor 	
Expected Duration		2-5 months



Alexandra Stream crossing into Rosedale Park using HDD

Two construction sites would be established; one located at 169 Bush Road (Rosedale Park HDD launch site) and the other within Rosedale Park (Rosedale Park HDD site). The HDD would drive south-east direction towards Rosedale Park. The pipe 'strings' would be welded together on the Bush Road site and the HDD rig would perform the pull-through from the Rosedale Park site. All drilling fluid injection, treatment and recycling would be performed at the Bush Rd site.

Key Activities		Typical Equipment	Approx Duration
Fencing	•	6T excavator	1-2 weeks
	•	Post borer	
	•	8m rigid Hiab truck	
Site Establishment (each site)	•	12m Hiab truck	1-2 weeks
	•	20T mobile crane	
	•	Mini road roller	
	•	Mini excavator	
HDD Pit 5 site	•	250-500T HDD rig	2-4 weeks + 2 week relocation
	•	100T mobile crane	for second pipe
	•	Continuous flight auger rig	
	•	Mud separator units/storage	
	•	Containerised generator	
PE pipe string welding	•	20T excavator	4-6 weeks
	•	Fusion welder	
	•	Generator	
	•	Tractor/bulldozer	
	•	100T mobile crane	
Line valve chamber	•	20T excavator	4-6 weeks per chamber (2)
construction	•	12m Hiab truck	
	•	20T mobile crane	
	•	Concrete trucks and pumping	
Expected Duration		·	4 months



Trenching through Rosedale Park and Rosedale WWTP

Trenching works would pass through Rosedale Park to the Rosedale WWTP. PE pipe would be laid and a minor above-ground structure constructed. The trench would be backfilled and the surface reinstated.

Key Activities	Typical Equipment	Approx Duration
Site establishment	20T excavator	1-2 weeks
	 Tipper trucks 	
	 Compactor/road roller 	
Saw cutting of existing road	 Diamond road saw 	1-2 weeks
surfaces, removal of kerbs	 Compressor 	
	 Jack hammer 	
Trench excavation, support,	20T excavator	4-6 weeks
removal/stockpile of spoil,	 Dewatering pumps 	
deliveries	 Compactor 	
	Trucks	
PE pipe string welding	20T excavator	4-6 weeks
	 Fusion welder 	
	 Generator 	
	• Tractor	
PE pipe install, backfilling,	20T long-arm excavator	4-6 weeks
reinstatement	 Dewatering pumps 	
	 Compactor 	
Scour valve chamber	20T excavator	4-8 weeks
construction and connections	• 12m Hiab truck	
	 20T mobile crane 	
	 Concrete trucks and pumping 	
Road surface reinstatement	• 12T excavator	1-2 weeks
	 20T tipper trucks 	
	Asphalt truck	
	 Vibrating/static roller 	
	Plate compactor	
Surface reinstatement and	20T tipper trucks	1-2 weeks
reseeding	Light vehicles	
Expected Duration		2-4 months



APPENDIX G NOISE SOURCE SOUND POWER LEVELS

	Octave Band Centre Frequency (Hz)							
Source	63	125	250	500	1000	2000	4000	dBA
Excavator	100	99	102	101	97	94	91	103
Tipper Truck	110	108	105	103	102	99	94	107
Mobile Crane	96	99	96	90	94	94	83	99
Truck Idling	84	89	86	87	86	86	79	91
Truck Moving	90	95	92	93	92	92	85	97
Containerised Generator	103	100	104	98	97	93	84	103
Compressor	94	94	94	97	100	100	100	106
Compressor (small)	88	88	88	91	94	94	94	100
Mobile Crane Moving	111	114	111	105	109	109	98	114
Vibro Sheet Piling	119	115	114	113	111	106	98	115
Concrete Truck Pumping	97	112	110	104	100	98	96	107
Vibrating Roller/Compactor	110	115	105	102	101	97	90	106
Asphalt Laying	109	109	106	106	104	100	98	109
Dewatering Pump	98	93	94	92	92	91	84	97
MTBM Ventilation Fan	94	96	100	99	98	94	90	102
Bored Piling	112	120	109	108	106	104	96	112
Pumping Slurry	83	85	92	91	90	88	84	95
Chainsaw	99	107	100	94	90	96	97	102
Diamond Road Saw	101	95	98	96	101	106	106	111
Jack Hammer	115	121	117	113	114	114	111	120
HDD Rig (Drilling)	105	111	101	96	101	108	112	115
Mud and Slurry Pump	112	120	109	108	106	104	96	112
Hydraulic Power Pack	73	78	85	89	94	87	79	96
Generator	107	111	107	101	94	91	86	103
Bulldozer	102	111	100	100	107	105	98	110
Mud Treatment	103	100	106	97	98	102	93	106
HDD Pipe Pull	102	102	101	101	98	93	88	103
Tug Boat	110	110	101	97	92	88	77	100
Dive Boat	97	92	85	86	84	79	74	88

Data was obtained from measurements undertaken by MDA at similar construction sites, and from British Standard BS5228-1:2009 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise".



APPENDIX H CONSTRUCTION NOISE TABLE OF EFFECTS

Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
Hobsonville PS						
Teal Way dwellings	Up to 62	Site Establishment	6-14	None required	62	Yes
	Up to 52	PS upgrade	Up to 20	None required	52	Yes
	Up to 64	Pipework and connections	Intermittently, concurrently with other works	None required	64	Yes
	Up to 64	Site remediation	6-12	None required	64	Yes
Waiarohia Pl dwellings	Up to 45	Site Establishment	6-14	None required	45	Yes
	Up to 50	PS upgrade	Up to 20	None required	60	Yes
	Up to 65	Pipework and connections	Intermittently, concurrently with other works	None required	65	Yes
	Up to 56	Site remediation	6-12	None required	56	Yes
70 Buckley Avenue	Up to 48	Site Establishment	6-14	None required	48	Yes
	Up to 55	PS upgrade	Up to 20	None required	55	Yes
	Up to 69	Pipework and connections (vibro sheet piling)	Intermittently, concurrently with other works	None required	69	Yes
	Up to 61	Site remediation	6-12	None required	61	Yes

²⁶ Number in brackets indicates predicted night-time noise level with screening/acoustic enclosure in place

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
SH18 Crossing						
Teal Way dwellings	Up to 49	Jacking shaft C&O	4-8	None required	49	Yes
	Up to 49	Pipe install, grouting, backfilling	2-4	None required	49	Yes
	Up to 51	Receive shaft C&O	4-8	None required	51	Yes
70 Buckley Avenue	Up to 52	Jacking Shaft C&O	4-8	None required	52	Yes
	Up to 52	Pipe install, grouting, backfilling	2-4	None required	52	Yes
	Up to 52	Receive shaft C&O	4-8	None required	52	Yes
Waiarohia PI dwellings	Up to 53	Jacking shaft C&O	4-8	None required	53	Yes
	Up to 53	Pipe install, grouting, backfilling	2-4	None required	53	Yes
	Up to 58	Receive shaft C&O	4-8	None required	58	Yes
30 Ockleston Landing	Up to 52	Receive shaft C&O	4-8	None required	52	Yes
	Up to 44	Pipe install, grouting, backfilling	2-4	None required	44	Yes
Summerset Village Monterey Park	Up to 57	Receive shaft C&O	4-8	None required	57	Yes
	Up to 50	Pipe install, grouting, backfilling	2-4	None required	50	Yes

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
SH18 to Widened Causeway						
Summerset Village	Up to 86	Site establishment – jack hammer road	<1 day	Mobile screening or management mitigation	76	No
	Up to 76	Site establishment – saw cutting asphalt	<1 day	Mobile screening or management mitigation	66	Yes
Up to 79	Up to 79	Trenching—tracked crane movements	Infrequent	Management mitigation	79	No
	Up to 77	Trenching – excavation	<1 week in a given location	Management mitigation	77	No
	Up to 74	Trenching – compaction	<1 week in a given location	Management mitigation	74	No
	Up to 73	Air valve chamber construction – tracked crane movements	Infrequent	Management mitigation	73	No
Hobsonville Point	Up to 58	Air valve chamber construction – tracked crane movements	Infrequent	None required	58	Yes
	Up to 58	Trenching – excavation	<1 week in a given location	None required	58	Yes
Open Cut Trenching						
L6 Traffic Road, 18 Rahui Rd	Up to 88	Site prep – jack hammer	1-2	Mobile screening	78	No
	Up to 78	Trenching – compaction	2-4	Mobile screening	68	Yes
	Up to 75	Trenching – excavation	2-4	Management through CNVMP	75	No

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
	Up to 80	Road surface reinstatement	1-2	Management through CNVMP	80	No
14A Rahui Rd, 11,9,7,14, 10,6,8,5,3,4,1 Traffic Rd	Up to 82	Site prep – jack hammer	1-2	Mobile screening	72	No
	Up to 72	Trenching – compaction	2-4	Mobile screening	62	Yes
	Up to 69	Trenching – excavation	2-4	None required	69	Yes
	Up to 74	Road surface reinstatement	1-2	Management through CNVMP	74	No
Greenhithe Road ²⁷						
Open Cut Trenching						
30 and 34 Newbury Place	Up to 73-80	Site prep – jack hammer, saw cutting asphalt	1-2	Mobile screening	63-70	Yes
	Up to 78	Trenching – compaction	2-4	Mobile screening	68	Yes
	Up to 77	Trenching – excavation	2-4	Management through CNVMP	77	No
	Up to 66	Road surface reinstatement	1-2	None required	66	Yes
9 Witton Place	Up to 79-88	Site prep – jack hammer, saw cutting asphalt	1-2	Mobile screening	69-78	No

²⁷ Similar setback distances would occur for receivers located adjacent to trenching works along Greenhithe Road. Therefore, similar noise levels to those predicted for other parts of the route would occur

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Affected Street/Dwelling	5 11 16 11 1					
	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
	Up to 78	Trenching – compaction	2-4	Mobile screening	68	Yes
	Up to 77	Trenching – excavation	2-4	Management through CNVMP	77	No
	Up to 66	Road surface reinstatement	1-2	None required	66	Yes
222 and 224 Schnapper Rock Road, 32 Newbury Pl	Up to 67-75	Site prep – jack hammer, saw cutting asphalt	1-2	Mobile screening	57-65	Yes
	Up to 78	Trenching – compaction	2-4	Mobile screening	68	Yes
	Up to 77	Trenching – excavation	2-4	Management through CNVMP	77	No
	Up to 63	Road surface reinstatement	1-2	Management through CNVMP	63	Yes
50, 52 and 59 Aberley Rd, and 5 Witton Pl	Up to 79-88	Site prep – jack hammer, saw cutting asphalt	1-2	Mobile screening	69-78	No
	Up to 73	Trenching – compaction	2-4	Mobile screening	63	Yes
	Up to 67	Air valve construction – concrete trucks and pumping	4-8	None required	67	Yes
	Up to 70	Trenching – excavation	2-4	None required	70	Yes
	Up to 57	Road surface reinstatement	1-2	None required	57	Yes
15 and 17 Newbury Pl, 7,8,17 and 11 Witton	Up to 79-88	Site prep – jack hammer, saw cutting asphalt	1-2	Mobile screening	69-78	No

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
	Up to 73	Trenching – compaction	2-4	Mobile screening	63	Yes
	Up to 70	Trenching – excavation	2-4	None required	70	Yes
	Up to 57	Road surface reinstatement	1-2	None required	57	Yes
Witton Pl Pipe Bridge						
9 Witton Place	Up to 73	Tracked crane movements	Intermittent	Management through CNVMP	73	No
	Up to 71	Bored piling	10-20	Management through CNVMP	71	Marginal non compliance
	Up to 65	Truck deliveries	10-20	None required	65	Yes
11 Witton Place	Up to 77	Tracked crane movements	Intermittent	Management through CNVMP	77	No
	Up to 75	Bored piling	10-20	Management through CNVMP	75	No
	Up to 71	Concrete truck and pumping	10-20	Management through CNVMP	71	Marginal non- compliance
	Up to 68	Excavation	10-20	None required	68	Yes
17 Witton Place	Up to 75	Tracked crane movements	10-20	Management through CNVMP	75	No
	Up to 73	Bored piling	10-20	Management through CNVMP	73	No
	Up to 69	Concrete truck and pumping	10-20	None required	69	Yes

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
	Up to 67	Excavation	10-20	None required	67	Yes
82 Laurel Oak Drive	Up to 76	Tracked crane movements	10-20	Management through CNVMP	76	No
	Up to 75	Bored piling	10-20	Management through CNVMP	75	No
	Up to 69	Concrete truck and pumping	10-20	None required	69	Yes
	Up to 68	Excavation	8-16	None required	68	Yes
111 Laurel Oak Drive	Up to 66	Site prep	2-6	None required	66	Yes
	Up to 65	Excavation	4-8	None required	65	Yes
	Up to 62	Bored piling	10-20	None required	62	Yes
Open Cut Trenching						
St Andrews Way dwellings (West facing facade)	Up to 78-87	Site prep – cutting road and jack hammering	3-5	Mobile screening	68-77	No
	Up to 73	Trenching – compaction	7-14	Mobile screening	63	Yes
	Up to 70	Trenching – excavation	7-14	None required	70	Yes
	Up to 76	Surface reinstatement – asphalt truck	7-12	Management through CNVMP	76	No
10, 12 and 18 Appleby Road	Up to 87	Site prep – cutting road and jack hammering	3-5	Management through CNVMP and/or Mobile screening	77	No

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Affected Street/Dwelling	Predicted Sound Level Without Mitigation	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶	Comply with 6803:1999
	(dB L _{Aeq})				(dB L _{Aeq})	
	Up to 73	Trenching – compaction	7-14	Management through CNVMP and/or Mobile screening	63	Yes
	Up to 70	Trenching – excavation	7-14	None required	70	Yes
	Up to 76	Surface reinstatement – asphalt truck	7-12	Management through CNVMP	76	No
Albany Junior High School	Up to 80	Site prep – cutting road and jack hammering	3-5	Mobile screening	70	Yes
	Up to 67	Trenching – compaction	7-14	None required	67	Yes
	Up to 64	Trenching – excavation	7-14	None required	64	Yes
	Up to 70	Surface reinstatement – asphalt truck	7-12	None required	70	Yes
ABC Childcare	Up to 80	Site prep – cutting road and jack hammering	3-5	Management through CNVMP and/or Mobile screening	70	Yes
	Up to 67	Trenching – compaction	7-14	None required	67	Yes
	Up to 65	Trenching – excavation	7-14	None required	65	Yes
	Up to 71	Surface reinstatement – asphalt truck	7-12	None required	71	Marginal non- compliance
313, 317, 319 and 321 Albany Highway	Up to 84	Site prep – cutting road and jack hammering	3-5	Management through CNVMP and/or Mobile screening	74	No
	Up to 70	Trenching – compaction	7-14	None required	70	Yes
	Up to 68	Trenching – excavation	7-14	None required	68	Yes

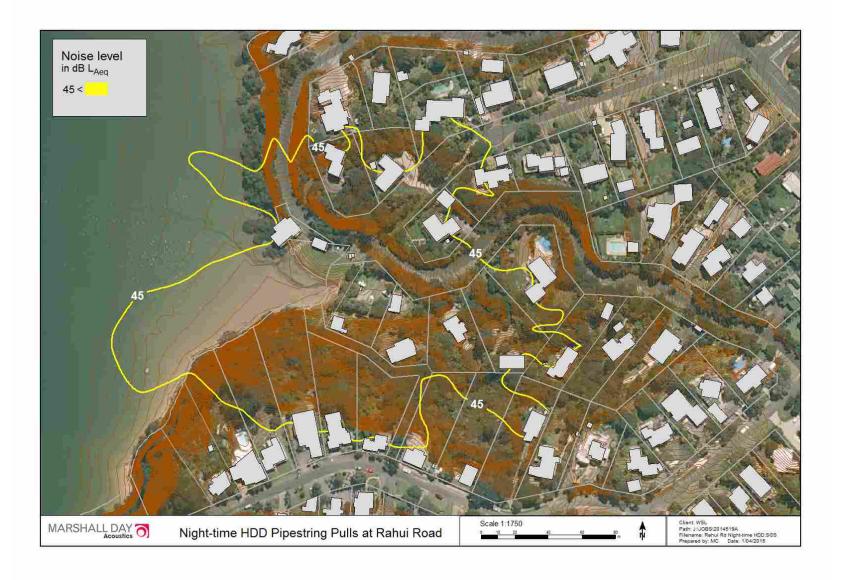
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Affected Street/Dwelling	Predicted Sound Level Without Mitigation $(dB\ L_{Aeq}\)$	Key Activities	Duration of Works (weeks)	Potential Mitigation Options	Predicted Sound Level With Mitigation ²⁶ (dB L _{Aeq})	Comply with 6803:1999
	Up to 74	Surface reinstatement – asphalt truck	7-12	Management through CNVMP	74	No



Figure H1: Night-time HDD pipe pull noise contour level (with mitigation)





APPENDIX I UNDERWATER CONSTRUCTION NOISE

Long-arm Excavation (Dredging)

Figure I1: Barge-mounted long-arm excavation



Activity Description

Sound sources associated with this activity can be grouped into several categories: removal of material from the seabed, placement of material into barge, and mechanical noise.

The physical removal of seabed material using a long-arm excavator would generate low-level sound from the bucket interacting with the soft seabed floor.

Mechanical noise would break out through the hull of the dredging barge and originate from the excavator's engine, onboard generator, pumps etc and the physical placement of material into the barge hold. Mechanical noise would also come from propeller cavitation noise from the tug boat used to maintain the barge/excavator in the correct position.

MDA notes that this form of dredging is relatively quiet when compared to other forms such as cutter suction dredging and trailing suction hopper dredging, both of which have significant noise sources located underwater.

A crane barge would be used to lift pipe sections into place and then push underwater spoil piles back into the trench around the laid pipes. These activities are considered to be relatively benign.



Controlled flow excavation

Figure I2: Controlled flow excavation process²⁸

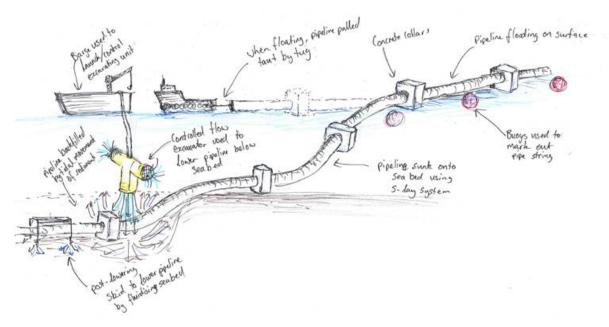


Figure I2: Controlled flow excavation plant²⁹



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²⁸ MWH Global

²⁹ http://www.jfsubseaexcavation.com/



Activity Description

Controlled flow excavation is a contactless underwater trenching method which uses an encased impellor to generate a vertical column of water which travels down to the seabed at relatively high velocity, where it fluidises the seabed and disperses the soil, creating a trench.

Surface sound sources associated with this activity include a tug boat, crane barge and ancillary plant including generator.

The sub-surface sound source consists of impellor noise from the unit. Currently, underwater noise generated by this type of plant is not widely known, although would be similar to that of a submerged pump of comparable duty. The character of noise would be generally broadband (a tone may be present at the blade pass frequency of the impellor) and steady-state.

Jetting sled excavation

Figure I3: Jetting sled excavation³⁰



Activity Description

Jet sled excavation utilises powerful multiple water jets to excavate the seabed beneath a submerged pipe string. The water jets displace the seabed and the pipe string falls down into the trench. Post-lowering, the trench would be back-filled with seabed material.

Surface sound sources associated with this activity include a tug boat, crane barge and ancillary plant including a generator, and water pumps which deliver the high velocity water through a supply line from the surface down to the water jets.

The primary sub-surface sound source consists of turbulent water flow at high velocity through the jets.

-

³⁰ http://www.oes.net.au/photographs_projects_and_versatility.shtml



Table I1: Underwater anthropogenic noise sources³¹

Sound Source	Source Level (dB re 1µPa @1m)	Bandwidth (Hz)	Major Amplitude (Hz)	Duration (ms)	Directionality
TNT	272 – 287 Peak	2 - 1000	6 - 21	~ 1 - 10	Omni
Air-gun array	254 – 256 Peak	10 – 100 000	10 - 120	30 - 60	Vertically focused
Military sonar mid-frequency	223 – 235 Peak	2800 - 8200	3 500	500 - 2000	Horizontally focused
Pile driving	228 peak 237 – 251 Peak	20 ->20 000	100 - 500	50	Omni
Military sonar low-frequency	235 Peak	100 - 500	-	600 - 1000	Horizontally focused
Echosounders	235 Peak	Variable	Variable 1500 – 36 000	5 - 10	Vertically focused
ADDs / AHDs	132 – 200 Peak	5000 – 30 000	5000 – 30 000	Variable 15 – 500	Omni
Large vessels	180 – 190 rms	6 -> 30 000	> 200	CW	Omni
Small boats and ships	160 – 180 rms	20 -> 1000	> 1000	CW	Omni
Dredging	168 – 186 rms	30 -> 20 000	100 - 500	CW	Omni
Drilling	145 – 190 rms	10 – 10 000	< 100	CW	Omni
Wind turbine	142 rms	16 – 20 000	30 - 200	CW	Omni
Tidal and wave energy	165 – 175 rms	10 – 50 000	-	CW	Omni

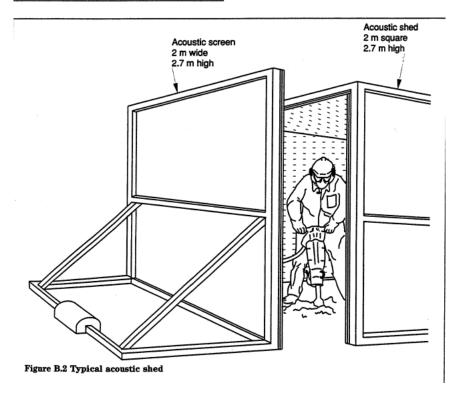
 $^{^{31}}$ OSPAR. (2009). Assessment of the environmental impact of underwater noise. OSPAR Commission



APPENDIX J MOBILE NOISE SCREENING/ENCLOSURE DESIGN

Source: BS 5228:1 1997

Type of enclosure (see figure B.3)	Reduction dB(A)				
	Facing the opening(s)	Sideways	Facing rear of shed		
Open-sided shed lined with absorbent material; no screen	1	9	14		
Open-sided shed lined with absorbent material; with reflecting screen in front	10	6	8		
Open-sided shed lined with absorbent material; with absorbent screen in front	10	10	10		





APPENDIX K PROJECT NOISE MANAGEMENT PLAN REQUIREMENTS

Annex E NZS 6803: 1999

E2 Noise management plan requirements:

- (a) Outline process of community liaison
- (b) Need for educating management and workers in maintaining community goodwill
- (c) Likely affected persons and special needs of those people or the public in general
- (d) Designating responsible public relations persons
- (e) The role of the local/regional authority
- (f) Complaints procedures
- (g) Establish likely noise emissions
- (h) Establish likely durations of exposure on a specific neighbourhood basis
- (i) Determine the need for any special construction activities, e.g. activities that must take place outside normal working hours
- (j) Consultation procedures for special works
- (k) The practicable noise control measures available
- (I) The applicable noise performance standards
- (m) Any resulting limits on hours of operation
- (n) Site screening and landscaping
- (o) Noise monitoring procedures
- (p) Education and training of workers in noise management

NB: Would be similar for vibration management