



Draft Groundwater and Settlement Monitoring & Contingency Plan

Whenuapai Conveyance - Package 1

Prepared for

Beca Limited

Prepared by

Tonkin & Taylor Ltd

Date

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Job Number

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Glossary

This glossary defines the specific meaning of certain words and phrases used in this report. Note that some words and phrases used in this report have different definitions and meanings in other literature.

Council	Auckland Council (AC).
Commencement of dewatering	Excavation/tunnelling below groundwater level and/or commencing taking any groundwater.
Completion of dewatering	When all excavation/tunnelling is completed, and ground openings are backfilled above the groundwater level.
Commencement of excavation	Excavations deeper than 1.5 m and greater than 1 m ³ in volume.
Completion of excavation	When all tunnelling and excavations have been completed, tunnel liner has been installed, and ground openings have been backfilled.
Completion of construction	Means when the Certificate of Completion is issued by AC.
Minor severity	Damage and defects that are typically localised in nature and their effects are typically of low significance and readily repairable (e.g. hairline cracks).
Moderate severity	Damage and defects that are typically spread over a larger area and/or may be of greater significance and impact upon serviceability (e.g. sticking doors and cracked window panes).
Severe	Damage and defects that are typically widespread in nature and/or their effects are typically of high significance (e.g. visible deformation and crack in structural elements).
Damage	Includes aesthetic, serviceability and severe damage.
Aesthetic damage	Superficial damage and defects that do not affect the use, integrity or serviceability of the item. In certain situations, aesthetic damage may develop into serviceability and/or structural damage. Aesthetic damage may include fine cracks easily treated during normal redecoration, cracks in exterior visible upon close inspection, etc.
Serviceability damage	Damage and defects that may impact the use, integrity or serviceability of the item but have not led to (nor are expected to immediately develop in) structural damage. Serviceability damage may include cracked windowpanes, uneven pavements, bowing and/or cupping decking boards, sticking windows and doors etc. Over time, serviceability damage may develop into structural damage.
Structural damage	Damage and defects that affect structural components of an item and have the potential to cause structural failure of the item. This may include bulging concrete block walls, detached structural members, decay in structural timber members, differential settlement in foundations resulting in reduced stability etc.
Alert Level	Monitoring reaches a level close to where damage may occur unless movement continues unchecked and requires review of available monitoring information (plus other information) to assess the future trend.
Alarm Level	Monitoring reaches a level where damage may occur and requires immediate action including the cessation of ground dewatering and other construction activities that may have an effect on ground deformation.
The Council	Auckland Council (Team Leader, Water Allocation, NRSI) or nominated AC staff acting on The Team Leader's behalf.

NRSI	Natural Resources and Specialist Input, Auckland Council.
RL	Reduced Level.
Services	Includes for example fibre optic cables, sanitary drainage, gas and water mains, power and telephone, road infrastructure assets such as footpaths, kerbs, catch-pits, pavements and street furniture.

1 Introduction

1.1 Background

Beca Limited (Beca) has been engaged by Watercare under the Consultancy Services Panel Framework Agreement, to undertake Feasibility, Design and Consenting for Whenuapai-Redhills Wastewater Service Scheme – Package 1. Tonkin & Taylor Ltd (T+T) has been engaged as a subconsultant to Beca to provide geotechnical service for this project.

As part of our service, we have been asked to prepare a Draft Groundwater and Settlement Monitoring and Contingency Plan (GSMCP) to support a Resource Consent application for the proposed Whenuapai-Redhills Wastewater Service Scheme – Package 1 (the project), in Whenuapai, Auckland (the site). Monitoring and settlement contour plans are shown in Appendix A.

The GSMCP is based on the following reports prepared for the project:

- Whenuapai-Redhills Wastewater Service Scheme – Package 1, Geotechnical Effects Report by T+T reference 1013050.v4 dated 25 August 2023.

This GSMCP is an adaptive plan that serves to establish a set of project controls to measure groundwater drawdown and ground settlements, and to address potential geotechnical effects related to the project works. The GSMCP also provides contingency and mitigation measures that may be applied should monitoring results indicate ground settlement and groundwater drawdown to be approaching or likely to exceed established alert and alarm limits.

This report should be reviewed once detailed design has been completed and construction methodologies have been confirmed to confirm that the recommendations of this report are still valid.

This report should be read in conjunction with the Whenuapai Wastewater Servicing Package 1: Wetland Monitoring and Reinstatement Plan prepared by Beca, October 2023.

1.2 Project overview and construction method

The Project aims to provide wastewater servicing capacity for approximately 10,240 dwellings, or 30,720 people, in the Whenuapai catchment. This growth is projected to occur by 2041. The Project includes the following five key components (see Figure 1.1):

- 1 A **Pump Station** at a point where the Whenuapai and Redhills Catchments meet at 23-27 Brigham Creek Road, with an emergency overflow outfall to Sinton Stream.
- 2 A **Gravity Main Pipeline** (approximately 700 m long and 375 – 475 mm in diameter) between Whenuapai Village Pump Station on Tamiro Road and the new pump station.
- 3 A **Rising Main** (approximately 1.4 km long and 500 mm in diameter) between the Pump Station and a proposed new break pressure chamber on Mamari Road (the boundary of Package 2)¹.
- 4 A **Culvert** (approximately 63 m long including wing wall and rip rap) to provide access for the rising main across Sinton Stream.
- 5 A **Break Pressure Chamber** which connects to the Massey Connector rising main (proposed under Package 2).

¹ An extension of the rising main is part of 'Package 2' and will be designed to connect to the planned Northern Interceptor Phase 2 tunnel and deliver flows from the Whenuapai Catchment to the Rosedale Wastewater Treatment Plant for treatment. Package 2 is subject to a separate consent application.

The Project extends from the existing Whenuapai Village pump station site in Tamiro Road in the north, across Brigham Creek Road, to Spedding Road in the south.

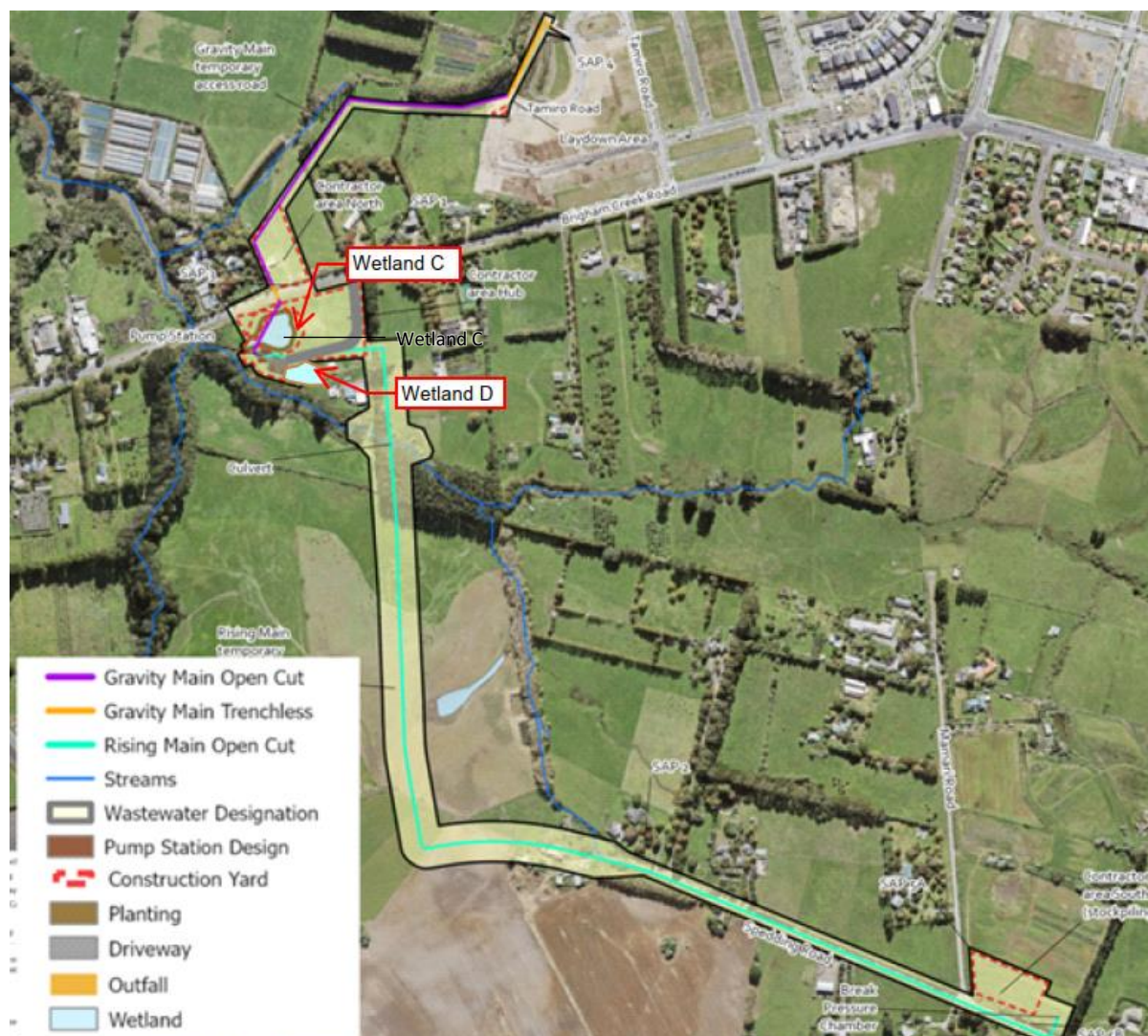


Figure 1.1: Package 1 – ‘the Project’ overview.

Section 1.2.1 through to section 1.2.3 provide further detail of the proposed infrastructure to be constructed.

1.2.1 Pump station at 23-27 Brigham Creek Road

A new wastewater pump station is proposed to be installed at 23-27 Brigham Creek Road. The pump station will comprise:

- 2 No. wet wells – approximately 8.65 m deep to invert which will require an excavated depth of approximately 9.5 m.
- 5 No. storage tanks – approximately 5.3 m depth to invert, which will require an excavated depth of approximately 6.0 m.

The construction methodology presented in the Beca Assessment of Effects on the Environment (October 2023) proposes that the pump station is to be constructed by open bulk excavation. To reduce groundwater seepage flows from the wetland into the excavation, temporary sheet piles acting as a partial seepage cut off wall will be installed around the southern boundary of the wetland

prior to commencement of excavation. The sheet piles are expected to be driven approximately 0.5 m to 1 m into the underlying rock (approximately 6 m below existing ground level) and clutched together.

Construction works will be staged for the inlet manhole, wet wells (pump station), storage tanks, and connecting pipes to limit the extent of excavation open at any given time and limit potential dewatering effects. Excavations for each component are to be carried out in two stages in which a wider, upper excavation is to extend through the soil layers, and a smaller excavation is to be carried out within and to the design depth through into the ECBF bedrock.

For the wet wells, each level of the excavation is to be supported by a double slide rail system to provide safe access, and limit ground deformations associated with mechanical and consolidation settlements. For the storage tanks, the upper excavation area will be battered at approximately 1V:2H, whilst the deeper excavation area will be supported by double slide rails.

Groundwater recharge is expected to be required across both Wetland C and Wetland D during construction to maintain suitable hydrological conditions for the wetland as outlined in the Wetland Monitoring and Reinstatement Plan.

1.2.2 Gravity main

A gravity main is proposed from the existing Whenuapai Village pump station to the pump station comprising:

- Approximately 715 m long 375 mm – 475 mm diameter gravity pipeline with an invert level ranging between approximately 2.4 and 5.5 m below ground level. The pipeline will commence at the existing Whenuapai Village pump station and extend through farmland between 20 and 28 Brigham Creek Road before crossing underneath Brigham Creek Road to terminate at the pump station.
- 11 No 1540 mm diameter manholes (SSMH-1 through SSMH-11).

The construction methodology proposes:

- Pipe hammering underneath Brigham Creek Road between chambers SSMH3 and SSMH4.
- Trenchless construction between SMH11 and SMH12.
- The remainder of the alignment will be installed by open cut method. Trenches shall be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days, and manhole structures no longer than 30 days.

Temporary support for excavations will be required. For the purposes of this assessment, we have considered the following excavation and seepage control methods:

- SMH11 – trench shields with no seepage controls.
- Brigham Creek Road Drive Shaft – sheet piles with lateral restraint.
- Brigham Creek Road Receiving Shaft – trench shields with no seepage control.

Open cut methods may be required where trenchless methods are proposed in case of an obstruction. If this is the case, the settlement results from the driving and receiving shafts can be adopted to predict the settlement that may arise between these two points if the pipeline shall be trenched.

1.2.3 Rising main

A rising main is proposed from the pump station to the break pressure tank at 32 Mamari Road comprising:

- Approximately 1492 m long 500 mm diameter riser pipeline with an invert level ranging between approximately 0.5 and 5.9 m below the existing ground level. The pipeline will commence at the pump station and extend along the future extension of Spedding Road, then Spedding Road, and terminate 32 Mamari Road.

The construction methodology proposes:

- That the full length of the rising main is to be installed by open cut method. The pipeline is intended to run underground for its full length except where it passes through a culvert at Sinton Creek. Trenches for the pipeline will be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days.
- To enable culvert construction at Sinton Creek, sheet piles shall be installed to provide ground support over a length of approximately 60 m for a duration of approximately 12 weeks.
- An air valve chamber and connection chamber are proposed at approximately chainage 155 and 235 respectively, north of Sinton Creek. The chambers will require excavations approximately 3.3 m and 2.4 m deep. The excavations are expected to take up to 4 weeks to construct and backfill.

2 Monitoring

2.1 General

Ground settlement and groundwater drawdown monitoring during the construction works will be undertaken to assess if the response of the surrounding structures is within design tolerances. This process allows for the geotechnical effects to be monitored and can act as an indication for mitigation or remedial measures to be implemented if required.

Monitoring and surveying of the following shall be undertaken during construction:

- Building, Culvert and Ground Settlement Monitoring Points via survey markers.
- Groundwater level monitoring via standpipe piezometers.

The monitoring results will be collected by the contractor prior to and during construction and collated by the Geotechnical Engineer for comparison with the specified Alert and Alarm trigger levels (refer to Section 2.2.3 of this Plan). Should any Alert or Alarm levels be breached, the response detailed in the sections below shall be implemented.

Monitoring records will be included in summary reports prepared by the Geotechnical Engineer and issued to AC every two months during the implementation of this GSMCP.

2.2 Building, culvert and ground settlement monitoring

2.2.1 General

Building, culvert and ground settlement monitoring marks shall be established at the approximate locations presented in the Ground settlement monitoring plan presented in Appendix A.

The philosophy of the monitoring programme is to monitor that actual settlements are less than the values that can be expected to result in the onset of minor severity damage to structures under worst-case assumptions.

The potential for the onset of minor damage under worst-case assumptions equates to the Alarm Trigger Level. This corresponds to the point at which remedial actions to prevent further settlement are enacted. Alarm Trigger Levels are presented in Section 2.2.3. Required actions are presented in Section 6.

Each monitoring point has an Alert Trigger Level which represents a settlement at 70% of the Alarm Trigger Level. These are defined in Section 2.2.3. The purpose of the Alert Trigger Level is to provide sufficient notice for additional monitoring and assessment of construction operations to be undertaken prior to the Alarm Trigger Level being reached. The Alert Trigger Level checks that adjacent structures will not suffer damage from either excavation or groundwater drawdown effects.

Building and Culvert Monitoring Points have been assigned to any structure that lies within the envelope of potential settlement effects adjacent to the pump station or pipe installation via open trench excavation. Buildings and culverts that are outside the calculated settlement envelope will not be directly monitored. Ground Monitoring Points will be utilised to assess ground movements within and immediately outside the calculated settlement envelope, particularly along Brigham Creek Road where multiple services are installed within the roadway corridor.

The Alert and Alarm settlement levels are uniform for all Building, Culvert Monitoring Points and Ground settlement monitoring points, as their purpose is to monitor that settlement of a magnitude sufficient to cause minor damage will not occur. A minimum of three Building monitoring points arranged in a triangular orientation and four Culvert monitoring points arranged in a rectangular orientation are proposed on each structure to monitor differential settlements as shown in Appendix A.

Ground Monitoring Points have been placed at approximately 30 m centres along and parallel to the road alignment. Ground Monitoring Points placed along the roadway are to provide settlement monitoring for underground services.

Vertical survey measurements shall be accurate to ± 2 mm vertically. It is noted that the settlement markers will be subject to landowner approval when placed on private property and may require re-locating.

2.2.2 Settlement monitoring intervals

Surveys shall be carried out by the Contractor or the contractor's approved surveyor at the intervals outlined in Table 2.1. Although no settlement effects can reasonably be expected to occur beyond 100 m from the work site, those points located at this distance or greater are to be surveyed once every 2 months as a means of assessing the magnitude of natural ground surface elevation fluctuations.

Table 2.1: Settlement monitoring interval summary

Phase	Monitoring frequency
Prior to excavation and dewatering	A minimum period of 3 months prior to commencement of dewatering.
During excavation/dewatering	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering.

	Monthly where: All monitoring markers within 100 m of excavations or dewatering.
After completion of excavation and dewatering	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated, and written confirmation is provided from AC to cease monitoring.

Monitoring frequency to be increased as advised by the Geotechnical Engineer at any monitoring point where the measured rate of settlement indicates that the alert or alarm level trigger may be approached prior to the next normally scheduled monitoring round.

2.2.3 Settlement trigger levels

Alert and Alarm Trigger Levels are summarised in Table 2.2. Monitoring data shall be compared with the trigger levels within 24 hours of recording. If an Alert or Alarm Trigger Level is breached, the actions identified in Section 6 of this GSMCP shall be undertaken.

Table 2.2: Building (B), Culvert (C) and Ground (G) settlement trigger levels

Monitoring item	Description	Settlement Alert level (mm)	Settlement Alarm level (mm)	Differential settlement Alert level	Differential settlement Alarm level
BS01-BS03, CS01-CS04	Building or Culvert monitoring point	7	10	1 in 750 between any two building or culvert settlement survey markers	1 in 500 between any two building or culvert settlement survey markers
GS01-GS10	Ground monitoring point	18	25	1 in 750 between any two ground settlement survey markers	1 in 500 between any two ground settlement survey markers

2.3 Groundwater monitoring

2.3.1 General

Groundwater levels shall be monitored at eight groundwater monitoring wells (standpipe piezometers) installed along the pipe alignment. Additional monitoring wells may be required during the course of the project if the proposed works is likely to destroy the groundwater monitoring well or if excavations change from the proposed locations.

Should any of the monitoring bores be damaged and become in-operable during construction works, then AC is to be informed and a new monitoring bore is to be drilled at an appropriate nearby location.

2.3.2 Groundwater monitoring intervals

Groundwater monitoring shall be carried out by the Contractor prior to, during and post construction at the intervals specified in Table 2.3. Groundwater monitoring wells are required to be operational prior to commencement of dewatering to establish the baseline readings summarised in the Table 2.3 below. If groundwater monitoring wells are within the excavation footprint and shall be damaged, the wells shall be re-established outside the excavation footprint.

Table 2.3: Groundwater monitoring interval summary

Phase	Monitoring frequency
Prior to dewatering	Monthly for a minimum period of 3 months prior to commencement of dewatering.
During excavation/dewatering	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: - All monitoring markers within 100 m of excavations or dewatering.
After completion of excavation/dewatering	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated, and written approval is granted from AC to cease monitoring.

Monitoring frequency to be increased as advised by the Geotechnical Engineer at any monitoring point where the measured water level indicates that the alert or alarm trigger level may be approached prior to the next normally scheduled monitoring round.

Monitoring frequency may be reduced if stable measurements are observed, and written confirmation is provided by AC.

2.3.3 Groundwater trigger levels

Monitoring data shall be compared with the design assumptions and baseline readings. The baseline reading shall be taken as the summer low groundwater level (GWL) where possible and recorded before the commencement of construction. Preliminary Alert and Alarm levels prior to establishing baseline readings are summarised in Table 2.4. If the Alert or Alarm levels are reached, the actions outlined in Section 6 shall be carried out.

The trigger levels set for BH-WL1, BH-WL2 and BH117 are proposed to be preliminary thresholds and be adaptive to respond to the adaptive Wetland Management Plan.

Table 2.4: Groundwater drawdown trigger levels

Monitoring item	Description	Alert level for drawdown below summer low GWL (m)	Alarm level for drawdown below summer low GWL (m)
BH05 (A&B)	Groundwater monitoring wells – Standpipe piezometers.	1.0	1.5
BH-WL1, BH-WL2, BH117	Groundwater monitoring wells – Standpipe piezometers.	0.2 (preliminary - to be adapted based on the Wetland Management Plan).	0.3 (preliminary - to be adapted based on the Wetland Management Plan).
BH113, BH116	Groundwater monitoring wells – Standpipe piezometers.	1.0	1.5

Monitoring item	Description	Alert level for drawdown below summer low GWL (m)	Alarm level for drawdown below summer low GWL (m)
BH-WL3	Groundwater monitoring wells – Standpipe piezometers.	0.5	0.8

3 Pre and Post construction condition survey

A pre-construction condition survey of the property listed in Table 3.1 shall be carried out a maximum of 3 months prior to the commencement of construction and/or dewatering (whichever occurs first). An external survey should be undertaken as a minimum.

Table 3.1: Summary of property to be surveyed

Building Address	Legal Title	Building Type
18 Brigham Creek Road	LOT 2 DP 89629	Residential

The survey report shall confirm the existing condition of this property (including dwelling, garage and sheds where applicable). Major features of the buildings and site developments shall be recorded including location, type of construction, age and present conditions including defects.

The survey shall include, but not limited to the following:

- Type of foundations (where observable or otherwise inferred).
- Condition of existing asset including existing level of damage.
- Susceptibility of structure to further movement and damage.
- Review of proposed Alert and Alarm levels to confirm they are appropriately set based on the building type and condition.
- Photographic evidence of (1), (2), and (3) above.

During construction, visual external observations of the structure and surrounding ground of the assets identified in the pre-construction property survey shall be performed on a fortnightly basis where properties are within 25 m of active works.

Within six months of completion of construction, a post-construction survey covering the items detailed above shall be completed for any building that had a pre-construction survey carried out. The survey report shall include a determination of the cause of damage identified (if any) since the pre-construction or previous survey and steps to repair it.

A copy of the pre and post-construction survey reports shall be forwarded to AC within 15 working days of completing the reports. Reports should be reviewed and signed by a Chartered Professional Engineer who has certified that the survey has been completed in a professional manner and is an accurate assessment of the condition of the buildings concerned.

4 Summary of monitoring frequency

The monitoring frequency requirements detailed in the previous sections are summarised in Table 4-1 below.

Table 4-1: Summary of monitoring frequency requirements

Monitoring system	Monitoring Locations	Prior to commencement of excavation and dewatering	During excavation and dewatering	After completion of excavation and dewatering	After completion of construction
Settlement monitoring points	BS01-BS03, CS01-CS04, GS01-GS10	A minimum of 3 months prior to excavation and dewatering to establish baseline levels.	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: - All monitoring markers within 100 m of excavations or dewatering.	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated and written confirmation is provided from AC to cease monitoring.	Post-construction condition survey of 18 Brigham Creek Road
Standpipe piezometers	BH05A, BH05B, BH-WL1, BH-WL2, BH-WL3, BH113, BH116, BH117	Monthly for a minimum period of 3 months prior to commencement of dewatering.	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: - All monitoring markers within 100 m of excavations or dewatering.	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated and written confirmation is provided from AC to cease monitoring.	N/A

5 Reporting of monitoring records

5.1 Baseline readings

Baseline readings for building, culvert and ground deformation shall be established before the commencement of dewatering and excavation.

These baseline readings shall be compiled and submitted to AC's representative prior to commencement of dewatering.

Groundwater monitoring shall be undertaken monthly throughout the summer period when possible for a minimum period of 3 months prior to dewatering. The lowest recorded groundwater level during monitoring season will be taken as the baseline level.

All monitoring results shall be submitted to AC and written confirmation provided that all pre-construction monitoring has been completed prior to beginning works.

5.2 Reporting intervals and requirements

All monitoring records as detailed in this report shall be compiled and submitted to AC's representative at 2 month intervals from the commencement of construction until three months after the completion of excavation and dewatering (or at such time following the completion of excavation that stable measurements are demonstrated and written confirmation is provided from AC).

Each report shall include the following:

- Monitoring records presented in a tabulated format as well as on a timeline plot with rainfall data.
- Comparison of monitoring data with trigger levels.
- Previous results set out with an explanation of any trends.
- A construction progress summary.
- Results of fortnightly visual observations of the structure and surrounding ground of the assets identified in the relevant pre-construction property survey.
- Any other information relevant to the reporting period (i.e. exceedance of trigger levels and contingency measures being undertaken).

6 Alert and Alarm trigger level response procedures

6.1 Response procedure if the Alert trigger levels are exceeded

If any of the monitoring Alert trigger levels are reached, then one or more of the contingency options described in Section 7 of this plan shall be carried out together with the following:

- Notify the Project Manager.
- Notify AC, in writing within one working day of the trigger level being exceeded, with details of any actions being undertaken.
- Survey all survey monitoring marks within 25 m of the affected monitoring marks to confirm the extent of deformation and exceedance of the Alert trigger.
- Review the monitoring data, as-built details and geology, and compare against the assumptions made in the design analyses.

- Submit a written report by a Suitably Qualified Engineering Professional to AC for approval, within one week of trigger level exceedance, which provides analyses of all monitoring data relating to the exceedance of any of the trigger levels and any recommendations for remedial actions and time frames for implementing these actions.
- If considered necessary:
 - Increase monitoring frequency.
 - Develop a detailed contingency plan and submit to AC.

6.2 Response procedure if the Alarm trigger are exceeded

If the monitoring Alarm trigger levels are reached for any building, culvert or ground then the following shall be carried out for the different works in addition to the actions outlined in Section 7:

- Cease further excavation or any other activity such as dewatering which has the potential to cause further deformations. Dewatering will not cease where this may result in the potential loss of ground instability in an excavation.
- Submit a written report by a Chartered Professional Engineer to AC for approval, within one week of Alarm trigger level exceedance, which provides analyses of all monitoring data and any recommendations for remedial action.
- Once approved by AC the recommendations shall be implemented.

Dewatering and/or construction may be resumed once AC's representative provides written notice to the Contractor that AC's representative is satisfied that damage to buildings, structures and services is unlikely with or without any approved additional mitigation measures to be undertaken and that AC is satisfied that owners of potentially affected buildings, structures and services have given written approval for construction to continue.

7 Contingency options

7.1 General

If any of the monitoring trigger levels are exceeded the general response will be as detailed in Section 6. Specific actions will be selected depending on the exact nature of the problem. Possible contingency actions are detailed in the following sections.

7.2 Building, culvert and ground, and deformation contingency measures

In the event of building, culvert or ground deformation exceeding the monitoring trigger levels, one or more of the following actions shall be taken:

- Review pre-construction condition surveys of the affected buildings or culverts, followed up by discussions on the situation with the property/service owner that may be affected.
- If deformations are due to groundwater drawdown, groundwater injection may commence.
- Monitor the rate of settlement (assuming that other steps have been undertaken to address the cause).
- Check public safety is maintained.

7.3 Underground service settlement contingency measures

Contingency measures for the settlement of underground services shall be established with the asset owner.

8 Monitoring and contingency plan review

The GSCMP shall be reviewed as required during construction to reflect on any changes that relate to implementation of the GSCMP. Reviews shall take into consideration the following:

- Changes in ground conditions and or site conditions.
- Changes in existing structures.
- Changes in analysis, design or construction methods.
- Changes in legal requirements, consent conditions, guidance notes, industry best practices standards, etc.
- Unresolved comments and/or complaints and responses to the complaints and remedial action (if taken) to the address.

9 **Applicability**

This report has been prepared for the exclusive use of our client Beca Limited , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

Report Reviewed by:

.....

Kishan Ranchhod
Geotechnical Engineer

.....

Eduard Mandru
Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:

.....

Tim Coote
Project Director

20-Oct-23
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package 1 draft gsmcp 20231020 v3.docx

Appendix A Monitoring Plans

LEGEND

EXISTING

- W — W — WATER NETWORKS
- SS — SS — WASTEWATER NETWORKS
- SW — SW — STORMWATER
- G — G — GAS
- E(OH) — E(OH) — OVERHEAD POWER CABLES
- T — T — TELECOMMUNICATION
- FO — FO — TELECOM FIBRE OPTIC
- — — — — PROPERTY BOUNDARY
- // — // — FENCE
- — — — — OVERLAND FLOW PATH
- 100-YEAR FLOOD PLAIN

PROPOSED

- WW — WW — WASTEWATER GRAVITY
- SSMH — SSMH — WASTEWATER MANHOLE

Settlement Contours:

- Approx 5mm settlement contour line
- Approx 10mm settlement contour line
- Approx 15mm settlement contour line
- Approx 20mm settlement contour line
- Approx 5mm settlement contour line if open trench method adopted

Note: settlement contours of greater than 5mm have not been displayed where there are no structures

Map Annotations:

- EXISTING SSMH 2696093
- EXISTING WHENUAPAI VILLAGE PUMP STATION
- EXISTING SSMH 2695930
- SSMH-11 1540mmØ
- SSMH-10 1540mmØ
- SSMH-9 1540mmØ
- SSMH-8 1540mmØ
- SSMH-7 1540mmØ
- SSMH-6 1540mmØ
- SSMH-5 1540mmØ
- SSMH-4 1540mmØ
- SSMH-3 1540mmØ
- SSMH-2 1540mmØ
- SSMH-1 1540mmØ
- PROPOSED 375mmØ WASTEWATER GRAVITY MAIN (SSMH-4 TO EXISTING SSMH 2696093)
- PROPOSED 475mmØ WASTEWATER GRAVITY MAIN (SSMH-1 TO SSMH-4)
- 20 Brigham Creek Road to be occupied by WSL and used as laydown
- 18 Brigham Creek Road
- Pipe hammer construction method proposed between SSMH-3 and SSMH-4
- Wetland C
- Wetland D
- PROPOSED INTERIM PUMP STATION
- sheet pile partial seepage cut-off wall
- water recharge to be applied across Wetland C & D (blue hatch) to maintain hydrological conditions and in accordance with the Wetland Management Plan
- Trenchless construction proposed between SSMH-11 and Existing SSMH 2696093

DETAILED DESIGN
NOT FOR CONSTRUCTION

				DESIGNED	PH	12-21	 Watercare COPYRIGHT - This drawing, the design concept, remain the exclusive property of Watercare Services Limited and may not be used without approval. Copyright reserved.	WHENUAPAI-REDHILLS WASTEWATER SERVICING BRIGHAM CREEK ROAD, WHENUAPAI INTERIM SLAUGHTERHOUSE PS - WASTEWATER GRAVITY MAIN - GENERAL LAYOUT	 	CAD FILE	R0017910.002	DATE	10-12-21
			DES. APPROVED	SW	12-21	ORIGINAL SCALE				A3 1:2000	CONTRACT No.	6484-6934	
3	12-21	ISSUED FOR DETAILED DESIGN	J.C.	DRAWN	JC	12-21				REF No.	12508391 3-AWD32		
2	8-21	RE-ISSUED FOR PRELIMINARY DESIGN	J.C.	DWG. APPROVED	DJ	12-21				DWG No.	R0017910.004	ISSUE	3
1	5-21	ISSUED FOR PRELIMINARY DESIGN	J.C.	WSL DESIGN MGMT.									
ISSUE	DATE	AMENDMENT	BY	APPD.	BY	DATE							
				WSL PROJ. LEAD									



NOTE:

1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <<https://data.linz.govt.nz/layer/95497-auckland-0075m-urban-aerial-photos-2017/>> , LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 17/12/2020.
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PR C No. 1014985

D	N	D	CBM	Dec.20
DRA	N	JC		Dec.20
C	C	D	CBM	Dec.20

APPR D DA

C N **WATERCARE SERVICES LIMITED**
PR C **WHENUAPAI AND REDHILLS WASTEWATER SCHEME**

GEOTECHNICAL INVESTIGATION
SITE INVESTIGATION PLAN

CA A 1:7500 No. FIGURE 1

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