REPORT

Tonkin+Taylor

MILLWATER SUBDIVISION - ARRANS HILL PRECINCT 5 STAGE 1

Geotechnical Completion Report

Prepared for
WFH Properties Ltd
Prepared by
Tonkin & Taylor Ltd
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Table of contents

Executive summary

Tonkin + Taylor Ltd (T+T) was engaged by WFH Properties Ltd to monitor and provide earthworks certification for the 48 No. Residential Lots contained within Stage 1 of Arrans Hill Precinct 5 at the Millwater Subdivision in Silverdale. Stage 1 comprises Residential Lots 1 to 36 and 143 to 154, Wetland Reserve Lot 804, Joint Owned Access Lane Lot 600, and Road Lot 900 (parts of Roads 1, 2, 3, and 4 within Stage 1) inclusive as shown on the Woods Final Contour As–Built Plans (Woods Ref 37501–01–100–AB to 102–AB) in Appendix A1.

This Geotechnical Completion Report contains information required for subdivisional earthworks completion reporting, as well as outlining geotechnical design issues that need to be considered for subsequent building design and construction on each residential Lot.

Previous geotechnical investigation work across the subdivision was undertaken by T+T and reported in:

a 2000 and 2001 Preliminary feasibility reporting (Ref. [1] and [2]).

b 2003 Major reconnaissance report covering land in the Silverdale North and Orewa West areas (Ref. [3]).

c March 2013 Geotechnical Investigation Report for the North Bridge to Grand Drive (Ref. [4]).

d December 2015 Geotechnical Investigation Report for Arrans Hill Precinct 5 (Ref. [5]).

Woods Ltd (Woods) undertook the engineering design for this stage and the overall subdivision.

Bulk earthworks associated with development of Stage 1 of Arrans Hill Precinct 5 commenced in November 2015 and were completed by October 2017. Earthworks comprised the following:

a Stripping of vegetation, organic materials and topsoil to stockpile.

b Installation of subsoil drains.

c Cut to fill earthworks across the entire Stage 1 area as shown on the Woods Cut & Fill As–Built Plans (Woods Ref 37501–01–110–AB to 112–AB) in Appendix A1.

d Construction of 1 No. Shear Key (SK01) as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

e Construction of 3 No. geogrid reinforced segmental block walls (i.e. Allan Block Wall 1 and Screen Block Walls 2 and 5) as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

f Construction of a 5m high, 1 in 2 (V:H) engineered fill batter slope (RE 1) immediately above Wall 1 across Residential Lots 3 to 31 as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

g Construction of a 9m high, 1 in 1.5 (V:H) engineered fill batter slope (part of RE 7) along the northern boundary of Residential Lots 32 to 36 (immediately above Wall 5 across Residential Lots 34 to 35) as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

Civil earthworks commenced on site in October 2017 and were completed by May 2018, and comprised the following:

a Minor cut to fill earthworks across parts of the site as part of final Lot development.

b Construction of a 8m high, 1 in 2 (V:H) engineered fill batter slope (RE 6) along the western boundary of Residential Lots 143 to 153 as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

c Construction of 1 No. geogrid reinforced segmental block wall (i.e. Allan Block Wall 7) as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

d Construction of 2 No. gabion basket retaining walls (i.e. Wetland Gabion Walls 1 and 2) as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

e Installation of roading and services.

Overall subdivisional soil types are moderately expansive (Class M), based on laboratory testing undertaken in accordance with AS 2870:2011 (Ref. [7]). Due to this classification, soils lie outside the definition of good ground within NZS 3604:2011 (Ref. [8]). Building foundations will require either specific foundation design for expansive soils or foundation design in accordance with AS 2870:2011 (Ref. [7]). Subject to design issues outlined in Section 3, and CSIRO recommendations outlined in the Appendices relating to expansive soils foundation design and home owner maintenance, each residential Lot is considered to have a building platform area generally suitable for domestic residential development subject to specific geotechnical assessment and foundation design due to the presence of expansive soils and where Lots contain, or are adjacent to, land with slopes steeper than 1 in 4 (V:H).

Foundation design for residential development should proceed in accordance with Sections 6.5 to 6.10 of this report.

1 Introduction

1.1 General

Tonkin + Taylor Ltd (T+T) was engaged by WFH Properties Ltd to monitor and provide earthworks certification for the 48 No. Residential Lots contained within Stage 1 of Arrans Hill Precinct 5 at the Millwater Subdivision in Silverdale. Stage 1 comprises Residential Lots 1 to 36 and 143 to 154, Wetland Reserve Lot 804, Joint Owned Access Lane Lot 600, and Road Lot 900 (parts of Roads 1, 2, 3, and 4 within Stage 1) inclusive as shown on the Woods Final Contour As–Built Plans (Woods Ref 37501–01–100–AB to 102–AB) in Appendix A1.

Previous geotechnical investigation work across the subdivision was undertaken by T+T and reported in:

a 2000 and 2001 Preliminary feasibility reporting (Ref. [1], [2]).

b 2003 Major reconnaissance report covering land in the Silverdale North and Orewa West areas (Ref. [3]).

c March 2013 Geotechnical Investigation Report for the North Bridge to Grand Drive (Ref. [4]).

d December 2015 Geotechnical Investigation Report for Arrans Hill Precinct 5 (Ref. [5]).

The preliminary (Ref. [1], [2]) and investigation (Ref. [3], [4], [5]) reports noted the presence of existing instability comprising landsliding, soil creep and shallow slope movement across much of Arrans Hill Precinct 5. These features were proposed to be stabilised, and/or undercut and replaced with engineered fill, during development works. Stability analyses further indicated that shear keys and geotechnical remediation works were also required to achieve satisfactory factors of safety against instability for the finished development of Stage 1.

Earthworks compaction control, in terms of minimum shear strengths and maximum air voids, was recommended, and, along with other recommendations, has been incorporated into our control of the works and, where applicable, included in completion reporting.

The scope of work covered by this completion report includes:

a Review of geotechnical investigation reporting for the site;

b Monitoring and certification of earthworks operations in compliance with NZS 4431:1989 (Ref. [6]), including construction of 3 No. reinforced earth slope (RE 1, RE 6 and part of RE 7);

c Monitoring and certification of construction of 4 No. geogrid reinforced segmental block (Screen Block and Allan Block) walls (Wall 1, Wall 2, Wall 5 and Wall 7);

d Monitoring and certification of construction of 2 No. Gabion retaining walls within the Wetland Reserve (Lot 804 - Wetland Walls 1 and 2);

e Assessment of soils for expansive conditions in accordance with AS 2870:2011 (Ref. [7]);

f Certification of completed Lots for residential development in accordance with NZS 3604:2011 (Ref. [8]).

Woods Ltd (Woods) undertook subdivision engineering design and civil works construction observations. As-built plans showing final contours and cut and fill depths have been prepared by Woods and are attached in Appendix A1.

1.2 Description of Subdivision

The Millwater subdivision is situated to the north of the Silverdale Township, and west of the Metro Park East reserve area, and comprises approximately 260 hectares. The subdivision is bound to the south and west by Wainui Road, to the north by the Orewa Estuary and to the east by the Orewa

Estuary and Millwater Parkway. The original site comprised a mix of farm properties and associated dwellings and existing residential developments.

The Arrans Hill Precinct 5, Stage 1 area of the Millwater subdivision is located within what is known as Precinct 5 in the Orewa West Structure Plan.

The Arrans Hill Precinct 5 area is bound by State Highway 1 to the west, Grand Drive to the north, Arran Drive to the east, and the Orewa estuary to the south. The overall Arrans Hill Precinct 5 and Stage 1 areas are shown on T+T Drawing 21854.0031–AHP5S1–100 in Appendix A2.

Pre-development gradients within the Stage 1 area were gentle to moderately steep (1 in 3, to 1 in 15 (V:H)) with an overall fall to the northeast.

Post-development gradients within the Stage 1 area generally remain gentle to moderately steep (1 in 3, to 1 in 15 (V:H)) and fall to the south, east and north. In order to form more level building platforms, steep reinforced earth slopes of between 1 in 2 and 1 in 1.5 (V:H) and geogrid reinforced segmental block (Screen Block and Allan Block) walls have been constructed as shown on T+T Drawing 21854.0031–AHP5S1–101. In addition, Gabion basket retaining walls have been constructed around the wetland outlet in the south eastern corner of Precinct 5 Stage 1.

Stage 1 is presently accessed from the existing Arran Drive.

1.3 Geological Setting

Published geological mapping and information indicates the Arrans Hill Precinct 5 area is underlain by East Coast Bays Formation (ECBF) materials. In addition to the ECBF materials, our investigations identified the presence of alluvial and colluvial materials on site along the stream margins.

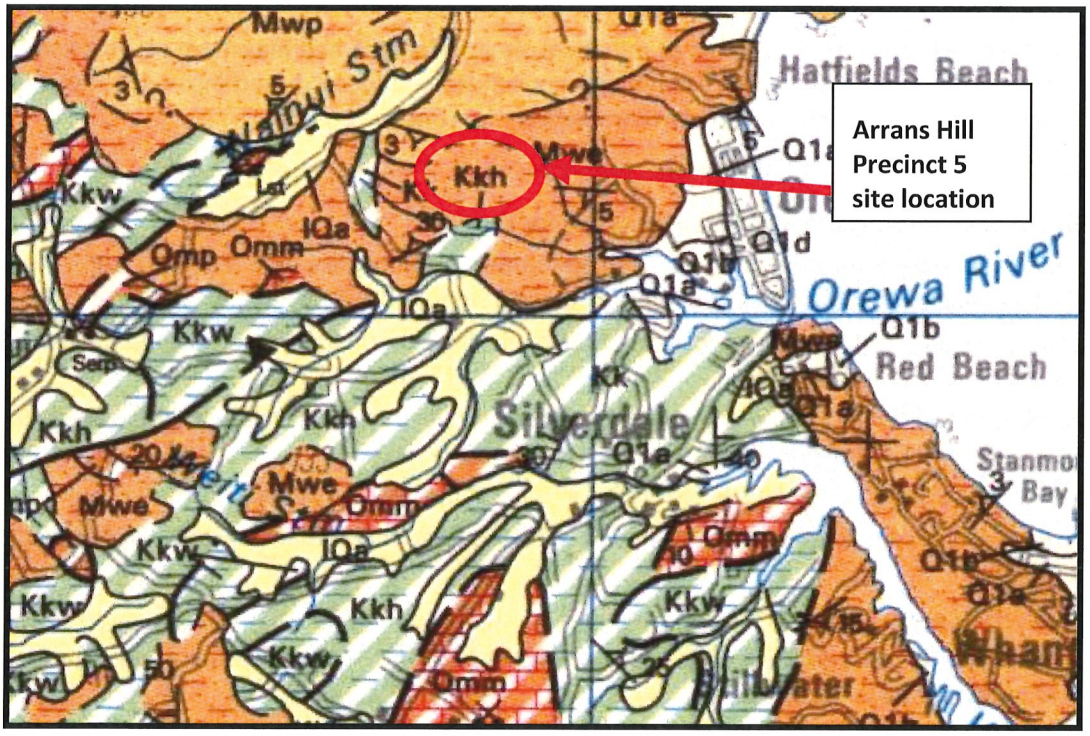


Figure 1 - Local Geology (from Edbrooke)

Summary descriptions of geological units in the Arrans Point area (after Kermode 1991) are as follows:

a East Coast Bays Formation

Alternating sandstone and mudstone with variable volcanic content (volcanic-poor lower in the sequence and mixed volcanic content higher) and interbedded volcaniclastic grit beds. These material typically show a well-developed weathering profile of clay, silt or sand depending on the parent lithology.

b Pleistocene Age Alluvium and Colluvium

Alluvium and Colluvium are generally observed on the lower slopes, along the edges of the tidal tributaries of the Orewa River - along the southern and eastern boundary of the site. In places, it is locally discontinuous or absent.

The alluvial deposits are typically very thinly to very thickly bedded, yellow-grey to orange-brown, angular to well rounded, mixed sizes (usually graded, coarse becoming fine upwards) of mud, sand and gravel, comprising rock fragments and weathered rock residue from the hinterland. They include some beds of black, humus-rich clay and white, pumice silt.

Colluvium closely resembles the undisturbed residual soil materials, comprising a mix of clayey silts and silts, but is often of lesser strength due to the deformation and disturbance that has occurred during transportation down-slope.

Geological cross-sections through the Arrans Hill Precinct 5 Stage 1 area, based on site investigations and observations during construction, are enclosed as Drawing Number 21854.0031–AHP5S1–103 to –110 in Appendix A2.

Fill material placed across the site to form the final design profile typically comprised site-won East Coast Bays Formation materials.

2 Earthworks Operations

2.1 Plant

Bulk earthworks and civil works were undertaken by Hick Bros Civil Construction Ltd (Hicks). Various areas of soft and/or wet materials were encountered during the works and were undercut and replaced with engineered fill. Much of this undercut material was considered suitable for re-use as engineered fill if conditioned appropriately. Accordingly, mixing of the cohesive fill materials with lime/cement to facilitate fill placement and compaction was undertaken by Hiway Stabilizers Ltd (Hiway) under Hicks' control. Construction of the retaining walls was undertaken by ICB Retaining and Construction Ltd (ICB), also under Hicks' control.

Various earthworks equipment was used to undertake the works, comprising motor scrapers, articulated dump trucks, tractors and discs, sheepsfoot compactors, padfoot rollers, and a number of 12 to 35 tonne excavators. This plant generally carried out all construction earthworks.

Specialist contractors and plant were brought on site for pavement construction. Certification of the pavement construction is beyond the scope of this report.

2.2 Construction Programme

Subdivisional earthworks commenced from November 2015 through to October 2017 under Hicks' control. Civil earthworks and construction for the residential Lots were also under Hicks' control and were undertaken progressively from October 2017 through to completion in May 2018.

Key Stage 1 earthworks components included:

a Stripping of vegetation, organic materials and topsoil to stockpile.

b Installation of subsoil drains.

c Cut to fill earthworks across the entire Stage 1 area as shown on the Woods Cut & Fill As–Built Plans (Woods Ref 37501–01–110–AB to 112–AB) in Appendix A1.

d Construction of 1 No. Shear Key (SK01), 3 No. geogrid reinforced segmental block walls (i.e. Allan Block Wall 1, and Screen Block Walls 2 and 5) and 2 No. reinforced earth slopes (i.e. RE 1 and part of RE 7), as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

Key Stage 1 civil works components included:

a Minor cut to fill earthworks across parts of the site as part of final Lot development.

b Construction of 1 No. reinforced earth slope (i.e. RE 6), 1 No. geogrid reinforced segmental block wall (i.e. Allan Block Wall 7) and 2 No. Gabion basket retaining walls, as shown on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

c Installation of roading and services.

The earthworks, retaining walls, shear keys, undercuts and subsoil drainage as–built plans are included in Appendix A1 (Woods Drawings 37501–01–100–AB to 102–AB, 110–AB to 112–AB, 120–AB to 122–AB and 130–AB to 134–AB), and show the earthworks undertaken across the site.

2.3 Compaction Control

Compaction control criteria, consisting of maximum allowable air voids and minimum allowable shear strengths, were used for cohesive fill control. The Technical Specification included in our Geotechnical Investigation Report (Ref. [4],[5]) included the following requirement for the subdivisional earthworks:

Minimum Shear Strength and Maximum Air Voids Method

Minimum Undrained Shear Strength (Measured by insitu vane – IANZ calibrated)

General fills:

Average value not less than	140 kPa
Minimum single value	110 kPa

High Strength Structural fills (Shear Key, Undercuts & Reinforced Earth Fill Slopes):

Average value not less than	150 kPa
Minimum single value	120 kPa

Maximum Air Voids Percentage (as defined in NZS 4402:1986)

General fills:

Average value not more than	10%
Maximum single value	12%

High Strength Structural fills (Shear Key, Undercuts & Reinforced Earth Fill Slopes):

Average value not more than	8%
Maximum single value	10%

The average corrected shear strength value was determined over any ten consecutive tests.

Compaction control criteria consisting of minimum allowable Clegg Impact Values and minimum allowable in-situ dry density were used for cohesionless fill control. The Technical Specification included in our Geotechnical Investigation Report (Ref. [4],[5]) included the following requirement for the subdivisional earthworks (and in particular during construction of Walls 3 and 9):

Minimum Clegg Impact Value and Minimum In Situ Dry Density Method

Minimum Clegg Impact Value (Measured by Clegg Impact Hammer – IANZ calibrated)

General fills:

Average value not less than	20
Minimum single value	18

Minimum In-Situ Dry Density Percentage (as defined in NZS 4402:1986)

General fills:

Average value not less than	95%
Minimum single value	90%

The average Clegg Impact value was determined over any ten consecutive tests.

Regular in situ density, strength and water content tests were carried out on the filling at, or in excess of, the frequency recommended by NZS 4431:1989 (Ref. [6]). Test results are contained in Appendix E.

Quality Control (QC) testing showed that the results for the filling were consistently meeting the required undrained shear strength, density and air voids criteria, demonstrating that the water content of placed fill was consistently at, or close to, optimum. To the best of our knowledge, any problems encountered were rectified, where required, by close monitoring of the selection of borrow materials, discing and remixing of the available soil types and minor reworking.

3 Geotechnical Development Works

3.1 Subsoil Drainage

A network of subsoil drains has been installed across Arrans Hill Precinct 5 during bulk earthworks as part of the shear key, reinforced earth slopes and geogrid reinforced segmental block walls construction.

The subsoil drains installed within the shear key and reinforced earth slopes were excavated into the underlying soil and rock to intercept groundwater and springs, and are as detailed in Sections 3.2 and 3.4.

Subsoil drains installed as part of the geogrid reinforced segmental block walls construction comprised the following:

a 160mm diameter, Hiway grade, perforated Nexus pipes along the backface of the wall and base of the rear of the reinforced soil block.

b SAP50 scoria over the top of the Nexus pipe and up the back face of the reinforced soil block, to within 1m of the ground surface (at time of construction).

c Bidim A19 geotextile filter-cloth over the top of the scoria prior to placement of the reinforced soil.

The retaining wall drains were connected to the reticulated stormwater system (Walls 1 and 7), discharge directly into the wetland (Wall 2), or via an outlet to the existing stormwater culvert below Grand Drive (wall 5), as shown on the Woods Shear Key, Undercut and Subsoil Drain As–Built Plans (Woods Ref 37501–01–120 to –122–AB) and the Retaining Wall As–Built Plans (Woods Ref 37501–01–130–AB to 134–AB) in Appendix A1, and on T+T Drawing 21854.0031–AHP5S1–101 in Appendix A2.

3.2 Shear Key

Based on stability analyses undertaken as part of the investigation reporting, shear keys were identified as being required across Arrans Hill Precinct 5 to provide satisfactory factors of safety against instability for the finished development of Stage 1.

1 No. Shear Key (i.e. SK01) was excavated within Stage 1 during the bulk earthworks in the location shown on the T+T Drawing 21854.0031–AHP5S1–101, included in Appendix A2. Excavation for the Shear Key was inspected and mapped by an Engineering Geologist to check that the key base had been extended sufficiently into the competent underlying ECBF rock materials, and that there were no apparent adverse structural features or lower strength materials exposed within the base and sides of the excavation. Any areas of suspect ground, including areas of identified land-slippage, were removed under the instruction of our site Engineering Geologist and replaced with well compacted engineered fill, placed in accordance with the bulk earthworks specification (Section 2.3 above).

The shear key long–section for SK01 was developed based on the mapping undertaken and is included in Appendix A2 (T+T Drawings 21854.0031–AHP5S1–128 and –129). This long–section shows the materials exposed within the side of the shear key excavation and relevant geological structural information mapped during our inspections.

Following completion of the shear key excavation, drainage blankets were placed along the rear face of the key, and comprised the following:

a 160mm diameter perforated Hiway grade Nexus drain pipe: This was run along the base of the rear of the excavation and discharges into the Orewa estuary in several locations (as per the Woods As–Built plans 37501–01–120–AB to 122–AB). Additional Novaflo pipes were also

installed along mid-height benches where appropriate and connected into the key drainage outlet system.

b SAP50 scoria: A minimum 300mm thick layer of SAP 50 was placed across the entire rear face, and extended to within 2m of the top of the key. It should be noted that the top of the key at this stage generally coincided with the original ground surface.

c Bidim A19 geotextile filtercloth: This was placed over the surface of the SAP 50 scoria to prevent contamination of the drainage aggregate with overlying bulk earthworks materials.

The rear face drainage blanket was extended up to at least 1 metre above the soil / rock interface to intercept perched groundwater flows which typically flows along this interface.

Ground conditions exposed during shear key construction were generally as anticipated from the design stage of the development. The slope stability analysis results from the original design phase are discussed in Section 4.

3.3 Geogrid Reinforced Segmental Block Retaining Walls

4 No. geogrid reinforced segmental block walls (i.e. Allan Block Walls 1 and 7, and Screen Block Walls 2 and 5) were constructed within Stage 1.

Walls 1, 2 and 5 were constructed during the bulk earthworks period, while Wall 7 was constructed during the civil works period. RE 1 and a section of RE 7 (discussed in Section 3.4) were constructed immediately above Wall 1 and Wall 5, respectively.

The Screen Block retaining walls comprise uniaxial High Density Polyethylene (HDPE) geogrids placed at a maximum of 1.0m (vertical) intervals within the well compacted engineered fill (i.e. hardfill and cohesive fill), placed in accordance with the bulk earthworks specification (Section 2.3 above). The grids for Wall 2 extend up to within 0.5m of the ground surface. The grids for Wall 5 extend up to the toe of RE 7 immediately above.

The Allan Block retaining walls comprise uniaxial High Density Polyethylene (HDPE) geogrids placed at a maximum of 0.4m (vertical) intervals within the well compacted engineered fill (i.e. hardfill and cohesive fill), placed in accordance with the bulk earthworks specification (Section 2.3 above). The grids for Wall 1 extend up to the toe of RE 1 immediately above. The grids for Wall 7 extend up to within 0.3m of the ground surface. For the section of wall retaining less than 1m, the reinforced block is backfilled with no fines concrete (i.e. no geogrid reinforcement).

The walls have been designed to accommodate a maximum 10kPa surcharge, or construction of the reinforced earth slope discussed in Section 3.4 where present immediately above, although development immediately behind/above the wall is likely to be precluded by Council planning rules.

Construction of the Screen Block retaining walls comprised the following:

a placement and compaction of fill to the required levels;

b placement of the Screen Block units, including starter sections of geogrids cast into the blocks at the appropriate levels;

c placement of the geogrid and connection to the starter sections using a "Bodkin" joint, ensuring that the grid is held tightly in place;

d spreading of fill across the surface of the geogrid with lightweight plant;

e compaction and placement of further fill up to the level of the next grid layer.

Construction of the Allan Block retaining walls comprised the following:

a placement and compaction of fill to the required levels;

b placement of the Allan Block units;

c placement of the geogrid, ensuring that the grid is held tightly in place;

d spreading of fill across the surface of the geogrid with lightweight plant;

e compaction and placement of further fill up to the level of the next grid layer.

Typical cross–sections of the geogrid reinforced segmental block walls are shown on T+T Drawings 21854.0031–AHP5S1–112 to –116, –118, –120 to –121 and –123 in Appendix A2.

As noted in Section 3.1, a drainage blanket was installed at the rear of the reinforced block of soil which comprises a minimum 300mm thickness of SAP50 scoria, covered in Bidim A19 geotextile filtercloth. A 160mm diameter perforated Nexus pipe along the backface of the wall and base of the rear of the reinforced soil block provides a discharge outlet for any groundwater captured in the drainage blanket. The drainage pipes from behind the walls are connected into the reticulated stormwater system (Walls 1 and 7), discharge into the wetland directly (Wall 2), or via an outlet to the existing stormwater culvert below Grand Drive (wall 5), as shown on the Woods subsoil drainage as–built plan in Appendix A1.

Certification of these walls, in accordance with the relevant Engineering Approval or Approved Building Consent, is to be supplied under separate cover.

3.4 Gabion Basket Retaining Wall

2 No. gabion basket retaining wall (i.e. Wetland Gabion Walls 1 and 2) were constructed on either side of the wetland outlet during the civil works period within Stage 1.

Construction of the gabion basket retaining walls comprised the following:

a excavation to the required levels;

b placement of the gabion basket units;

c compaction and placement of fill to backfill any over-excavation.

The gabion basket retaining wall has been designed to accommodate the maintenance access track immediately above.

Certification of this wall, in accordance with the relevant Engineering Approval, is to be supplied under separate cover.

3.5 Reinforced Earth Slopes

3 No. reinforced earth slopes (i.e. RE 1, RE 6 and part of RE 7) were constructed within Stage 1.

RE 1 and part of RE 7 were constructed during the bulk earthworks period, while RE 6 was constructed during the civil works period. RE 1 and a section of RE 7 are constructed immediately above Wall 1 and Wall 5 (discussed in Section 3.3), respectively.

The reinforced earth slopes comprise horizontally laid biaxial geogrids placed at 0.5m (vertical) intervals within the engineered, compacted earth fill. The grids extend up to within 1.5 (vertical) metres of the slope crest. They have been placed at various lengths, starting at the face of the slope.

Typical cross–sections of the reinforced earth slopes are shown on T+T Drawings 21854.0031–AHP5S1–112 to –116, –120 to –121 and –124 to –126 in Appendix A2.

The placement of the geogrid allows steeper finished gradients than is possible with bulk fills, and will minimise risk of instability across the face of the slope, particularly where finished gradients across the slopes are up to 1 in 1.5 (V:H).

Construction of the slope comprised the following:

a placement and compaction of fill, or excavation within natural ground, to the required levels;

b placement of the geogrid, ensuring that the grid is held tightly in place;

c spreading of fill across the surface of the geogrid with lightweight plant;

d compaction and placement of further fill up to the level of the next grid layer.

The fill was placed and compacted beyond the limit of the final slope face and then trimmed back to ensure full compaction of the slope face was achieved.

A drainage blanket was installed at the rear of the reinforced block of soil (essentially an extension of the underlying retaining wall drainage discussed in Section 3.3) and comprises a minimum of 300mm thickness of SAP50 scoria, covered in Bidim A19 geotextile filter-cloth. A 160mm diameter Novaflo pipe at the base of the drainage blanket provides regular discharge outlets for any groundwater captured in the drainage blanket. These pipes are connected into the retaining wall drainage system and are ultimately connected into the reticulated stormwater system (RE Slope 1) or into the culvert below Grand Drive (RE Slope 7).

The slopes have been designed to accommodate surcharge of up to 10kPa distributed load at the crest of the slopes.

The slope faces will be subject to a planting covenant and building limitation zone preventing construction within this area. Protection of the geogrids from damage also precludes construction across the slope faces and immediately adjacent to the slope crest. Accordingly, a building restriction zone has been applied across the slopes (See Sections 5.3 and 6.7).

3.6 Undercuts

Undercuts (minimum 2m deep and 5m wide) were excavated below Walls 1 and 5 and below the toe of RE 6 and RE 7 to ensure a consistent subgrade. The undercut was replaced with engineered, compacted fill, placed in accordance with the bulk earthworks specification (Section 2.3 above).

In addition, 1m deep undercuts were excavated to expose more competent soils (minimum shear strength of 75kPa) across the Residential Lots and through the road alignments in Stage 1 due to exposure of some areas of unsuitable subgrade materials (i.e. soft and wet). The undercut was replaced with engineered, compacted fill, placed in accordance with the bulk earthworks specification (Section 2.3 above).

The extent of the undercut areas is shown on the Woods Shear Key, Undercut and Subsoil Drain As–Built Plans (Woods Ref 37501–01–120–AB to 122–AB) in Appendix A1.

4 Stability Analyses

As noted in Section 3, slope stability analyses undertaken during the investigation stage of the project identified the need for shear keys to be constructed across Arrans Hill Precinct 5, so as to provide acceptable factors of safety against slope instability for the finished development of Stage 1.

During excavation of Shear Key 01, the excavated faces were mapped to confirm the shear key had been extended sufficiently into the underlying competent ECBF rock materials and to check for any apparent adverse oriented geological structure or other features exposed within the sides and lower part of the key.

We are satisfied that the design stability analyses remain valid for the completed works on the following basis:

a the exposed ground conditions generally conform to those assumed for design;

b the as-built profiles match design levels;

c the earthworks monitoring shows compliance with specified criteria, upon which fill properties have been based.

5 Project Evaluation / Building Design Considerations

5.1 General

Ground conditions within the Arrans Hill Precinct 5 Stage 1 area straddle a range of "design conditions" including cut ground, filled ground, expansive soils and constructed slopes up to 1 in 1.5 (V:H). The following sections set out relevant geotechnical design issues.

5.2 Bearing capacity for building foundations

All filled and natural ground within the influence of conventional residential shallow strip and pad foundation loads is assessed as generally having a geotechnical ultimate bearing capacity of 300kPa, as required by NZS 3604:2011 (Ref. [8]). This corresponds to a factored (Ultimate Limit State) bearing capacity of 150kPa and working (Serviceability Limit State) bearing capacity of 100kPa.

Due to the presence of expansive soils, foundation conditions fall outside the definition of "good ground" contained in NZS 3604:2011 (Ref. [8]). In terms of AS 2870:2011 (Ref. [7]), the soils present are considered to lie within Site Class M (moderately expansive) with characteristic surface movements anticipated to be in the range of 20mm to 40mm. Due allowance should be made for expansive soils, as discussed in Section 5.12.

Where a geotechnical ultimate bearing capacity greater than 300kPa is required to support any dwelling constructed outside the scope of NZS 3604:2011 (Ref. [8]), further specific site investigation and design of foundations will be required.

5.3 Building Limitation Zones – RE Slope

Identified steep slopes in the Stage 1 area have been constructed as reinforced earth fill structures with face gradients of between 1 in 1.5 and 1 in 2 (V:H). They are located in Lots 3 to 7, 9 to 19, 28 to 36 and Lots 143 to 153. Construction within the flatter parts of these Lots is intended, and a Building Restriction Zone ("No Build Zone") has been developed across the steeper sections of the Lots to ensure that the reinforcement of the slopes is not detrimentally affected by future development. The extent of the Building Limitation Zone associated with the RE slopes is shown on T+T Drawing 21854.0031–AHP5S1–131 (Building Limitation Plan) in Appendix A2. Excavation, fill placement and/or construction within this zone is not permitted.

Vegetation on slopes that are 1 in 4 (V:H) or steeper is recommended to reduce the potential for shallow slope instability and to minimise surface erosion. Where gradients are 1 in 4 (V:H) or steeper, there is potential for minor shallow creep of the topsoil layer. However, such creep is considered unlikely to detrimentally affect the global stability of the slope.

Where slopes exceed gradients of 1 in 2 (V:H), "Enkamat" or "Geocells" have been anchored to the face of the RE Slope to function as a protective reinforcing layer for the topsoil and plant root system.

5.4 Settlement

From our inspections during earthworks operations, the results of compaction quality control testing, and post construction survey monitoring, we consider that differential settlement induced by self-weight of engineered fill should now be largely complete. Further settlements should be within normally accepted design tolerances of 25mm, as outlined in NZS 3604:2011 (Ref. [8]), with respect to conventional building development.

Monitoring points were installed across the top of the retaining walls and reinforced earth slopes following completion of the construction works. The monitoring commenced between August 2017

and November 2017 and has continued through until June 2018. The monitoring shows that while settlements of up to 12mm have occurred, there has been negligible movement since March 2018.

In order to minimise the risk of ground settlements exceeding 25 mm, NZS 3604:2011 (Ref. [8]) allows a maximum fill surcharge of 600 mm over the building platform during future development. Filling in excess of this thickness should be subject to specific foundation design and assessment.

5.5 Retaining walls

Due to the relatively shallow grades across most of the Stage 1 Lots, it is not anticipated that significant retaining walls will be required. However, if walls are required, then retaining wall design will be dependent on the site specific requirements.

For preliminary design we recommend the use of the following geotechnical design parameters:

$\gamma = 18\ kN/m^3$,

$c' = 0\ kPa$,

$Ø' = 30°$,

$K_a = 0.30$,

$K_p = 3.33$,

"Su" of 50kPa for the embedment soil (subject to confirmation during construction).

These values are based on level ground above and below the wall and will require appropriate amendment to allow for slope, traffic and other surcharges or toe slopes and the specific lot geometry and development requirements, as applicable.

All retaining walls should include a layer of free draining granular fill (with geotextile over the top) immediately behind the wall covered with a 0.3m thick (minimum) compacted clay fill cap, with intercepted groundwater seepage piped into the reticulated stormwater system.

Any walls greater than 1.5m retained height will require a geotechnical assessment, as a minimum, to check and confirm that the stability of the subject (or adjacent) Lot is not detrimentally affected.

The existing geogrid reinforced segmental block walls constructed within the Stage 1 area are shown on the Woods Retaining Wall As–Built Plans (Woods Ref 37501–01–130–AB to 134–AB). These walls have been designed to accommodate a maximum 10kPa surcharge or a reinforced earth slope where present immediately above, although development immediately behind/above the walls is likely to be precluded by Council planning rules. The presence of these walls should be taken into account for any proposed works downslope of the walls, specifically to ensure that any proposed cuts do not undermine the base of the walls. In general, earthworks should be limited to no closer than 1.5m from the toe of the walls.

For clarity, the Lots within Stage 1 that will need to consider the presence of the existing retaining walls during site development are:

a Allan Block Wall 7 – Lots 21 to 25 and 27 inclusive

5.6 Subsoil Drainage

Following shear key construction during bulk earthworks, groundwater drainage was installed using Nexus drains covered in scoria and geotextile cloth to permanently handle ground water flows.

The extent of the subsoil drainage systems are shown on the Woods Shear Key, Undercut and Subsoil Drain As–Built Plans (Woods Ref 37501–01–120–AB to 122–AB) in Appendix A1, and on T+T Drawing 21854.0031–AHP5S1–102 in Appendix A2.

This drainage system is relatively deep and located so that it is unlikely to be encountered during future residential site development and is expected to be maintenance free. Any deep excavations should take account of the presence of these drains nonetheless. If a drain is encountered, damaged, or identified as defective, repairs should be observed by a Chartered Professional (Geotechnical) Engineer familiar with this report, and notified to Auckland Council.

5.7 Post Earthworks Investigations

Following the completion of earthworks operations, T+T have undertaken supplementary fieldwork to confirm the consistency of the natural subsoils and engineered fill. From the investigations, we confirm that the subsoils are considered to have a geotechnical ultimate bearing capacity of 300kPa, as required by NZS 3604:2011 (Ref. [8]). This corresponds to a factored (Ultimate Limit State) bearing capacity of 150kPa and working (Serviceability Limit State) bearing capacity of 100kPa. Associated borehole logs and site plan (T+T Drawing 21854.0031–AHP5S1–132) are attached in Appendix E.

5.8 Stormwater

Public stormwater services have been installed within Arrans Hill Precinct 5 Stage 1. Stormwater and runoff from roofs, decks and paved areas, together with discharges from future retaining wall drains and other subsoil drainage must be connected directly into the public stormwater drainage network.

5.9 Service lines

Trench backfill has been compacted to minimise potential for future settlements. However, where building envelopes lie adjacent to or across service lines, all foundations should extend and be founded below the 45 degree zone of influence line from pipe inverts. This requirement is to avoid excessive pipe surcharges, and to allow for future maintenance of the system without detrimentally affecting adjacent structures. Subject to approval from Auckland Council, foundations may extend and bridge over service lines provided specific foundation design is undertaken.

A copy of the Stormwater and Wastewater As–Built Plans (Woods Ref 37501–01–300–AB to 305–AB and 400–AB to 404–AB) is included in Appendix A1.

5.10 Road subgrades

Based on the fill monitoring and site observations during development, filled and natural ground within the road and vehicle access Lots is considered generally suitable for the proposed residential pavements. Subgrade strength testing was carried out following excavation to formation levels along the road alignments. These subgrade test results were passed on to Woods for use in their pavement design. All road subgrades have been lime and cement stabilised to assist in pavement strengths, and to minimise the impact of expansive soils on road pavements.

For future road construction in other parts of the Arrans Hill Precinct 5 Stage 1 development, within natural ground, a design CBR of 2% is considered appropriate while, within engineered fill areas, a design CBR of 7% is appropriate.

5.11 Topsoil

Following completion of topsoil spreading and grassing, topsoil depths were measured in a representative number of the Lots and these are shown on T+T Drawing 21854.0031–AHP5S1–133

attached in Appendix E. Due to variations in placement depths and earth worked surface levels, topsoil depths may vary from those recorded.

5.12 Expansive soils

Expansive soils (or "reactive soils" using Australian terminology) are clay soils that undergo appreciable volume change upon changes in moisture content. The reactivity and the typical range of movement that could be expected from soils underlying any given building site depend on the amount of clay present, clay mineral type, and proportion, depth and distribution of clay throughout the soil profile. Moisture changes tend to occur slowly in clays and produce swelling upon wetting and shrinkage upon drying.

Apart from seasonal moisture changes (wet winters / dry summers) other factors that can influence soil moisture content include:

a Influence of garden watering and site drainage;

b The presence of large trees (especially fast growing Australian species such as eucalyptus) close to building envelopes, and;

c Initial soil moisture conditions at construction time.

Visually, the surfaces of expansive soils are noted for developing extensive cracking during dry periods (especially late summer through autumn in Auckland) and can be locally identified by this feature when sites are excavated and left for a week or two to dry out. Further information on expansive soils is given in Appendices C and D of this report.

In order to assess for the presence of expansive soils within this stage of the development, representative soil samples were retrieved from near surface strata and tested by Geotechnics Ltd to determine soil shrinkage characteristics in accordance with AS 1289.7.1.1.

Based on the laboratory results (attached in Appendix E), the foundation soils on this stage of the subdivision lie outside the definition of 'good ground' as outlined in NZS 3604:2011 (Ref. [8]).

In terms of AS 2870:2011 (Ref. [7]), the soils present are considered to lie within Site Class M (moderately expansive) with characteristic surface movements anticipated to be in the range of 20mm to 40mm.

Accordingly, building foundations on this stage of the subdivision will need to be subject to specific foundation design by a Chartered Professional Engineer familiar with the contents of this report and responsible for design of structural elements (including foundations) of the building. Reference should be made to AS 2870:2011 (Ref. [7]) for assistance.

6 Statement of Professional Opinion as to the Suitability of Land for Building Development

I, Mr A.P. Stiles of Tonkin + Taylor Ltd, P O Box 5271, Wellesley St, Auckland, hereby confirm that:

6.1 I am a Chartered Professional Engineer experienced in the field of geotechnical engineering and an authorised representative of Tonkin + Taylor who was retained by WFH Properties Ltd as the Geotechnical Engineer on Arrans Hill Precinct 5 Stage 1 (comprising Residential Lots 1 to 36 and 143 to 154, Wetland Reserve Lot 804, JOAL Lot 600, and Road Lot 900 inclusive) of the Millwater Residential Subdivision Development off Arran Drive in Silverdale. Inspection and observation of the works have been carried out during construction by either myself or staff acting under my direction.

6.2 The extents of investigations are described in Tonkin + Taylor Ltd Geotechnical Investigation Report for Arrans Hill Precinct 5 Ref. No. 21854.0031 dated December 2015. The conclusions and recommendations of those documents have been re-evaluated in the preparation of this report. Details of all earthworks control tests performed are enclosed (Appendix E).

6.3 The Contractor has confirmed that the work undertaken has been completed in accordance with the drawings, specifications and any variations issued and is consistent with the inspections and observations carried out by Tonkin + Taylor Ltd. Complete Construction Certificates have been provided by the Contractors and are presented in Appendix B. Tonkin + Taylor Ltd accepts no liability for any errors or omissions represented by those documents.

6.4 On the basis of our observations and inspections together with the information supplied by others, including the Contractor's Construction Certificates, it is my professional opinion, not to be construed as a guarantee that:

6.4.1 The earth fills shown on the attached Woods drawings, Project No 37501, Millwater, Arrans Hill Precinct 5 Stage 1, Drawing Numbers 37501–01–100–AB to –102–AB, –110–AB to –112–AB and –120–AB to 122–AB, have been generally placed in compliance with NZS 4431:1989 (Ref. ([6]).

6.4.2 The completed earthworks give due regard to land slope and foundation stability considerations.

6.5 **For Lots 1 to 24, 28 to 36 and 143 to 154 inclusive:**

6.5.1 Foundation design

The filled and natural ground within residential Lot boundaries is considered generally suitable for the erection thereon of light timber framed, flexibly clad residential buildings subject to clauses 6.5.2 to 6.5.6.

6.5.2 Bearing capacity

Foundation design for these Lots should limit geotechnical ultimate bearing capacity to 300 kPa (factored (ULS) 150 kPa, working (SLS) 100 kPa). This is as specified in NZS 3604:2011 (Ref. [8]).

6.5.3 Expansive soils

Due to the presence of expansive clay soils, foundation soils lie outside the definition of 'good ground' in NZS 3604:2011 (Ref. [8]). Soils are considered to lie in Site Class M (moderately expansive) as defined in AS 2870:2011 (Ref. [7]) with anticipated characteristic surface ground movements of 20mm to 40mm. Clause 6.5.3.1 of this

Geotechnical Completion Report may be used for expansive soil foundation design on this subdivision:

6.5.3.1 Specific foundation design for expansive soils

Specific foundation design should be undertaken by a Chartered Professional Engineer familiar with the contents of this report and responsible for design of structural elements (including foundations) of the building.

The minimum specific design requirements set for expansive soils within this clause are:

i) Minimum foundation embedment of 600 mm following topsoil removal and benching of building platform areas to finished ground levels

ii) Four bar steel reinforcing cages should be used

iii) For buildings having brittle exterior cladding, for example brick veneer, stucco plaster, solid plaster, block work, styrofoam type cladding or sprayed plaster over harditex systems etc, the potential effects of seasonal ground movements need to be considered by the building designer.

The above minimum requirements within this clause may be superceded if individual engineers are able to demonstrate their specific design solutions are applicable to site soil conditions to the satisfaction of Auckland Council. Specific design may be undertaken by first principles or by reference to AS 2870:2011 (Ref. [7]), Section 4 and related documents.

6.5.4 Floor Slab Construction

Slab on grade construction is expected to be relatively straightforward across the subdivision, but problems can occur with slab construction on shrink/swell sensitive soils. In soils which become desiccated in summer, subsequent capillary moisture rise may cause dry soils to wet up and swell, causing slab uplift and building distress. Alternatively, construction during winter may result in subgrade soils with high moisture contents drying out through summer, with subsequent soil shrinkage and possible building deformation.

The structural engineer should take likely construction timeframes into account and confirm that their design and construction methodologies will accommodate the soil shrinkage or swelling that may occur.

The Contractor should ensure that the ground beneath the floor slab areas is suitably conditioned to ensure that the subgrade is neither too dry nor too wet prior to hardfill placement and concrete pouring to avoid undue shrink or swell movements.

6.5.5 Building maintenance - Owners responsibility

The owner is responsible for maintenance of the building and site and should be familiar with the performance and maintenance requirements set out in CSIRO sheet BTF18 Foundation Maintenance and Footing Performance: A Home Owners Guide. A copy of this sheet is included in Appendix D.

6.5.6 Retaining walls / Earthworks

No retaining wall construction in excess of 1.5 metres height and no earthworks involving fills in excess of 600mm depth should take place on these Lots unless endorsed by a suitable design undertaken by a Chartered Professional (Geotechnical) Engineer familiar with the contents of this report and responsible for design of structural elements of the building.

6.6 **For Lots 25 to 27 inclusive:**

6.6.1 Foundation design

The filled and natural ground within residential Lot boundaries is considered generally suitable for the erection thereon of light timber framed, flexibly clad residential buildings subject to clauses 6.6.2 to 6.6.6.

6.6.2 Bearing capacity

Due to the presence of softer natural ground within these Lots, foundation design for these Lots should limit geotechnical ultimate bearing capacity to 240 kPa (factored (ULS) 120 kPa, working (SLS) 80 kPa).

6.6.3 Expansive soils

Due to the presence of expansive clay soils, foundation soils lie outside the definition of 'good ground' in NZS 3604:2011 (Ref. [8]). Soils are considered to lie in Site Class M (moderately expansive) as defined in AS 2870:2011 (Ref. [7]) with anticipated characteristic surface ground movements of 20mm to 40mm. Clause 6.6.3.1 of this Geotechnical Completion Report may be used for expansive soil foundation design on this subdivision:

6.6.3.1 Specific foundation design for expansive soils

Specific foundation design should be undertaken by a Chartered Professional Engineer familiar with the contents of this report and responsible for design of structural elements (including foundations) of the building.

The minimum specific design requirements set for expansive soils within this clause are:

iv) Minimum foundation embedment of 600 mm following topsoil removal and benching of building platform areas to finished ground levels

v) Four bar steel reinforcing cages should be used

vi) For buildings having brittle exterior cladding, for example brick veneer, stucco plaster, solid plaster, block work, styrofoam type cladding or sprayed plaster over harditex systems etc, the potential effects of seasonal ground movements need to be considered by the building designer.

The above minimum requirements within this clause may be superceded if individual engineers are able to demonstrate their specific design solutions are applicable to site soil conditions to the satisfaction of Auckland Council. Specific design may be undertaken by first principles or by reference to AS 2870:2011 (Ref. [7]), Section 4 and related documents.

6.6.4 Floor Slab Construction

Slab on grade construction is expected to be relatively straightforward across the subdivision, but problems can occur with slab construction on shrink/swell sensitive soils. In soils which become desiccated in summer, subsequent capillary moisture rise may cause dry soils to wet up and swell, causing slab uplift and building distress. Alternatively, construction during winter may result in subgrade soils with high moisture contents drying out through summer, with subsequent soil shrinkage and possible building deformation.

The structural engineer should take likely construction timeframes into account and confirm that their design and construction methodologies will accommodate the soil shrinkage or swelling that may occur.

The Contractor should ensure that the ground beneath the floor slab areas is suitably conditioned to ensure that the subgrade is neither too dry nor too wet prior to hardfill placement and concrete pouring to avoid undue shrink or swell movements.

6.6.5 Building maintenance - Owners responsibility

The owner is responsible for maintenance of the building and site and should be familiar with the performance and maintenance requirements set out in CSIRO sheet BTF18 Foundation Maintenance and Footing Performance: A Home Owners Guide. A copy of this sheet is included in Appendix D.

6.6.6 Retaining walls / Earthworks

No retaining wall construction in excess of 1.5 metres height and no earthworks involving fills in excess of 600mm depth should take place on these Lots unless endorsed by a suitable design undertaken by a Chartered Professional (Geotechnical) Engineer familiar with the contents of this report and responsible for design of structural elements of the building.

6.7 **For Lots 3 to 7, 9 to 19, 28 to 36 and 143 to 153 inclusive:**

6.7.1 These Lots contain a "Building Line Limitation" relating to the reinforced earth slopes which forms the 1 in 1.5 to 1 in 2 (V:H) slopes along the Lot boundaries. The limitation zone is shown on T+T Drawing 21854.0031–AHP5S1–131 in Appendix A2. Excavation, filling and/or construction within this zone is not to be undertaken, to ensure stability of the slopes is not compromised.

6.7.2 The presence of geogrids within the reinforced earth slopes is brought to the attention of future building and services designers. The topmost grid is located between 1 to 2 metres below the surface at the top of the slope, and does not generally extend more than 2 metres back from the crest of the slope. It is not expected that the grids will be encountered during future development of this Lot, however, the presence of the grids should be recognized. Any exposure and/or damage and subsequent repair to the grids during any future development must be observed and certified by a Chartered Professional Engineer (Geotechnical) familiar with the contents of this report.

Design of the reinforced earth slopes have assumed a maximum distributed load of 10kPa (dead plus live loads) up to the edge of the Building Limitation Line.

6.7.3 Any cut or fill walls greater than 1.5m retained height, or of any height within 2m of the building restriction lines shown on T+T Drawing 21854.0031–AHP5S1–131 in

Appendix A2, will require a geotechnical assessment, as a minimum, to ensure stability of the subject or adjacent Lot is not detrimentally affected.

6.7.4 Development outside of the Building Line Limitation zone may proceed in accordance with the recommendations outlined in Section 6.5.

6.8 Underfill (Subsoil) drainage

Underfill (Subsoil) drains have been installed during subdivisional development in the locations shown on the Woods Shear Key, Undercut and Subsoil Drain As–Built Plans (Woods Ref 37501–01–120–AB to 122–AB) in Appendix A1, and on T+T Drawing 21854.0031–AHP5S1–102 in Appendix A2. These drains are considered to be maintenance free. This drainage system is relatively deep and located so that it is unlikely to be encountered during future residential site development. Although future works are unlikely to encounter the drains, their location should be considered prior to designing deep foundations and, if damaged, repairs should be observed by a Chartered Professional (Geotechnical) Engineer familiar with this report, and notified to Auckland Council.

6.9 Stormwater and Sanitary Sewer Lines

Where building envelopes lie adjacent to or across service lines, all foundations should extend and be founded below the 45 degree zone of influence line extending from pipe inverts. This requirement is to avoid excessive pipe surcharges, and to allow for future maintenance of the system without detrimentally affecting adjacent structures. Subject to approval from Auckland Council, foundations may extend and bridge over service lines provided specific foundation design is undertaken. A copy of the stormwater and sanitary sewer as–built plans are included in Appendix A1.

6.10 Road and Access Lots

Based on the fill monitoring and site observations undertaken during site development, the filled and natural ground within Arrans Hill Precinct 5 Stage 1 is considered generally suitable for residential road and accessway construction. Scala penetrometer testing should be undertaken when road subgrades have been prepared to confirm subgrade strengths. Subject to such subgrade testing, for future road construction in other parts of the Arrans Hill Precinct 5 Stage 1 development, within natural ground, a design CBR of 2% is considered appropriate, while within engineered fill areas, a design CBR of 7% is appropriate.

6.11 Unexpected ground conditions

Our assessment is based on interpolation between borehole positions, site observations and periodic earthworks control visits. Local variations in ground conditions may occur. Although unlikely, unfavourable ground conditions may be encountered during site benching and footing excavations. It is important that we be contacted in this eventuality, or in the event that any variation in subsoil conditions from those described in the report are found. Design assistance is available as required to accommodate any unforeseen ground conditions present.

7 Applicability

This report has been prepared for the benefit of WFH Properties Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

It does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling, especially in cases where concrete blockwork and/or brick veneer or stucco plaster buildings are sited partly on fill or partly on natural ground, or where they are entirely sited on filling whose depth changes significantly across the building platform.

Tonkin & Taylor Ltd

Report prepared by:

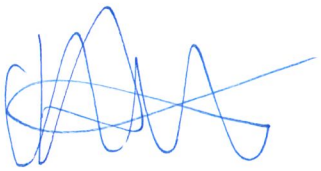
.....

P.P.

Andrew Linton

Senior Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



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Andrew Stiles

Project Director

JXXL
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8 References

[1] Tonkin & Taylor Ltd., October 2001. *Stoney Block,* T+T Ref. 18214.

[2] Tonkin & Taylor Ltd., May 2001. *Silverdale Blocks, Silverdale, Geotechnical Issues – Future Medium Density Development,* T+T Ref. 18213.

[3] Tonkin & Taylor Ltd., November 2003. *Silverdale North and Orewa West Blocks, Silverdale, Geotechnical Issues – Future Medium Density Development,* T+T Ref. 20914.

[4] Tonkin & Taylor Ltd., March 2013. *Millwater – North South Link, North Bridge to Grand Drive, Geotechnical Investigation Report,* T+T Ref. 21854.012.

[5] Tonkin & Taylor Ltd., December 2015. *Millwater Subdivision Arrans Hill – Precinct 5 – Geotechnical Investigation Report,* T+T Ref. 21854.0031.

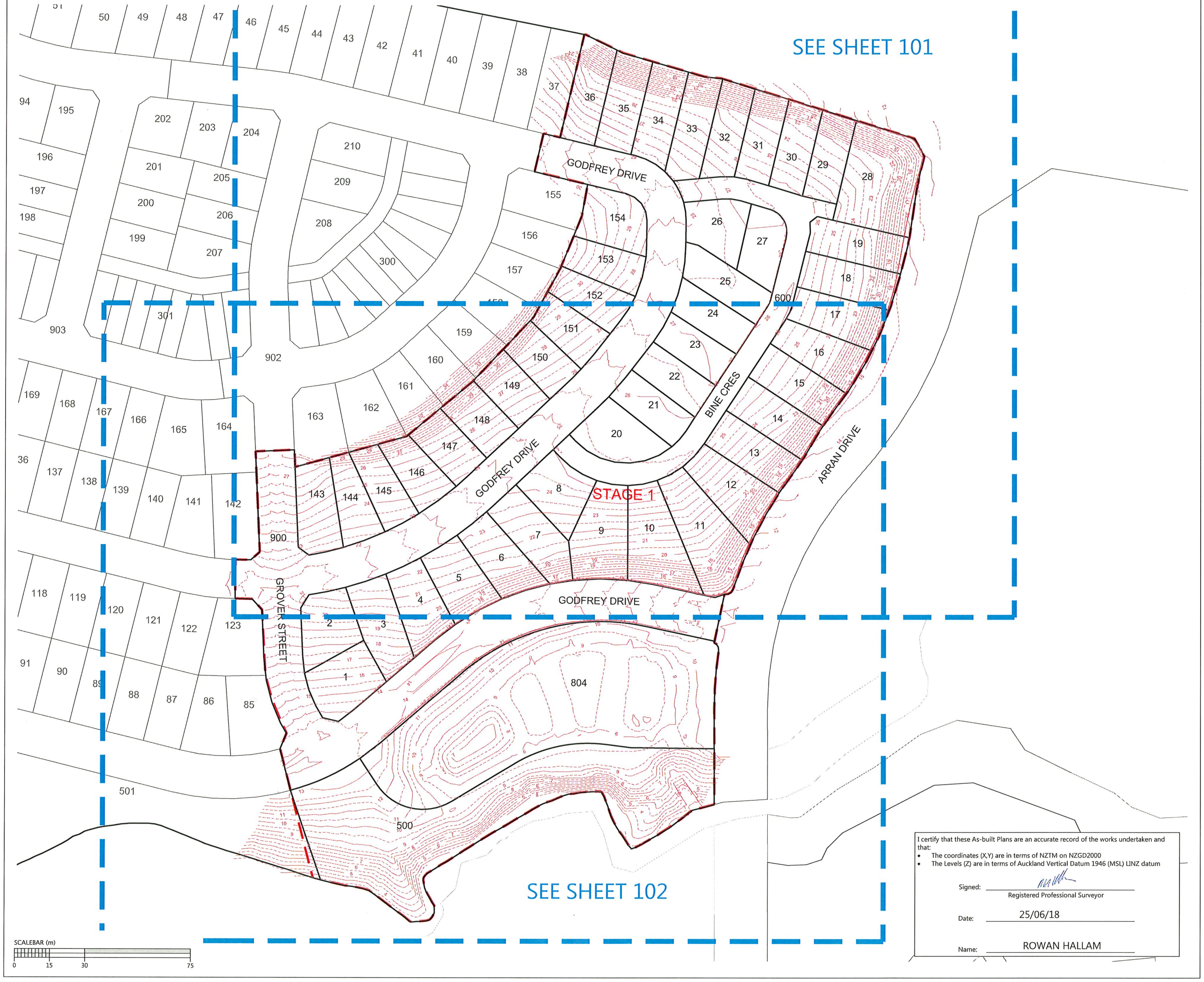
[6] New Zealand Standards, 1989. *NZS 4431:1989 Code of Practice for Earth Fill for Residential Development.*

[7] Standards Australia, 2011. *AS 2870:2011 Residential slabs and footings.*

[8] New Zealand Standards, 2011. *NZS 3604:2011 Timber Framed Buildings.*

Appendix A1: Woods Drawings

• 37501–01–100–AB to 102–AB	Final Contour AsBuilt Plans
• 37501–01–110–AB	Cut & Fill As–Built – Original to Lowest Surface
• 37501–01–111–AB	Cut & Fill As–Built – Lowest to Final Surface
• 37501–01–112–AB	Cut & Fill As–Built – Original to Final Surface
• 37501–01–120–AB to 122–AB	Shear Key, Undercut and Subsoil Drain AsBuilt Plans
• 37501–01–130–AB to 134–AB	Retaining Wall As–Built Plans
• 37501–01–300–AB to 305–AB	Stormwater As–Built Plans
• 37501–01–400–AB to 404–AB	Wastewater As–Built Plans



WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- CONTOURS MAJOR
- CONTOURS MINOR
- STAGE BOUNDARIES
- LOT BOUNDARIES

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED FOR ISSUE	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	PM	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
FINAL CONTOUR ASBUILT PLAN
SHEET 1 OF 3
(SLC - 66650)

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-100-AB	

WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- CONTOURS MAJOR
- CONTOURS MINOR
- STAGE BOUNDARIES
- LOT BOUNDARIES

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	PM	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
FINAL CONTOUR ASBUILT PLAN
SHEET 2 OF 3
(SLC - 66650)

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

STATUS	AS-BUILT	REV
SCALE	1:1000 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-101-AB	

SCALEBAR (m)
0 10 20 50

WOODS
Est.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- CONTOURS MAJOR
- CONTOURS MINOR
- STAGE BOUNDARIES
- LOT BOUNDARIES

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	PM	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
FINAL CONTOUR ASBUILT PLAN
SHEET 3 OF 3
(SLC - 66650)

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

STATUS	AS-BUILT	REV
SCALE	1:1000 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-102-AB	

SCALEBAR (m)
0 10 20 50

WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- ZERO CONTOUR
- CUT CONTOUR
- FILL CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES

GODFREY DRIVE
BINE CRES
ARRAN DRIVE
GROVER STREET
STAGE 1

SCALEBAR (m)
0 15 30 75

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

CUT & FILL AS-BUILT
ORIGINAL TO LOWEST SURFACE
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-110-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-110-AB-CUT FILL CONTOURS.DWG

WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- ZERO CONTOUR
- CUT CONTOUR
- FILL CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

CUT & FILL AS-BUILT
LOWEST TO FINAL SURFACE
(SLC-66650)

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-111-AB	

SCALEBAR (m)
0 15 30 75

Document No. K\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURV\AS-BUILT\37501-01-110-AB-CUT FILL CONTOURS.DWG

WOODS
Est.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- ZERO CONTOUR
- CUT CONTOUR
- FILL CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

CUT & FILL AS-BUILT
ORIGINAL TO FINAL SURFACE
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-112-AB	

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____ Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

SCALEBAR (m)

0 15 30 75

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-110-AB-CUT FILL CONTOURS.DWG

WOODS
Est.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS
2. SUBSOIL DATA SUPPLIED BY CONTRACTOR

LEGEND

- NOVACOIL SUBSOIL DRAINS
- UPVC SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE AT BOTTOM OF SHEARKEY

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
SHEAR KEY, UNDERCUT AND SUBSOIL DRAIN ASBUILT
SHEET 1 OF 3
(SLC-66650)

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-120-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURVAS-BUILT\37501-01-120-AB-SK UC & SUBSOIL.DWG

WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS
2. SUBSOIL DATA SUPPLIED BY CONTRACTOR

LEGEND

- NOVACOIL SUBSOIL DRAINS
- UPVC SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE AT BOTTOM OF SHEARKEY

SCALEBAR (m)
0 10 20 50

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	26/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
SHEAR KEY, UNDERCUT AND SUBSOIL DRAIN ASBUILT
SHEET 2 OF 3
(SLC - 66650)

STATUS	AS-BUILT	REV
SCALE	1:1000 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-121-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURVAS-BUILT\37501-01-120-AB-SK UC & SUBSOIL.DWG

WOODS
EST.1970

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS
2. SUBSOIL DATA SUPPLIED BY CONTRACTOR

LEGEND

- NOVACOIL SUBSOIL DRAINS
- UPVC SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE AT BOTTOM OF SHEARKEY

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	07/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
SHEAR KEY, UNDERCUT AND SUBSOIL DRAIN ASBUILT
SHEET 3 OF 3
(SLC - 66650)

STATUS	AS-BUILT	REV
SCALE	1:1000 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-122-AB	

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

SCALEBAR (m)

0 7.5 15 37.5

Rowan Hallam

Document No. K\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURVAS-BUILT\37501-01-120-AB-SK UC & SUBSOIL.DWG

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- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- TOP OF BANK
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE
- STAGE BOUNDARY

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	14/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
RETAINING WALL AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-130-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURV\AS-BUILT\37501-01-130-AB-WALLS.DWG

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- TOP OF BANK
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE
- STAGE BOUNDARY

WALL 5
0.52
BOTTOM OF RE SLOPE
BOTTOM OF NEW MASS BLOCK RETAINING WALL
POOL TYPE FENCE ON TOP OF RETAINING WALL
0.63
RE SLOPE 1
TOP OF RE SLOPE
POOL TYPE FENCE
0.02
BOTTOM OF NEW ALLAN BLOCK RETAINING WALL
POOL TYPE FENCE ON TOP OF RETAINING WALL
TOP OF RE SLOPE
POOL TYPE FENCE
WALL 1
0.23
BOTTOM OF RE SLOPE
0.51
RE SLOPE 1
WALL 1
0.56
POOL TYPE FENCE ON TOP OF RETAINING WALL
BOTTOM OF NEW ALLAN BLOCK RETAINING WALL
TOP OF RE SLOPE
BOTTOM OF RE SLOPE
RE SLOPE 1
WALL 1
0.07
WALL 7
POOL TYPE FENCE ON TOP OF RETAINING WALL
BOTTOM OF NEW ALLAN BLOCK RETAINING WALL
0.14
WALL 7
0.60
BOTTOM OF RE SLOPE

GODFREY DRIVE

37 36 35 34 33 32 31 30 29 28 27 26 25 600 24 155 154 153 152 151 19 18 17

SCALEBAR (m)
0 5 10 25

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	14/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

RETAINING WALL AS-BUILT
SHEET 2 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-131-AB	

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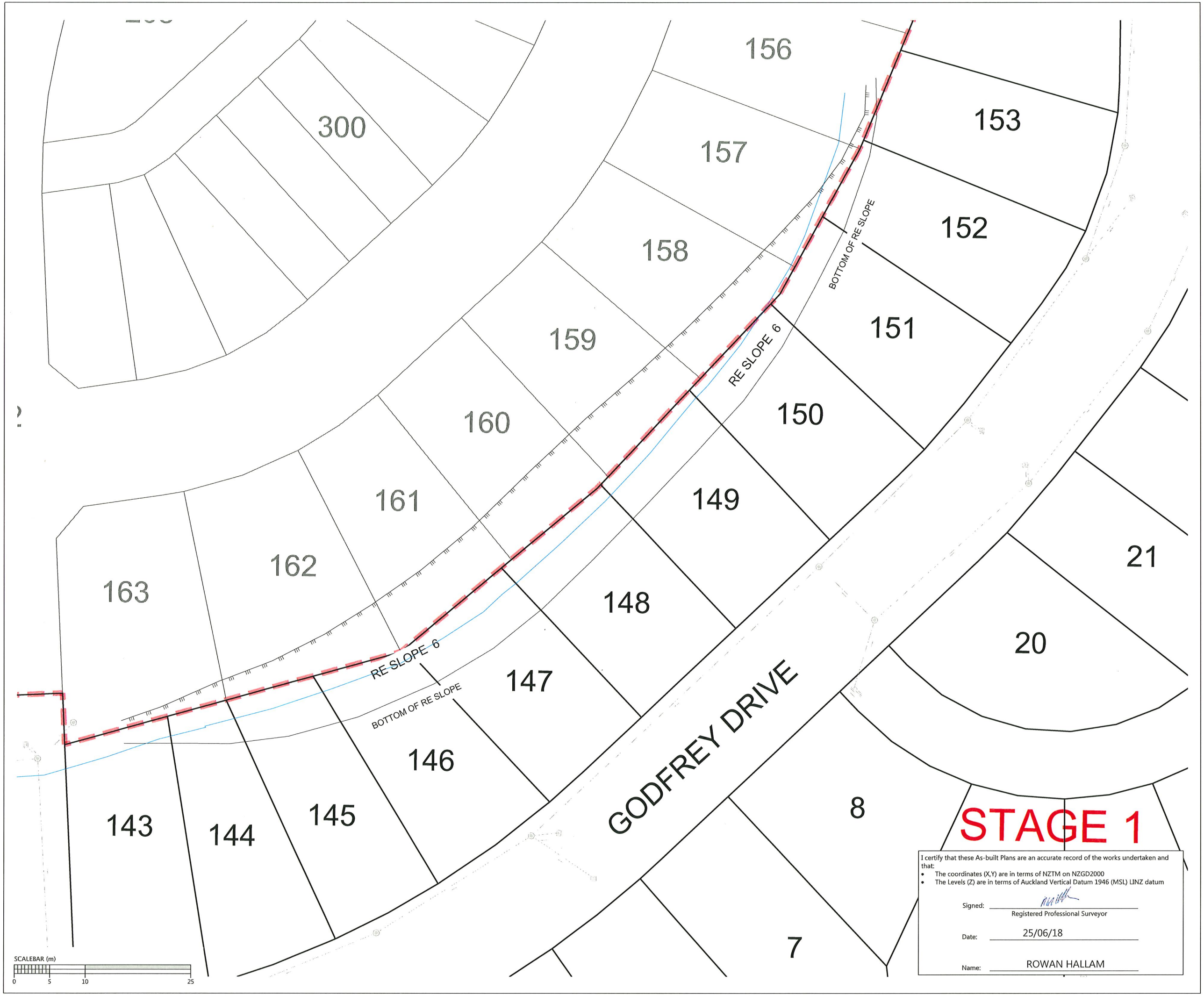


WOODS
EST.1970

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- TOP OF BANK
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE
- STAGE BOUNDARY

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	14/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

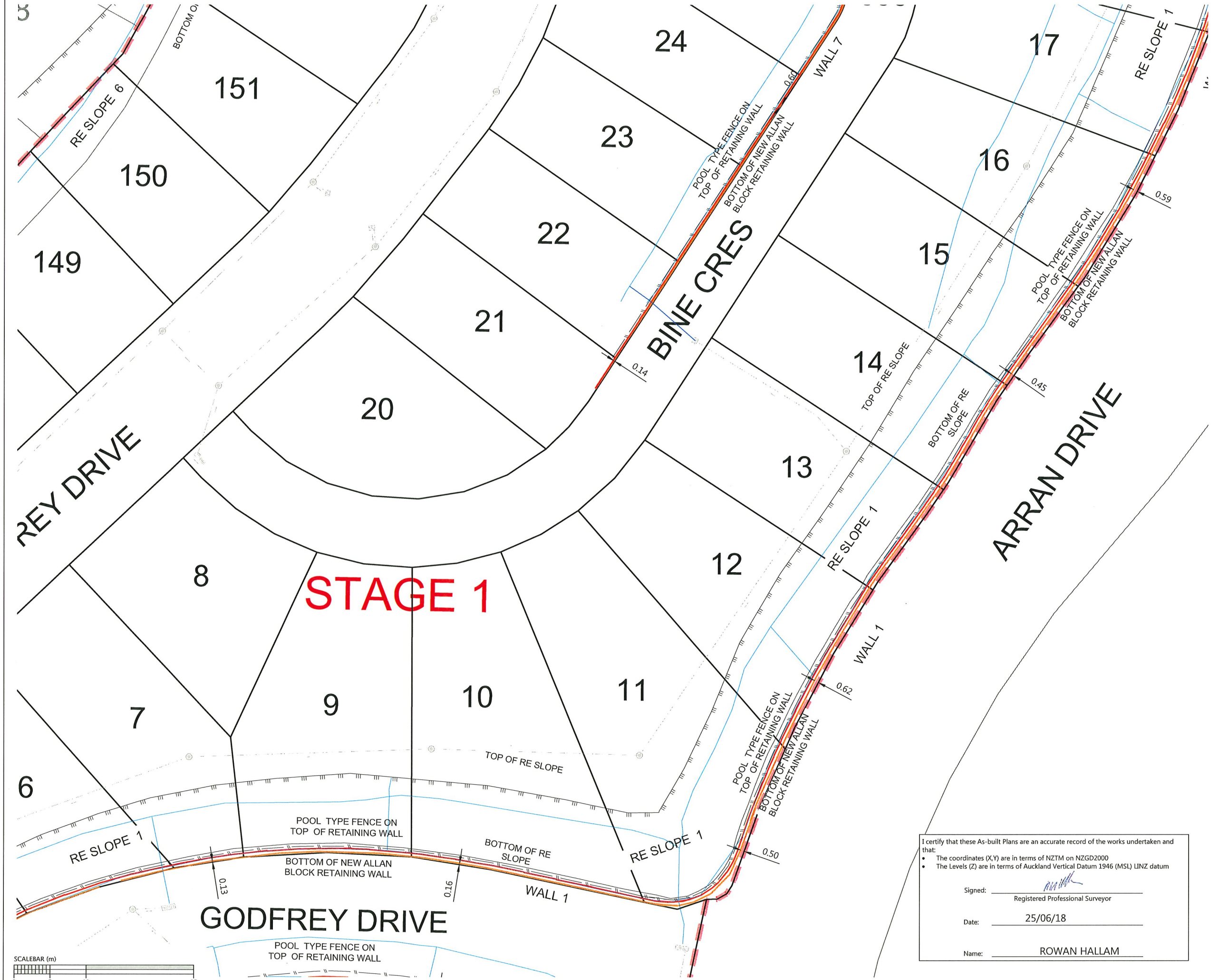
WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

RETAINING WALL AS-BUILT
SHEET 3 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-132-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURVAS-BUILT\37501-01-130-AB-WALLS.DWG



WOODS
EST.1970

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- TOP OF BANK
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE
- STAGE BOUNDARY

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	14/06/18
2	SIGNED AND ISSUED	MRH	25/06/08

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

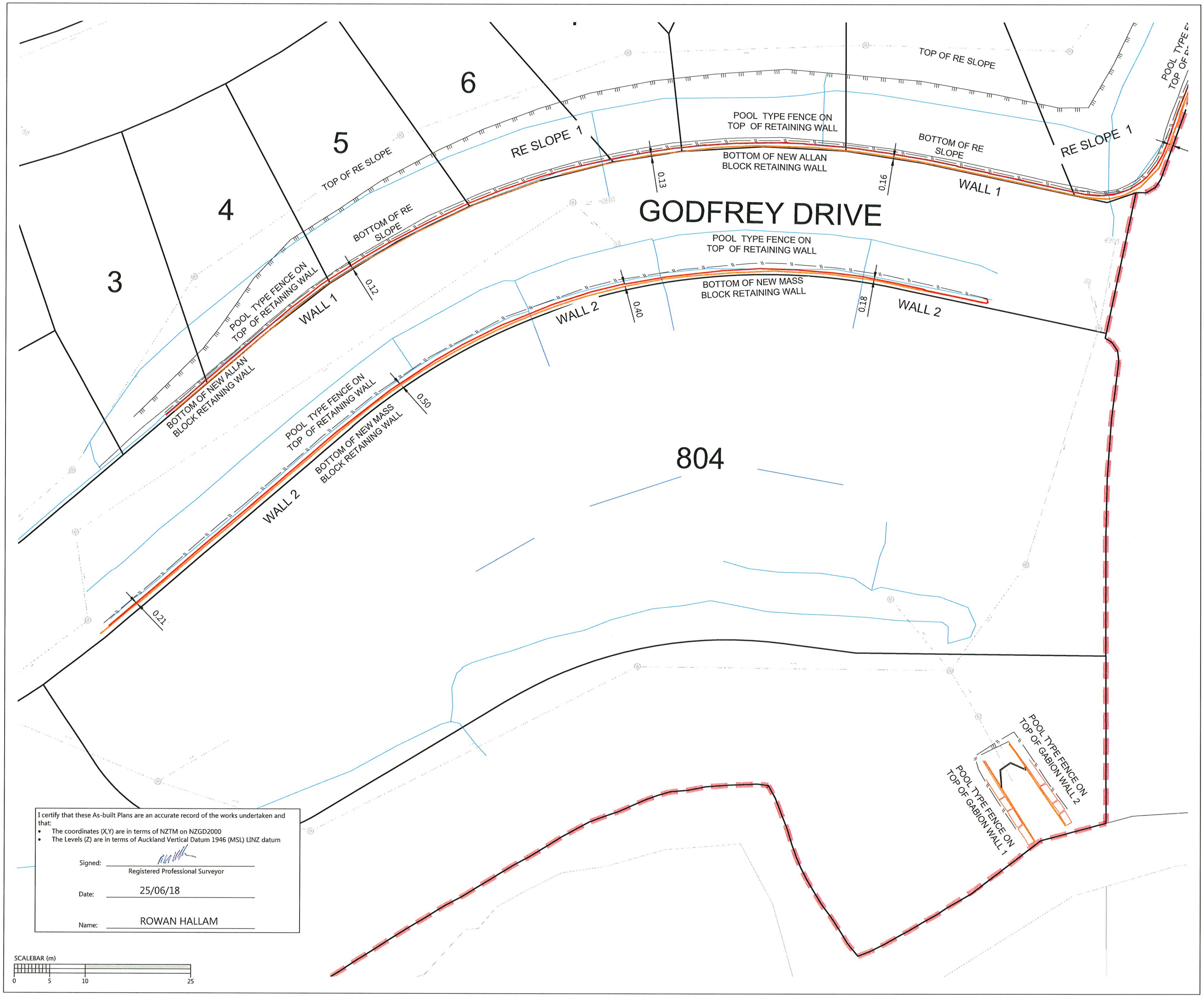
Name: ROWAN HALLAM

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

RETAINING WALL AS-BUILT
SHEET 4 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-133-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURV\AS-BUILT\37501-01-130-AB-WALLS.DWG



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- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 25/06/18

Name: ROWAN HALLAM

SCALEBAR (m)

0 5 10 25

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- TOP OF BANK
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE
- STAGE BOUNDARY

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	14/06/18
2	SIGNED AND ISSUED	MRH	25/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	T&T	
DRAWN	KR	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

MILLWATER PRECINCT 5 OREWA WEST STAGE 1

RETAINING WALL AS-BUILT
SHEET 5 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-134-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURV\AS-BUILT\37501-01-130-AB-WALLS.DWG

LEGEND

- STORMWATER MANHOLE
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY

NOTES

1. ALL WORKS AND MATERIALS COMPLY WITH AC STANDARDS FOR ENGINEERING DESIGN AND CONSTRUCTION.
2. ALL PIPE BEDDING COMPLIES WITH AC STANDARDS
3. ALL CESSPIT LEADS AND PIPES UNDER THE ROAD AND CARRIDGEWAYS ARE REINFORCED CONCRETE PIPES CLASS 4 (Z) RRJ. ALL OTHER PIPELINES ARE REINFORCED CONCRETE CLASS 2 (X) RRJ UNLESS OTHERWISE NOTED.
4. ALL PIPE CROSSINGS UNDER ROADS AND ACCESSWAYS HAVE BEEN HARDFILL BACKFILLED.
5. ALL SW 100mm DIA. RAMPED RISERS HAVE BEEN EXTENDED AND CAPPED OFF 1.0m BELOW THE FINISHED GROUND SURFACE.
6. ALL PRIVATE DRAINAGE CONNECTIONS ARE 100mmø.
7. LOT BOUNDARIES ARE SUBJECT TO FINAL SURVEY.
8. ASBUILT DATA HAS BEEN SOURCED FROM A COMBINATION OF WOODS SURVEY MEASURED DATA AND CONTRACTOR RECEIVED DATA.

Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
1	1749287.57	5949134.88	2.5
2	1749274.89	5949153.60	6.5
3	1749306.08	5949159.39	4.5
4	1749319.18	5949176.42	4.0
5	1749333.06	5949184.98	3.1
6	1749352.04	5949195.57	2.1
7	1749369.94	5949202.44	2.5
8	1749385.81	5949208.63	4.7
9	1749410.31	5949208.05	3.3
10	1749431.89	5949207.39	3.3
11	1749443.53	5949208.72	4.3
12	1749451.26	5949221.46	3.6
13	1749462.61	5949237.57	3.3
14	1749473.94	5949253.34	2.6
15	1749481.26	5949267.26	3.8
16	1749489.67	5949280.37	3.7
17	1749505.24	5949306.73	2.7
18	1749506.93	5949311.40	2.7
19	1749512.62	5949336.43	2.5
20	1749390.51	5949253.26	5.1
21	1749407.36	5949266.65	2.6
22	1749417.12	5949279.18	4.7
23	1749426.48	5949291.36	4.5
24	1749433.37	5949305.71	4.2
25	1749437.12	5949319.22	3.4
26	1749462.09	5949346.19	4.4
27	1749470.02	5949344.27	3.9
28	1749516.37	5949363.54	4.8
29	1749503.77	5949367.31	2.5
30	1749477.25	5949374.40	2.5
31	1749461.96	5949378.58	2.4
32	1749459.63	5949379.09	2.5
33	1749446.36	5949382.72	2.4
34	1749431.57	5949386.58	2.5
35	1749416.79	5949390.79	2.7
36	1749391.50	5949399.59	2.1
142	1749250.23	5949200.28	7.0
143	1749277.97	5949203.55	5.4
144	1749291.79	5949207.58	5.7
145	1749310.21	5949213.88	4.4
146	1749323.36	5949221.17	4.0
147	1749338.75	5949233.06	5.2
148	1749350.68	5949244.38	5.4
149	1749364.51	5949257.47	5.5
150	1749377.73	5949269.20	5.0
151	1749392.97	5949282.39	3.6
152	1749403.99	5949297.73	4.5
153	1749414.04	5949312.51	3.7
154	1749418.12	5949330.67	3.4

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 26/06/18

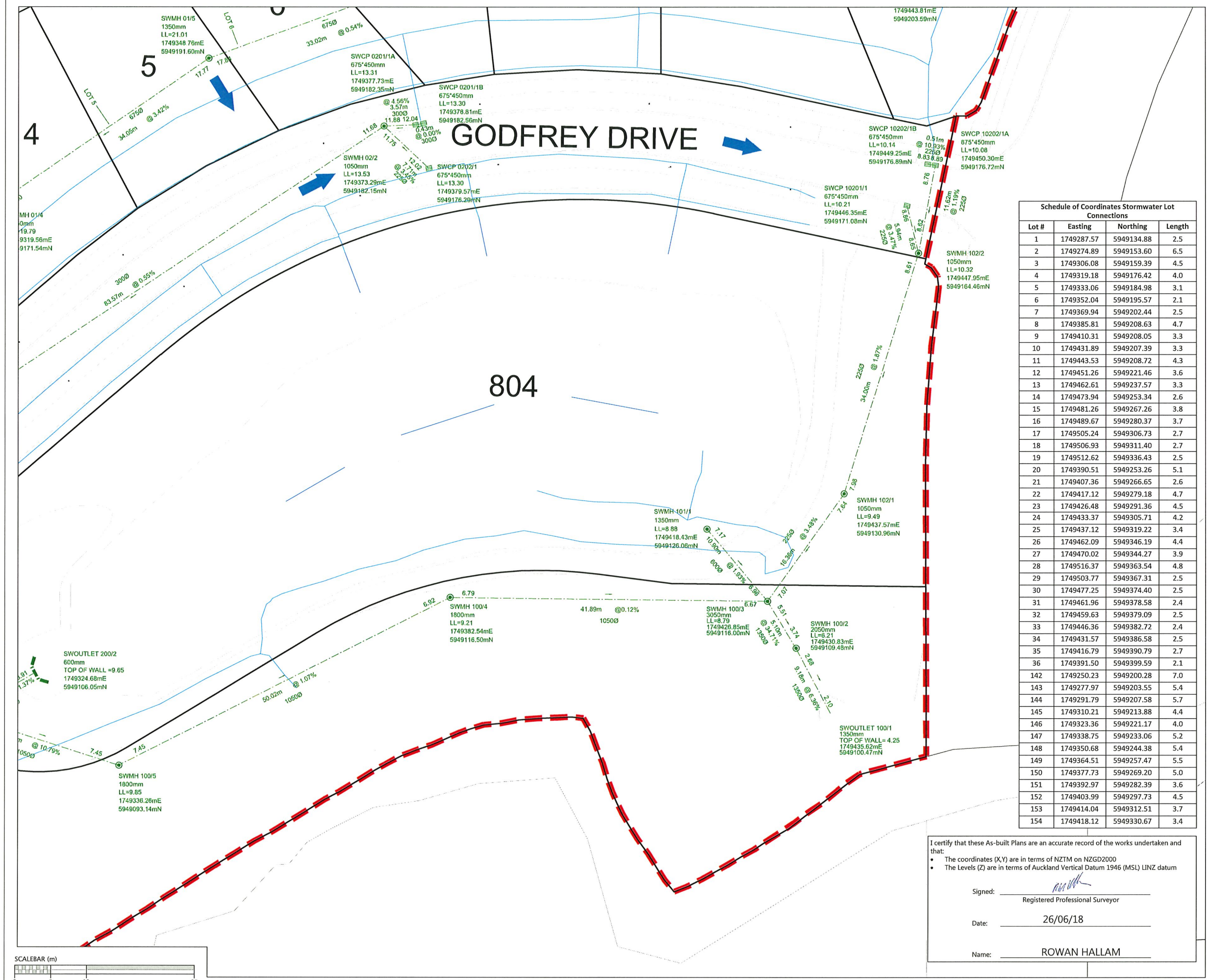
Name: ROWAN HALLAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/06/18
2	SIGNED AND ISSUED	MRH	26/08/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
STORMWATER AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-300-AB	



Schedule of Coordinates Stormwater Lot Connections			
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5	1749333.06	5949184.98	3.1
6	1749352.04	5949195.57	2.1
7	1749369.94	5949202.44	2.5
8	1749385.81	5949208.63	4.7
9	1749410.31	5949208.05	3.3
10	1749431.89	5949207.39	3.3
11	1749443.53	5949208.72	4.3
12	1749451.26	5949221.46	3.6
13	1749462.61	5949237.57	3.3
14	1749473.94	5949253.34	2.6
15	1749481.26	5949267.26	3.8
16	1749489.67	5949280.37	3.7
17	1749505.24	5949306.73	2.7
18	1749506.93	5949311.40	2.7
19	1749512.62	5949336.43	2.5
20	1749390.51	5949253.26	5.1
21	1749407.36	5949266.65	2.6
22	1749417.12	5949279.18	4.7
23	1749426.48	5949291.36	4.5
24	1749433.37	5949305.71	4.2
25	1749437.12	5949319.22	3.4
26	1749462.09	5949346.19	4.4
27	1749470.02	5949344.27	3.9
28	1749516.37	5949363.54	4.8
29	1749503.77	5949367.31	2.5
30	1749477.25	5949374.40	2.5
31	1749461.96	5949378.58	2.4
32	1749459.63	5949379.09	2.5
33	1749446.36	5949382.72	2.4
34	1749431.57	5949386.58	2.5
35	1749416.79	5949390.79	2.7
36	1749391.50	5949399.59	2.1
142	1749250.23	5949200.28	7.0
143	1749277.97	5949203.55	5.4
144	1749291.79	5949207.58	5.7
145	1749310.21	5949213.88	4.4
146	1749323.36	5949221.17	4.0
147	1749338.75	5949233.06	5.2
148	1749350.68	5949244.38	5.4
149	1749364.51	5949257.47	5.5
150	1749377.73	5949269.20	5.0
151	1749392.97	5949282.39	3.6
152	1749403.99	5949297.73	4.5
153	1749414.04	5949312.51	3.7
154	1749418.12	5949330.67	3.4

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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY

NOTES

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6. ALL PRIVATE DRAINAGE CONNECTIONS ARE 100mmø.
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REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/06/18
2	SIGNED AND ISSUED	MRH	26/08/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

N

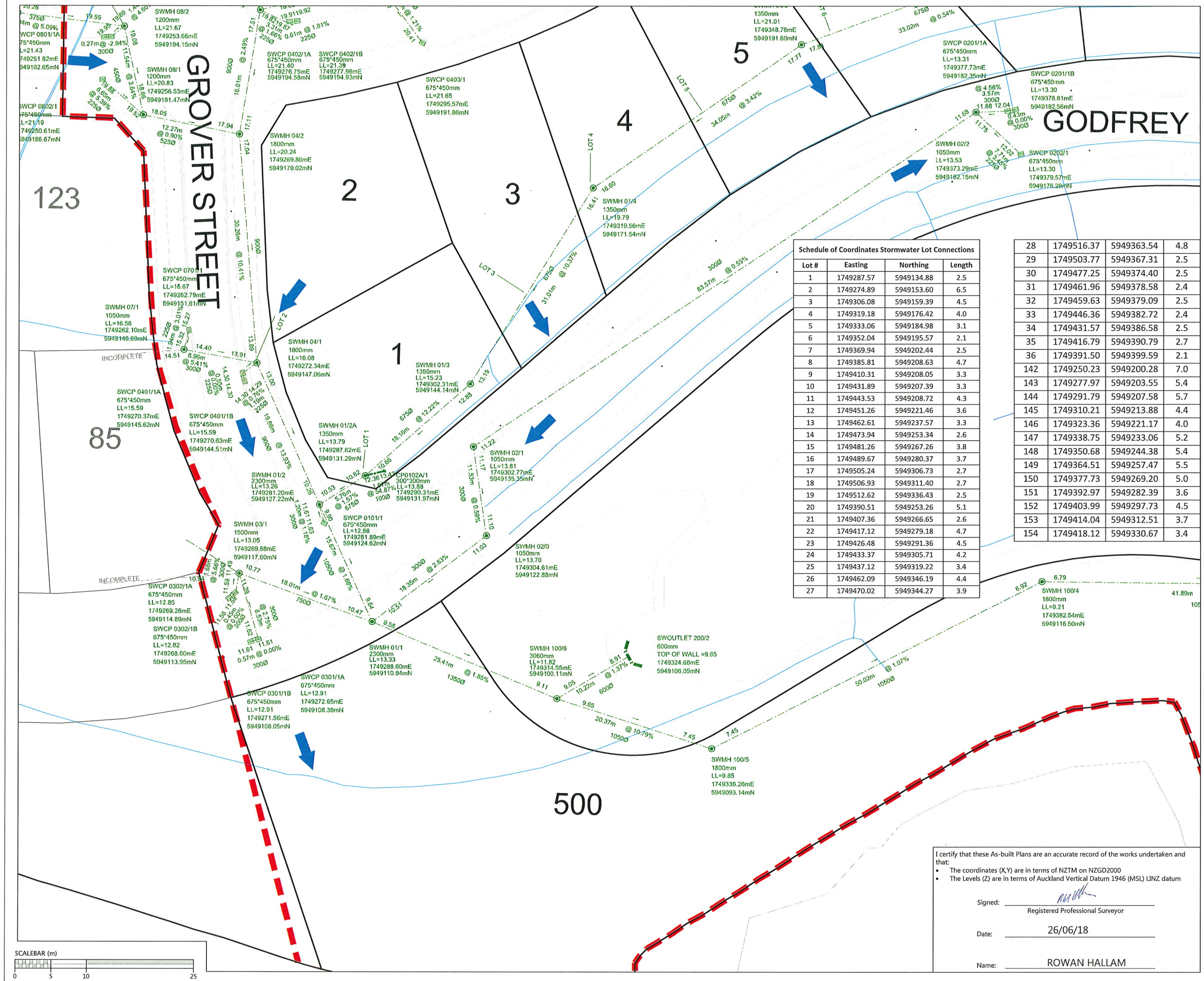
WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

STORMWATER AS-BUILT
SHEET 2 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-301-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURV\AS-BUILT\37501-01-300-AB-STORMWATER.DWG



Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
1	1749287.57	5949134.88	2.5
2	1749274.89	5949153.60	6.5
3	1749306.08	5949159.39	4.5
4	1749319.18	5949176.42	4.0
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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY

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SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

STORMWATER AS-BUILT
SHEET 3 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-302-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURV\AS-BUILT\37501-01-300-AB-STORMWATER.DWG

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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
1	1749287.57	5949134.88	2.5
2	1749274.89	5949153.60	6.5
3	1749306.08	5949159.39	4.5
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7	1749369.94	5949202.44	2.5
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11	1749443.53	5949208.72	4.3
12	1749451.26	5949221.46	3.6
13	1749462.61	5949237.57	3.3
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16	1749489.67	5949280.37	3.7
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27	1749470.02	5949344.27	3.9
28	1749516.37	5949363.54	4.8
29	1749503.77	5949367.31	2.5
30	1749477.25	5949374.40	2.5
31	1749461.96	5949378.58	2.4
32	1749459.63	5949379.09	2.5
33	1749446.36	5949382.72	2.4
34	1749431.57	5949386.58	2.5
35	1749416.79	5949390.79	2.7
36	1749391.50	5949399.59	2.1
142	1749250.23	5949200.28	7.0
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148	1749350.68	5949244.38	5.4
149	1749364.51	5949257.47	5.5
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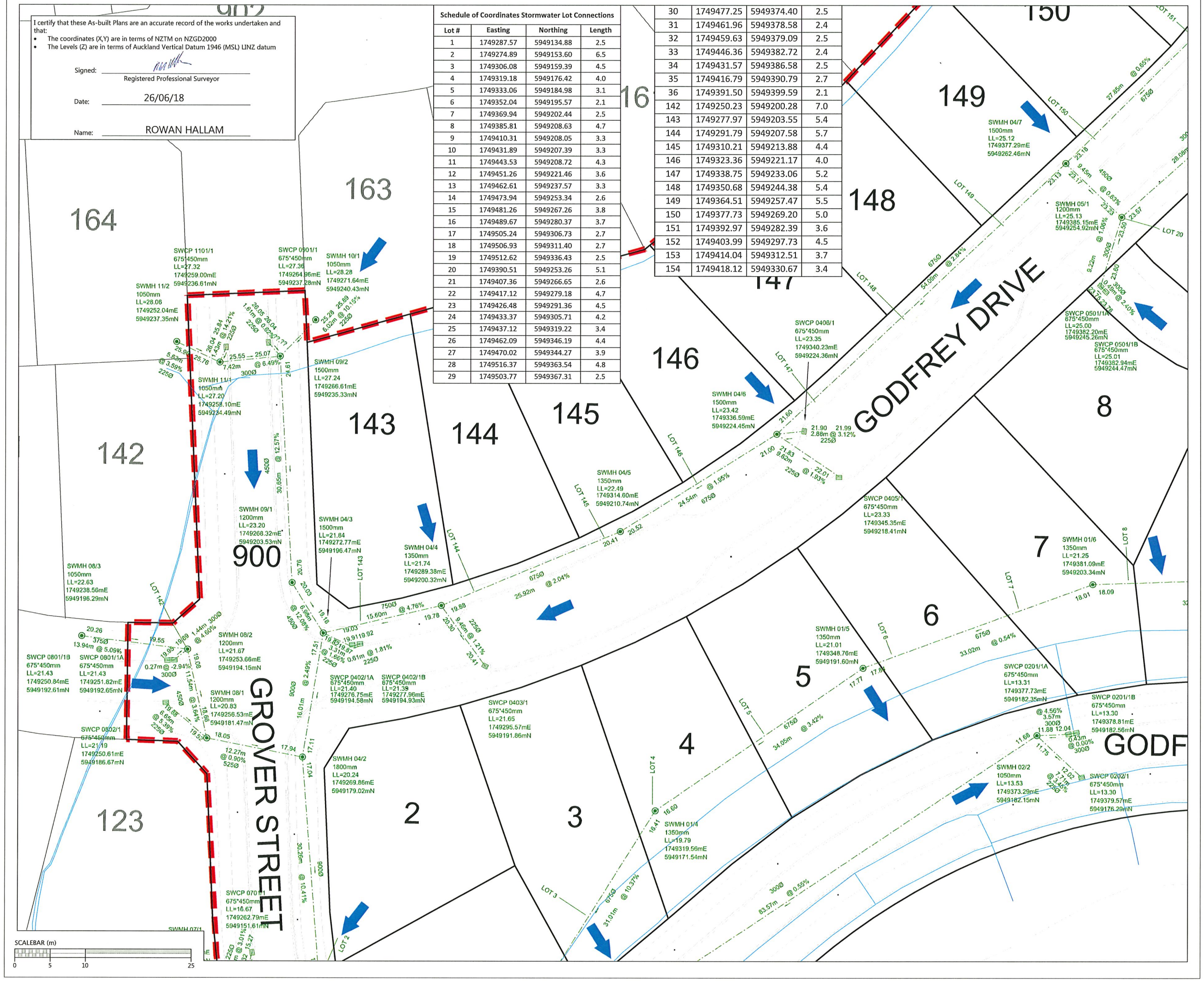

LEGEND

- STORMWATER MANHOLE
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY

NOTES

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REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/06/18
2	SIGNED AND ISSUED	MRH	27/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

N

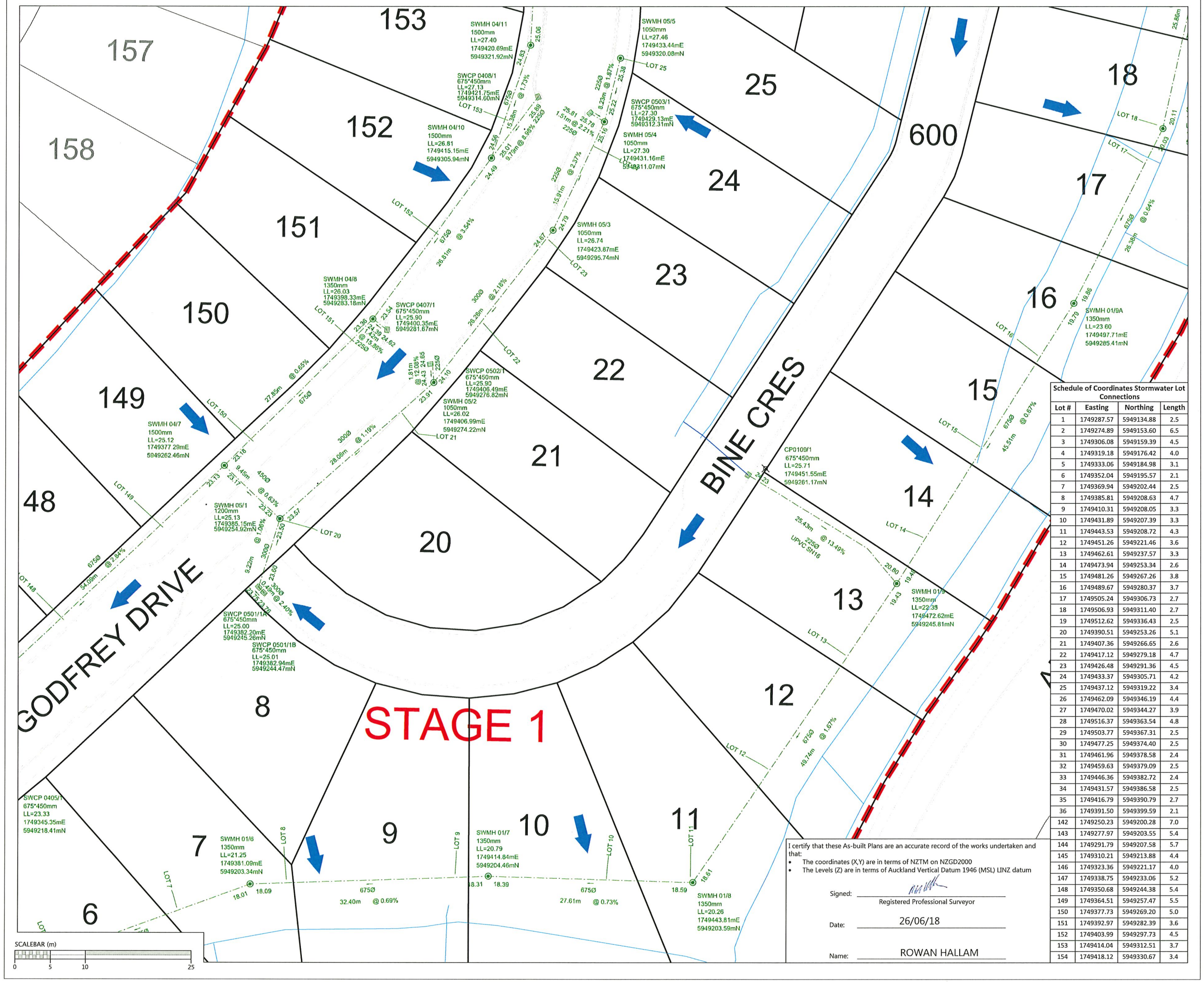
WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

STORMWATER AS-BUILT
SHEET 4 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-303-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-300-AB-STORMWATER.DWG



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27	1749470.02	5949344.27	3.9
28	1749516.37	5949363.54	4.8
29	1749503.77	5949367.31	2.5
30	1749477.25	5949374.40	2.5
31	1749461.96	5949378.58	2.4
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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY

NOTES

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REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/06/18
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SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

STORMWATER AS-BUILT
SHEET 5 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-304-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\ACAD DRAWINGS\SURV\AS-BUILT\37501-01-300-AB-STORMWATER.DWG

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WOODS EST.1970

LEGEND

- STORMWATER MANHOLE
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DESIGNED	AF	
DRAWN	PM	
CHECKED	KR	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

STORMWATER AS-BUILT
SHEET 6 OF 6
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-305-AB	

Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
1	1749287.57	5949134.88	2.5
2	1749274.89	5949153.60	6.5
3	1749306.08	5949159.39	4.5
4	1749319.18	5949176.42	4.0
5	1749333.06	5949184.98	3.1
6	1749352.04	5949195.57	2.1
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23	1749426.48	5949291.36	4.5
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148	1749350.68	5949244.38	5.4
149	1749364.51	5949257.47	5.5
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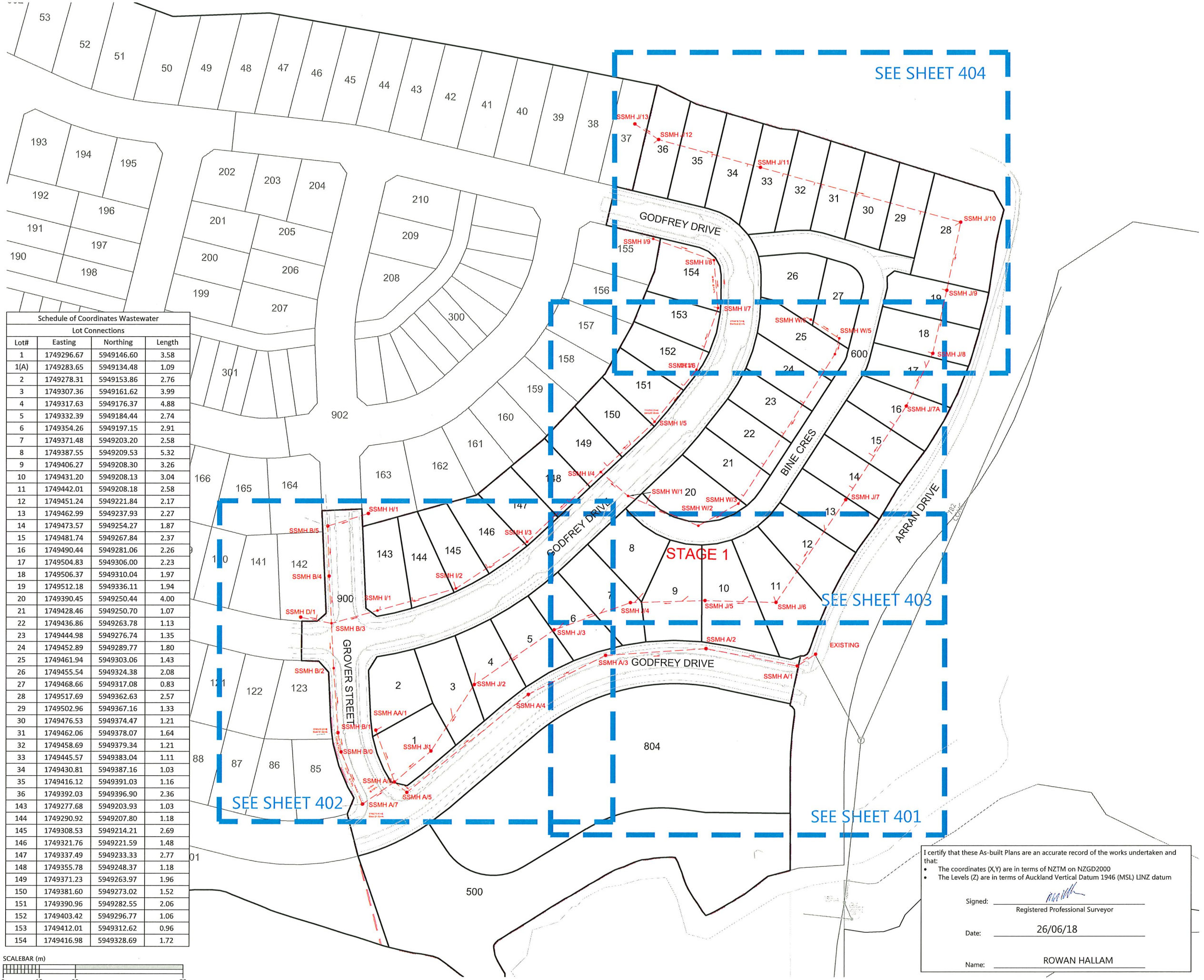
154	1749418.12	5949330.67	3.4

SCALEBAR (m)
0 5 10 25



Schedule of Coordinates Wastewater			
Lot Connections			
Lot#	Easting	Northing	Length
1	1749296.67	5949146.60	3.58
1(A)	1749283.65	5949134.48	1.09
2	1749278.31	5949153.86	2.76
3	1749307.36	5949161.62	3.99
4	1749317.63	5949176.37	4.88
5	1749332.39	5949184.44	2.74
6	1749354.26	5949197.15	2.91
7	1749371.48	5949203.20	2.58
8	1749387.55	5949209.53	5.32
9	1749406.27	5949208.30	3.26
10	1749431.20	5949208.13	3.04
11	1749442.01	5949208.18	2.58
12	1749451.24	5949221.84	2.17
13	1749462.99	5949237.93	2.27
14	1749473.57	5949254.27	1.87
15	1749481.74	5949267.84	2.37
16	1749490.44	5949281.06	2.26
17	1749504.83	5949306.00	2.23
18	1749506.37	5949310.04	1.97
19	1749512.18	5949336.11	1.94
20	1749390.45	5949250.44	4.00
21	1749428.46	5949250.70	1.07
22	1749436.86	5949263.78	1.13
23	1749444.98	5949276.74	1.35
24	1749452.89	5949289.77	1.80
25	1749461.94	5949303.06	1.43
26	1749455.54	5949324.38	2.08
27	1749468.66	5949317.08	0.83
28	1749517.69	5949362.63	2.57
29	1749502.96	5949367.16	1.33
30	1749476.53	5949374.47	1.21
31	1749462.06	5949378.07	1.64
32	1749458.69	5949379.34	1.21
33	1749445.57	5949383.04	1.11
34	1749430.81	5949387.16	1.03
35	1749416.12	5949391.03	1.16
36	1749392.03	5949396.90	2.36
143	1749277.68	5949203.93	1.03
144	1749290.92	5949207.80	1.18
145	1749308.53	5949214.21	2.69
146	1749321.76	5949221.59	1.48
147	1749337.49	5949233.33	2.77
148	1749355.78	5949248.37	1.18
149	1749371.23	5949263.97	1.96
150	1749381.60	5949273.02	1.52
151	1749390.96	5949282.55	2.06
152	1749403.42	5949296.77	1.06
153	1749412.01	5949312.62	0.96
154	1749416.98	5949328.69	1.72

SCALEBAR (m)

0 15 30 75

LEGEND

- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER
- EXISTING SANITARY SEWER
- FUTURE SANITARY SEWER
- STAGE BOUNDARY

NOTES

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I certify that these As-built Plans are an accurate record of the works undertaken and that:

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- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

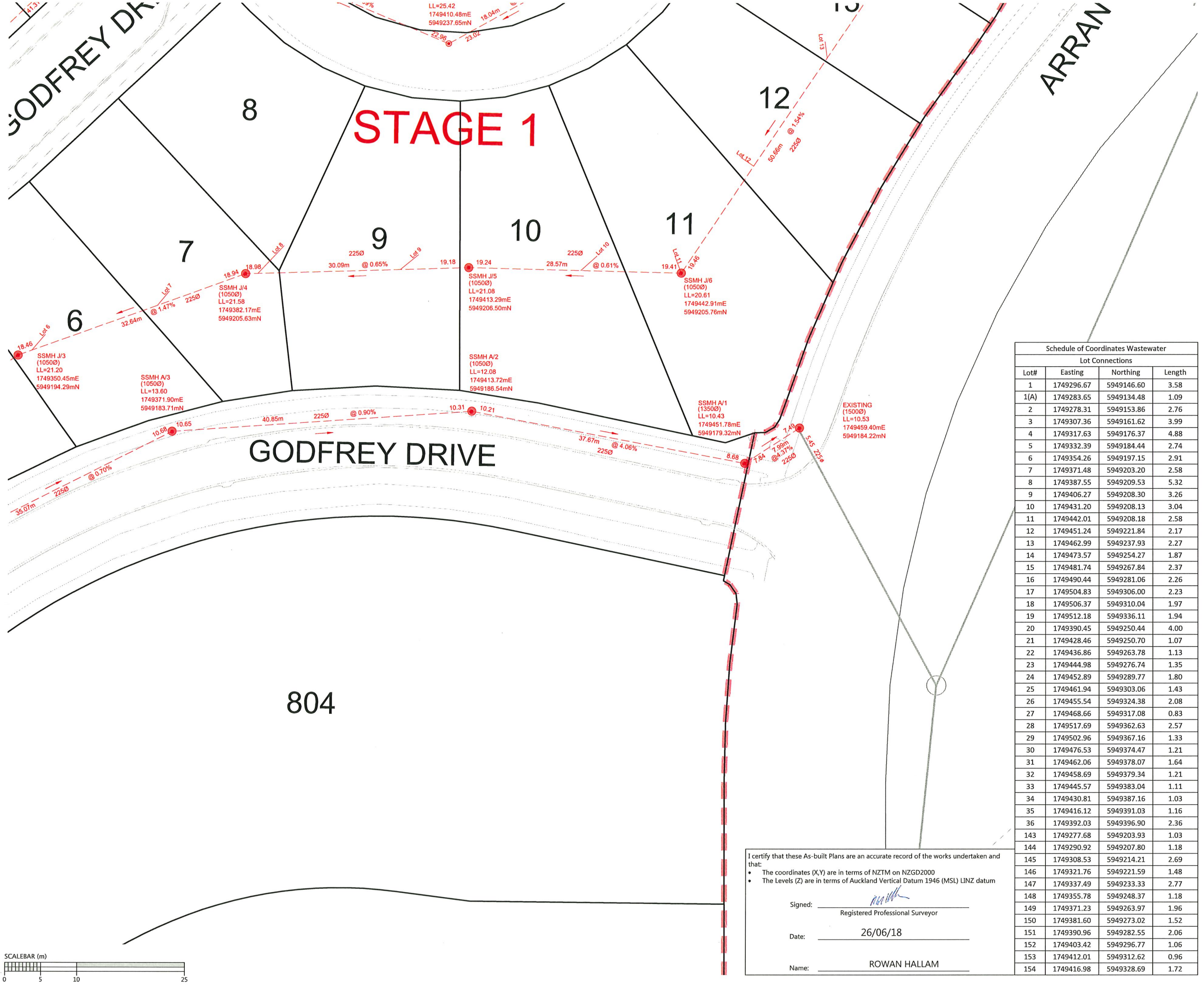
REVISION DETAILS		BY	DATE
1	ISSEUD FOR INFORMATION	KH	14/06/18
2	SIGNED AND ISSUED	MRH	27/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1
WASTEWATER AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 5
(SLC-66650)

STATUS	AS BUILT	REV
SCALE	1:1500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-400-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-400-AB-SEWER.DWG



WOODS
Est.1970

LEGEND

- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER
- EXISTING SANITARY SEWER
- FUTURE SANITARY SEWER
- STAGE BOUNDARY

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Schedule of Coordinates Wastewater

Lot Connections

Lot#	Easting	Northing	Length
1	1749296.67	5949146.60	3.58
1(A)	1749283.65	5949134.48	1.09
2	1749278.31	5949153.86	2.76
3	1749307.36	5949161.62	3.99
4	1749317.63	5949176.37	4.88
5	1749332.39	5949184.44	2.74
6	1749354.26	5949197.15	2.91
7	1749371.48	5949203.20	2.58
8	1749387.55	5949209.53	5.32
9	1749406.27	5949208.30	3.26
10	1749431.20	5949208.13	3.04
11	1749442.01	5949208.18	2.58
12	1749451.24	5949221.84	2.17
13	1749462.99	5949237.93	2.27
14	1749473.57	5949254.27	1.87
15	1749481.74	5949267.84	2.37
16	1749490.44	5949281.06	2.26
17	1749504.83	5949306.00	2.23
18	1749506.37	5949310.04	1.97
19	1749512.18	5949336.11	1.94
20	1749390.45	5949250.44	4.00
21	1749428.46	5949250.70	1.07
22	1749436.86	5949263.78	1.13
23	1749444.98	5949276.74	1.35
24	1749452.89	5949289.77	1.80
25	1749461.94	5949303.06	1.43
26	1749455.54	5949324.38	2.08
27	1749468.66	5949317.08	0.83
28	1749517.69	5949362.63	2.57
29	1749502.96	5949367.16	1.33
30	1749476.53	5949374.47	1.21
31	1749462.06	5949378.07	1.64
32	1749458.69	5949379.34	1.21
33	1749445.57	5949383.04	1.11
34	1749430.81	5949387.16	1.03
35	1749416.12	5949391.03	1.16
36	1749392.03	5949396.90	2.36
143	1749277.68	5949203.93	1.03
144	1749290.92	5949207.80	1.18
145	1749308.53	5949214.21	2.69
146	1749321.76	5949221.59	1.48
147	1749337.49	5949233.33	2.77
148	1749355.78	5949248.37	1.18
149	1749371.23	5949263.97	1.96
150	1749381.60	5949273.02	1.52
151	1749390.96	5949282.55	2.06
152	1749403.42	5949296.77	1.06
153	1749412.01	5949312.62	0.96
154	1749416.98	5949328.69	1.72

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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KH	14/06/18
2	SIGNED AND ISSUED	MRH	27/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5
OREWA WEST
STAGE 1

WASTEWATER AS-BUILT
SHEET 2 OF 5
(SLC-66650)

STATUS	AS BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-401-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-400-AB-SEWER.DWG

Schedule of Coordinates Wastewater			
Lot Connections			
Lot#	Easting	Northing	Length
1	1749296.67	5949146.60	3.58
1(A)	1749283.65	5949134.48	1.09
2	1749278.31	5949153.86	2.76
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10	1749431.20	5949208.13	3.04
11	1749442.01	5949208.18	2.58
12	1749451.24	5949221.84	2.17
13	1749462.99	5949237.93	2.27
14	1749473.57	5949254.27	1.87
15	1749481.74	5949267.84	2.37
16	1749490.44	5949281.06	2.26
17	1749504.83	5949306.00	2.23
18	1749506.37	5949310.04	1.97
19	1749512.18	5949336.11	1.94
20	1749390.45	5949250.44	4.00
21	1749428.46	5949250.70	1.07
22	1749436.86	5949263.78	1.13
23	1749444.98	5949276.74	1.35
24	1749452.89	5949289.77	1.80
25	1749461.94	5949303.06	1.43
26	1749455.54	5949324.38	2.08
27	1749468.66	5949317.08	0.83
28	1749517.69	5949362.63	2.57
29	1749502.96	5949367.16	1.33
30	1749476.53	5949374.47	1.21
31	1749462.06	5949378.07	1.64
32	1749458.69	5949379.34	1.21
33	1749445.57	5949383.04	1.11
34	1749430.81	5949387.16	1.03
35	1749416.12	5949391.03	1.16
36	1749392.03	5949396.90	2.36
143	1749277.68	5949203.93	1.03
144	1749290.92	5949207.80	1.18
145	1749308.53	5949214.21	2.69
146	1749321.76	5949221.59	1.48
147	1749337.49	5949233.33	2.77
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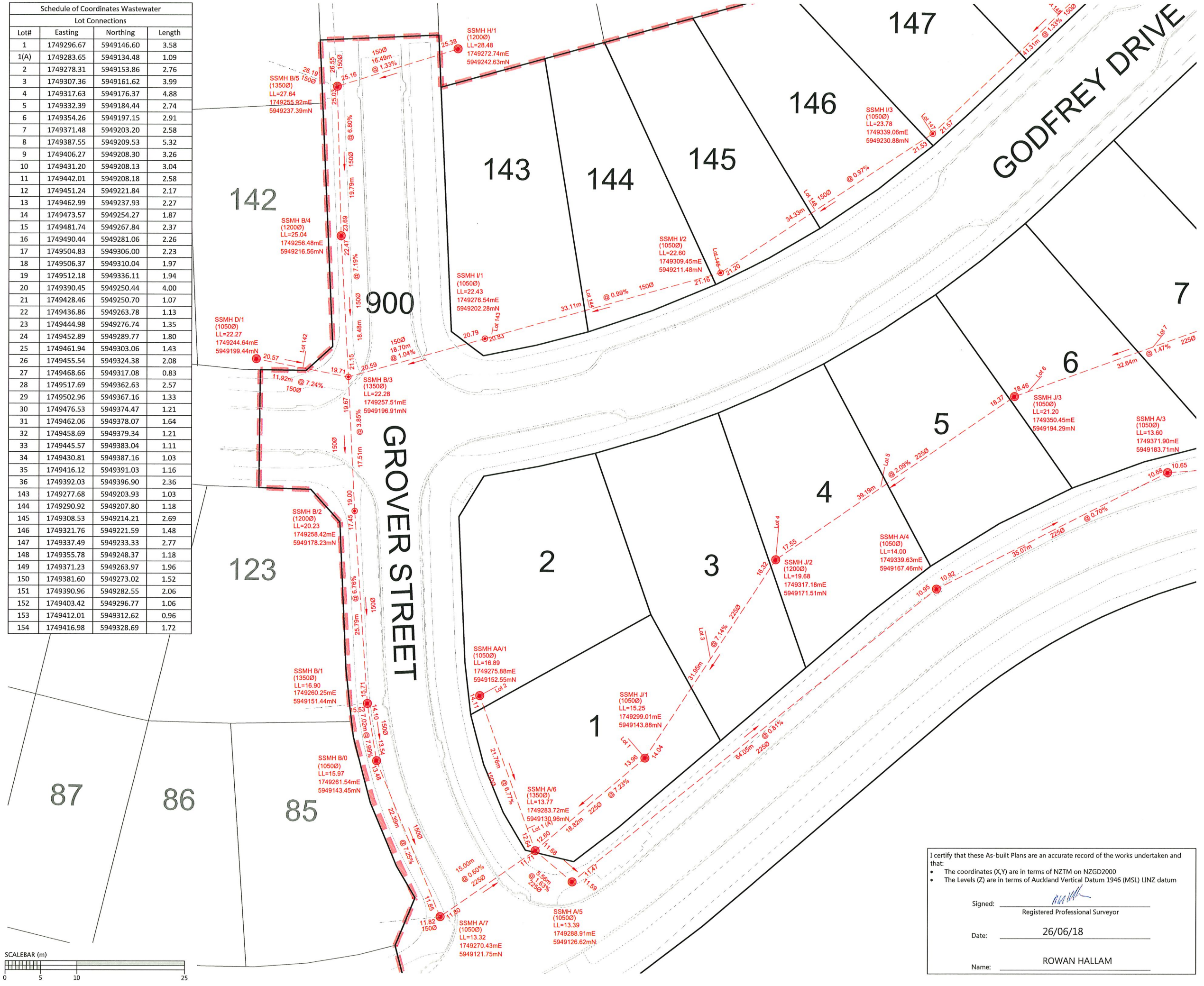
149	1749371.23	5949263.97	1.96
150	1749381.60	5949273.02	1.52
151	1749390.96	5949282.55	2.06
152	1749403.42	5949296.77	1.06
153	1749412.01	5949312.62	0.96
154	1749416.98	5949328.69	1.72



LEGEND

- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER
- EXISTING SANITARY SEWER
- FUTURE SANITARY SEWER
- STAGE BOUNDARY

NOTES

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REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KH	14/06/18
2	SIGNED AND ISSUED	MRH	27/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

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Signed: _____
Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

MILLWATER PRECINCT 5 OREWA WEST STAGE 1

WASTEWATER AS-BUILT SHEET 3 OF 5 (SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-402-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-400-AB-SEWER.DWG

Schedule of Coordinates Wastewater			
Lot Connections			
Lot#	Easting	Northing	Length
1	1749296.67	5949146.60	3.58
1(A)	1749283.65	5949134.48	1.09
2	1749278.31	5949153.86	2.76
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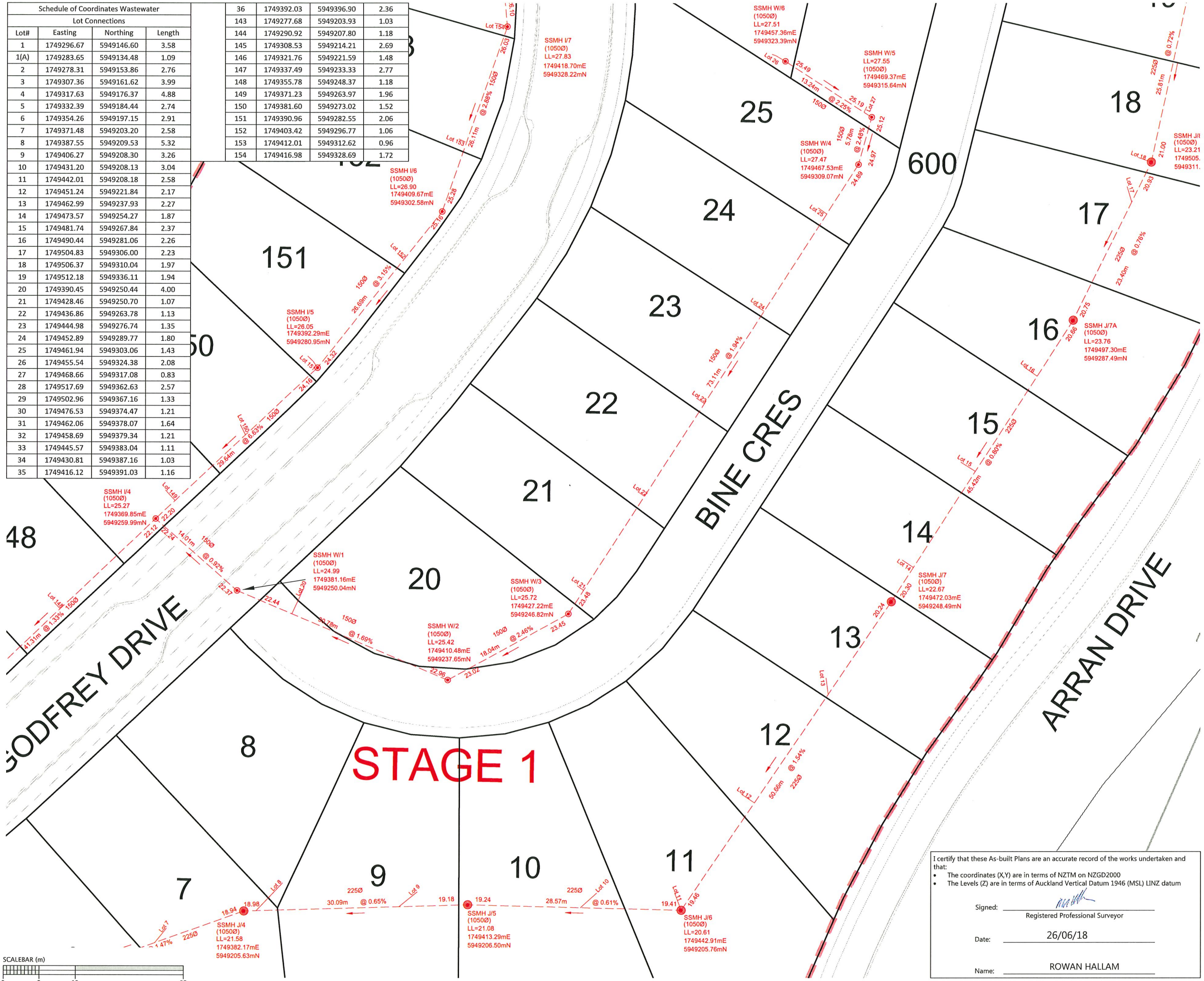

LEGEND

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- NEW SANITARY SEWER
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Registered Professional Surveyor

Date: 26/06/18

Name: ROWAN HALLAM

MILLWATER PRECINCT 5 OREWA WEST STAGE 1

WASTEWATER AS-BUILT SHEET 4 OF 5 (SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-403-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-400-AB-SEWER.DWG

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Name: ROWAN HALLAM

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28	1749517.69	5949362.63	2.57
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30	1749476.53	5949374.47	1.21
31	1749462.06	5949378.07	1.64
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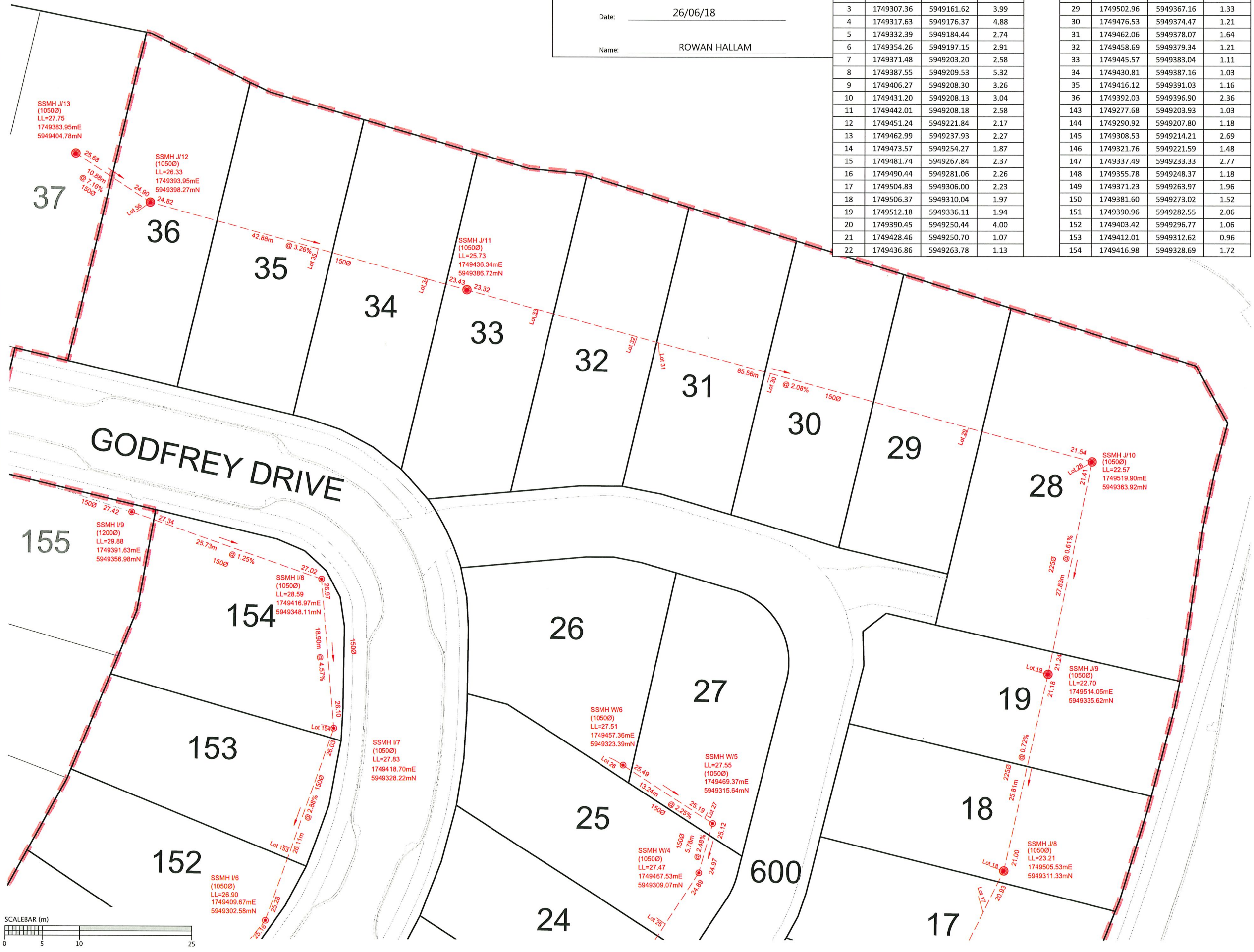
148	1749355.78	5949248.37	1.18
149	1749371.23	5949263.97	1.96
150	1749381.60	5949273.02	1.52
151	1749390.96	5949282.55	2.06
152	1749403.42	5949296.77	1.06
153	1749412.01	5949312.62	0.96
154	1749416.98	5949328.69	1.72



LEGEND

- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER
- EXISTING SANITARY SEWER
- FUTURE SANITARY SEWER
- STAGE BOUNDARY

NOTES

1. ALL WORKS AND MATERIALS COMPLY WITH AUCKLAND COUNCIL & WATERCARE SERVICES LTD STANDARDS FOR ENGINEERING DESIGN AND CONSTRUCTION.
2. ALL SANITARY SEWER LINES ARE 150mmØ uPVC CLASS SN16 UNLESS STATED OTHERWISE.
3. ALL PIPE BEDDING COMPLIES WITH WATERCARE STANDARDS.
4. ALL PIPE CROSSINGS UNDER ROADS AND ACCESSWAYS HAVE BEEN HARDFILL BACKFILLED.
5. ALL PRIVATE LOT CONNECTIONS ARE 100mmØ
6. LOT BOUNDARIES ARE SUBJECT TO FINAL SURVEY.
7. ALL PIPE AND MH DIAMETERS ARE INTERNAL, AND SHOWN IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
8. ASBUILT DATA HAS BEEN SOURCED FROM A COMBINATION OF WOODS SURVEY MEASURED DATA AND CONTRACTOR RECEIVED DATA.

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KH	14/06/18
2	SIGNED AND ISSUED	MRH	26/06/18

SURVEYED	WOODS	WOODS Ltd LEVEL 1 BUILDING B, 8 NUGENT STREET, GRAFTON AUCKLAND 1023 09 308 9229
DESIGNED	MB	
DRAWN	KH	
CHECKED	AF	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER PRECINCT 5 OREWA WEST STAGE 1

WASTEWATER AS-BUILT
SHEET 5 OF 5
(SLC-66650)

STATUS	AS-BUILT	REV
SCALE	1:500 @ A3	2
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37501-01-404-AB	

Document No. K:\37501 - ARRAN HILL PRECINCT 5 STAGE 1\PROJECT DATA\CAD DRAWINGS\SURVAS-BUILT\37501-01-400-AB-SEWER.DWG

Appendix A2: T+T Drawings

- 21854.0031–AHP5S1–100 Drawing List and Site Location Plan
- 21854.0031–AHP5S1–101 Geotechnical Works Plan
- 21854.0031–AHP5S1–102 Geotechnical Works Subsoil Drain Plan
- 21854.0031–AHP5S1–103 Geological Cross Section 1
- 21854.0031–AHP5S1–104 Geological Cross Section 2
- 21854.0031–AHP5S1–105 Geological Cross Section 3
- 21854.0031–AHP5S1–106 Geological Cross Section 4
- 21854.0031–AHP5S1–107 Geological Cross Section 5
- 21854.0031–AHP5S1–108 Geological Cross Section 6
- 21854.0031–AHP5S1–109 Geological Cross Section 7
- 21854.0031–AHP5S1–110 Geological Cross Section 8
- 21854.0031–AHP5S1–111 Retaining Wall 01 – Plan and Elevation
- 21854.0031–AHP5S1–112 Retaining Wall 01 – Typical Section (CH 0 to 30m)
- 21854.0031–AHP5S1–113 Retaining Wall 01 – Typical Sections (CH 30 to 180m)
- 21854.0031–AHP5S1–114 Retaining Wall 01 – Typical Sections (CH 180 to 280m)
- 21854.0031–AHP5S1–115 Retaining Wall 01 – Typical Sections (CH 280 to 450m)
- 21854.0031–AHP5S1–116 Retaining Wall 01 – Typical Sections (CH 450 to 465m)
- 21854.0031–AHP5S1–117 Retaining Wall 02 – Plan and Elevation
- 21854.0031–AHP5S1–118 Retaining Wall 02 – Typical Sections
- 21854.0031–AHP5S1–119 Retaining Wall 05 – Plan and Elevation
- 21854.0031–AHP5S1–120 Retaining Wall 05 – Typical Section (H<=3m)
- 21854.0031–AHP5S1–121 Retaining Wall 05 – Typical Section (3m<H<=4.7m)
- 21854.0031–AHP5S1–122 Retaining Wall 07 – Plan and Elevation
- 21854.0031–AHP5S1–123 Retaining Wall 07 – Typical Section

- 21854.0031–AHP5S1–124 RE Slope 6 – Typical Section
- 21854.0031–AHP5S1–125 RE Slope 7 – Typical Section (Sheet 1 of 2)
- 21854.0031–AHP5S1–126 RE Slope 7 – Typical Section (Sheet 2 of 2)
- 21854.0031–AHP5S1–127 Shear Key 01 and 02 Plan
- 21854.0031–AHP5S1–128 Shear Key 01 Longsection (Sheet 1 of 2)
- 21854.0031–AHP5S1–129 Shear Key 01 Longsection (Sheet 2 of 2)
- 21854.0031–AHP5S1–130 Geology Legend and Definition of Terms
- 21854.0031–AHP5S1–131 Building Limitation Plan

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WFH PROPERTIES LTD
MILLWATER - ARRANS HILL
PRECINCT 5 STAGE 1
Completion Report Issue

DRAWING	Rev	Title
GENERAL		
• 21854.0031-AHP5S1-100	1	DRAWING LIST AND LOCATION PLAN
• 21854.0031-AHP5S1-101	1	GEOTECHNICAL WORKS PLAN
• 21854.0031-AHP5S1-102	1	GEOTECHNICAL WORKS SUBSOIL DRAIN PLAN
• 21854.0031-AHP5S1-103	1	GEOLOGICAL CROSS SECTION 1
• 21854.0031-AHP5S1-104	1	GEOLOGICAL CROSS SECTION 2
• 21854.0031-AHP5S1-105	1	GEOLOGICAL CROSS SECTION 3
• 21854.0031-AHP5S1-106	1	GEOLOGICAL CROSS SECTION 4
• 21854.0031-AHP5S1-107	1	GEOLOGICAL CROSS SECTION 5
• 21854.0031-AHP5S1-108	1	GEOLOGICAL CROSS SECTION 6
• 21854.0031-AHP5S1-109	1	GEOLOGICAL CROSS SECTION 7
• 21854.0031-AHP5S1-110	1	GEOLOGICAL CROSS SECTION 8
• 21854.0031-AHP5S1-111	1	RETAINING WALL 01 - PLAN AND ELEVATION
• 21854.0031-AHP5S1-112	1	RETAINING WALL 01 - TYPICAL SECTION (CH 0 TO 30m)
• 21854.0031-AHP5S1-113	1	RETAINING WALL 01 - TYPICAL SECTION (CH 30 TO 180m)
• 21854.0031-AHP5S1-114	1	RETAINING WALL 01 - TYPICAL SECTION (CH 180 TO 280m)
• 21854.0031-AHP5S1-115	1	RETAINING WALL 01 - TYPICAL SECTION (CH 280 TO 450m)
• 21854.0031-AHP5S1-116	1	RETAINING WALL 01 - TYPICAL SECTION (CH 450 TO 465m)
• 21854.0031-AHP5S1-117	1	RETAINING WALL 02 - PLAN AND ELEVATION
• 21854.0031-AHP5S1-118	1	RETAINING WALL 02 - TYPICAL SECTIONS
• 21854.0031-AHP5S1-119	1	RETAINING WALL 05 - PLAN AND ELEVATION
• 21854.0031-AHP5S1-120	1	RETAINING WALL 05 - TYPICAL SECTION (H≤3m)
• 21854.0031-AHP5S1-121	1	RETAINING WALL 05 - TYPICAL SECTION (3m<H≤4.7m)
• 21854.0031-AHP5S1-122	1	RETAINING WALL 07 - PLAN AND ELEVATION
• 21854.0031-AHP5S1-123	1	RETAINING WALL 07 - TYPICAL SECTION
• 21854.0031-AHP5S1-124	1	RE SLOPE 6 - TYPICAL SECTION
• 21854.0031-AHP5S1-125	1	RE SLOPE 7 - TYPICAL SECTION (SHEET 1 OF 2)
• 21854.0031-AHP5S1-126	1	RE SLOPE 7 - TYPICAL SECTION (SHEET 2 OF 2)
• 21854.0031-AHP5S1-127	1	SHEAR KEY 01 AND 02 PLAN
• 21854.0031-AHP5S1-128	1	SHEAR KEY 01 LONGSECTION (SHEET 1 OF 2)
• 21854.0031-AHP5S1-129	1	SHEAR KEY 01 LONGSECTION (SHEET 2 OF 2)
• 21854.0031-AHP5S1-130	1	GEOLOGY LEGEND AND DEFINITION OF TERMS
• 21854.0031-AHP5S1-131	1	BUILDING LIMITATION PLAN
• 21854.0031-AHP5S1-132	1	POST EARTHWORKS INVESTIGATION PLAN
• 21854.0031-AHP5S1-133	1	TOPSOIL DEPTHS PLAN
• 21854.0031-AHP5S1-134	1	EARTHWORKS TESTING LOCATION PLAN

LOCATION PLAN
SCALE 1:10,000

SCALE 1:10,000
0 100 200 300 400 500 (M)

ORIGINAL IN COLOUR

• Denotes drawing this issue: 29/06/2018

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

NOT FOR CONSTRUCTION

APPROVED DATE

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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
DRAWING LIST AND LOCATION PLAN

SCALE (A3) 1:10,000 DWG No. 21854.0031-AHP5S1-100 REV 1

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GRAND DRIVE
PALISADE WALL 7
RE SLOPE 7
UNDERCUT 5
WALL 05
UNDERCUT 2
RE SLOPE 6
WALL 07
BINE CRES
ARRAN DRIVE
GODFREY DRIVE
GROVER STREET
UNDERCUT 3
SHEARKEY 2
SHEARKEY 1
WALL 02
RE SLOPE 1
WALL 01
WETLAND GABION WALLS
TP220 TP228 TP225 TP226 TP227 TP234 TP223 TP224 TP234A BH17 TP222 BH15 BH16 TP232 TP233 TP231 TP235 TP236 TP221 TP244 TP237 TP230 TP242 TP229 TP239 TP219A TP219 TP238 TP218 TP284 TP270 TP269 TP264 TP266 TP261 TP259 TP258 TP216 TP217 TP215 TP285 TP286 TP213 TP288 TP210 TP287 TP214 TP211 TP289 TP212 TP290 TP209 TP249 TP207 TP206 TP208 TP248 TP2 TP246 TP247 TP1
BH30 BH29 BH27 BH28 BH19 BH18 BH4 BH12 BH5 BH20 BH6 BH13 BH10
CPT1 CPT2 CPT3 CPT4 CPT5 CPT6 CPT7 CPT8 CPT9 CPT10 CPT11 CPT12 CPT13 CPT14 CPT15 CPT16 CPT23 CPT30 CPT31 CPT32 CPT33 CPT34 CPT35 CPT36 CPT37 CPT38 CPT39 CPT40

ORIGINAL IN COLOUR

A3 SCALE 1:2000

0 20 40 60 80 100 (m)

LEGEND

- STAGE 1 BOUNDARY
- 23 LOT BOUNDARIES
- 24 FINISHED GROUND PROFILE (0.5M INTERVAL)
- RETAINING WALLS
- 400 SED OR 250UC73 PILES
- GABION WALLS
- RE SLOPE EXTENT
- UNDERCUT EXTENT
- SHEAR KEY EXTENT

HISTORICAL INVESTIGATION BY TONKIN & TAYLOR

- BH4 BOREHOLES LOCATIONS (JUN.06)
- BH12 BOREHOLES LOCATIONS (APR.07)
- TP255 TESTPIT LOCATIONS (JUN.-AUG.07)
- BH18 BOREHOLES LOCATION (APR.08)
- BH28 BOREHOLES LOCATION (JULY10)
- CPT15 CONE PENETROMETER TEST LOCATIONS (JAN.10)
- CPT3 CONE PENETROMETER TEST LOCATIONS (JULY.10)
- CPT30 CONE PENETROMETER TEST LOCATIONS (JUNE.12)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOTECHNICAL WORKS PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-101 REV 1

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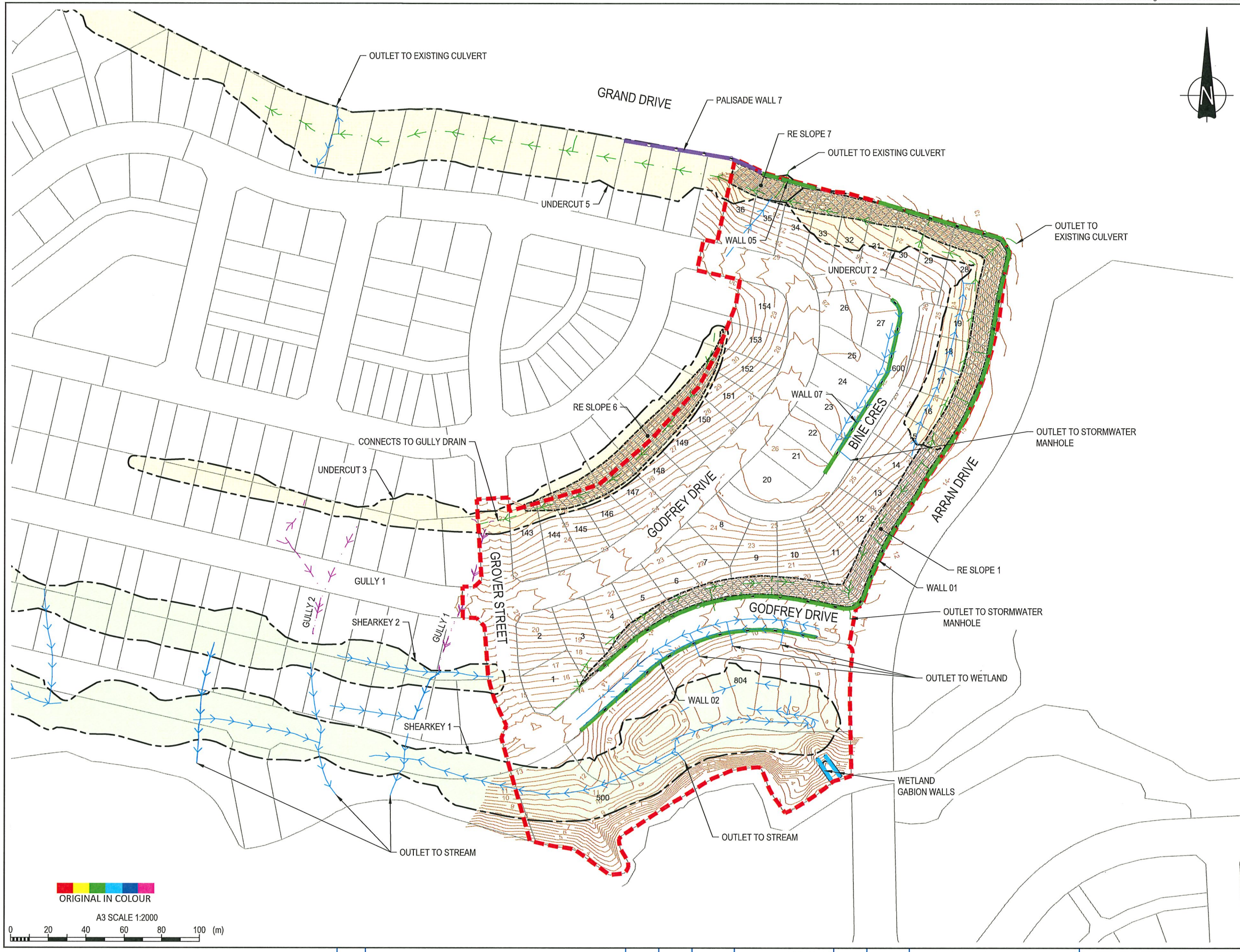

LEGEND

- STAGE 1 BOUNDARY
- 23 — LOT BOUNDARIES
- 24 — FINISHED GROUND PROFILE (0.5M INTERVAL)
- RETAINING WALLS
- 400 SED OR 250UC73 PILES
- GABION WALLS
- RE SLOPE EXTENT
- UNDERCUT EXTENT
- SHEAR KEY EXTENT
- SUBSOIL DRAIN
- REINFORCED EARTH SLOPE SUBSOIL DRAIN
- GULLY SUBSOIL DRAIN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

ORIGINAL IN COLOUR

A3 SCALE 1:2000

0 20 40 60 80 100 (m)

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS	COMPLETION REPORT
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APPROVED DATE

CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOTECHNICAL WORKS SUBSOIL DRAIN PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-102 REV 1

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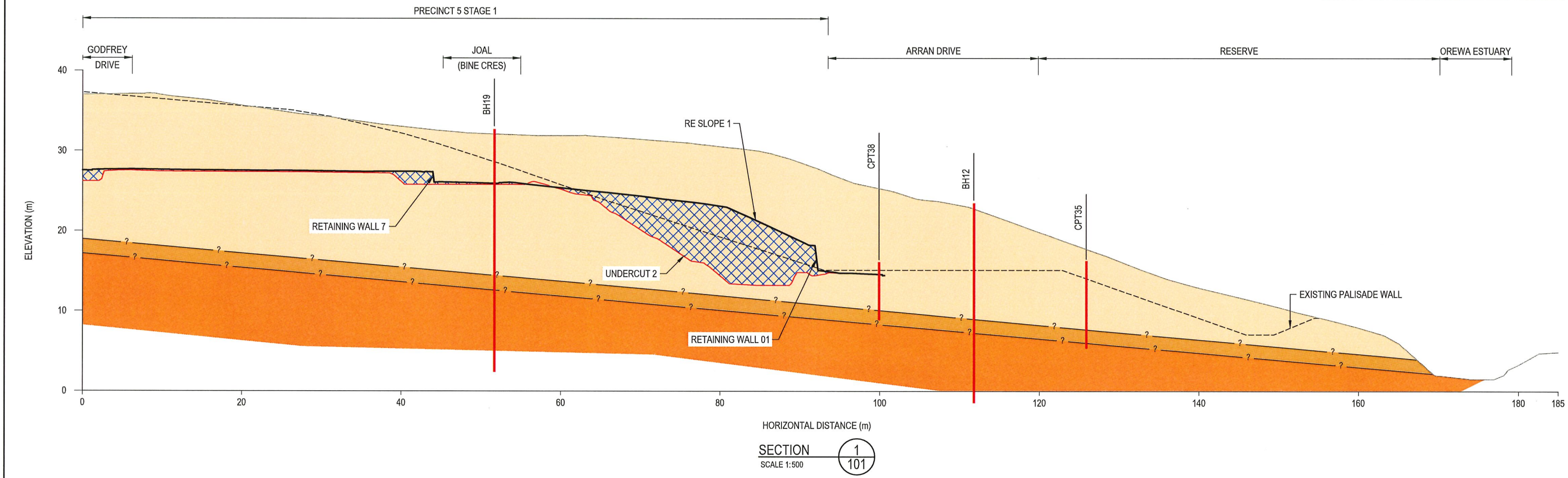
LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)



SECTION 1/101
SCALE 1:500

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

NOTE:
1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
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CLIENT: WFH PROPERTIES LTD
PROJECT: MILLWATER - ARRANS HILL
TITLE: PRECINCT 5 STAGE 1 GEOLOGICAL CROSS SECTION 1
SCALE (A3): 1:500 DWG No. 21854.0031-AHP5S1-103 REV 1

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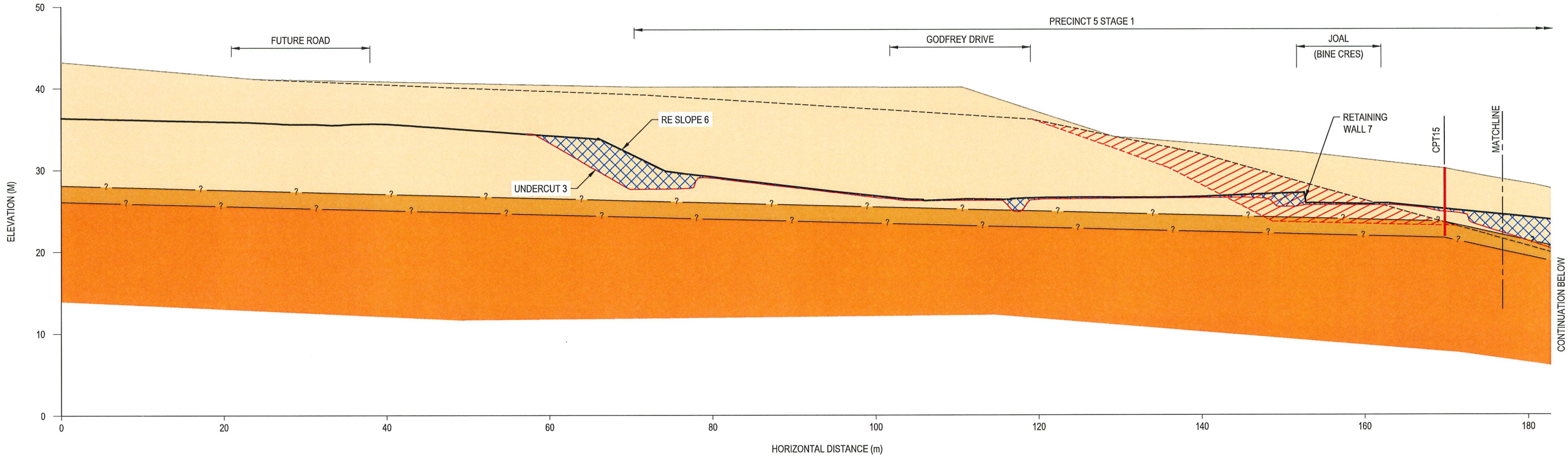

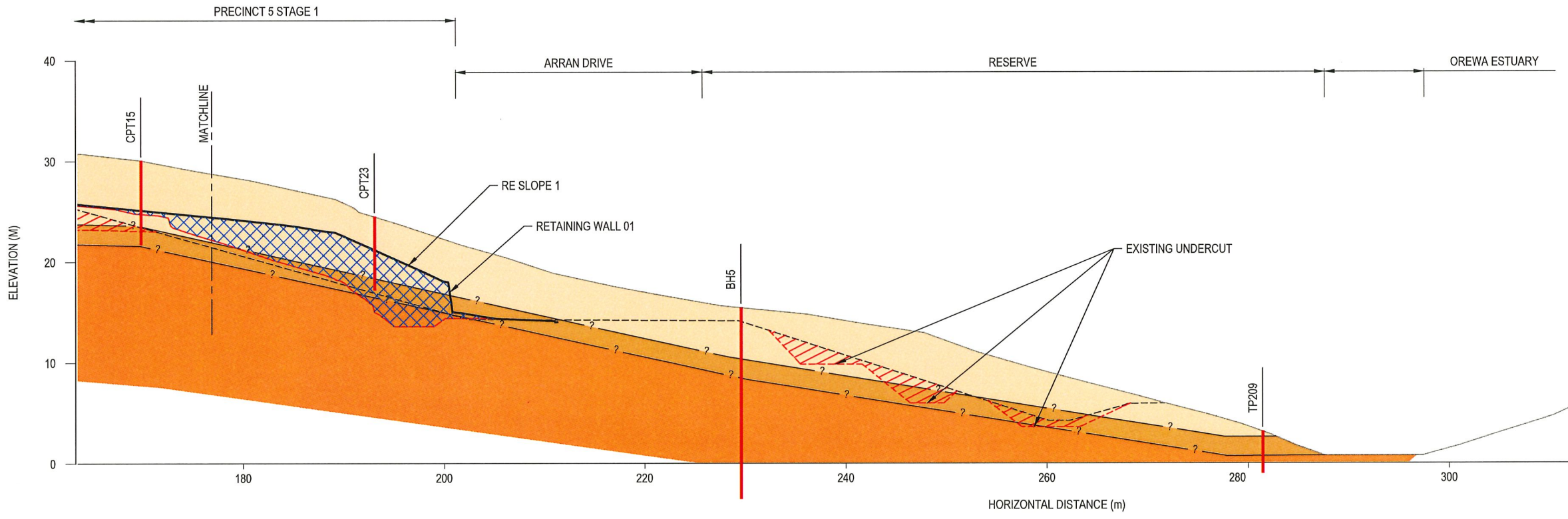

LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)

A3 SCALE 1:500

0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

SECTION 2/101

SCALE 1: 500

NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.

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REV	DESCRIPTION	CAD	CHK	DATE
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DRAWING CHECKED			

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PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 2

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-104 REV 1

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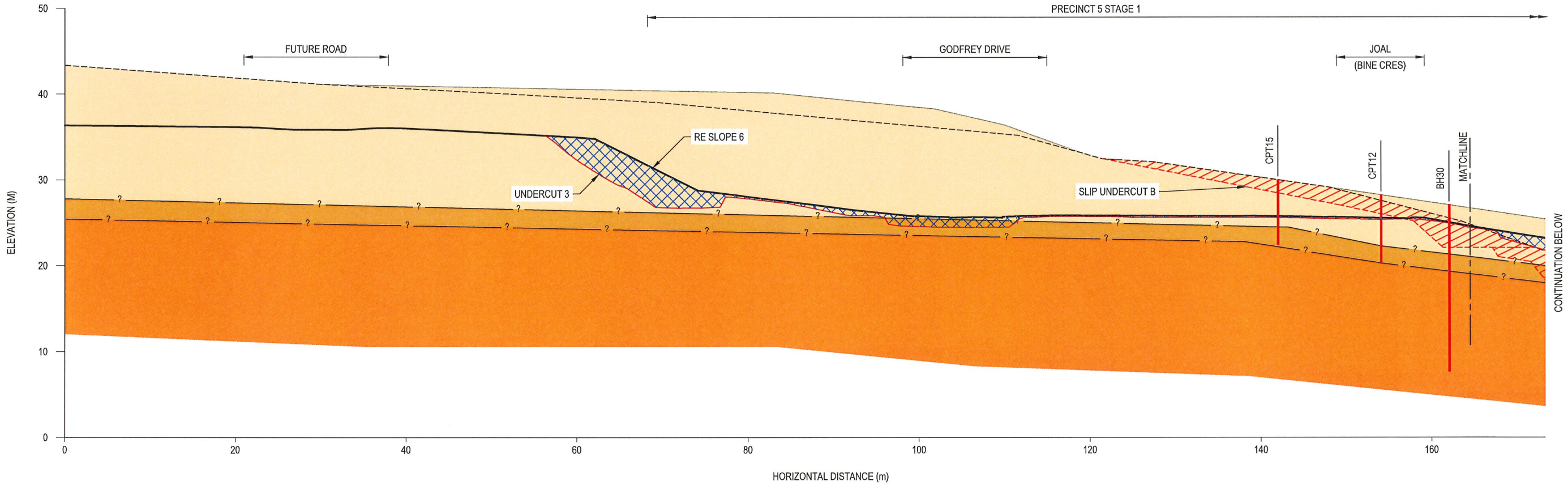

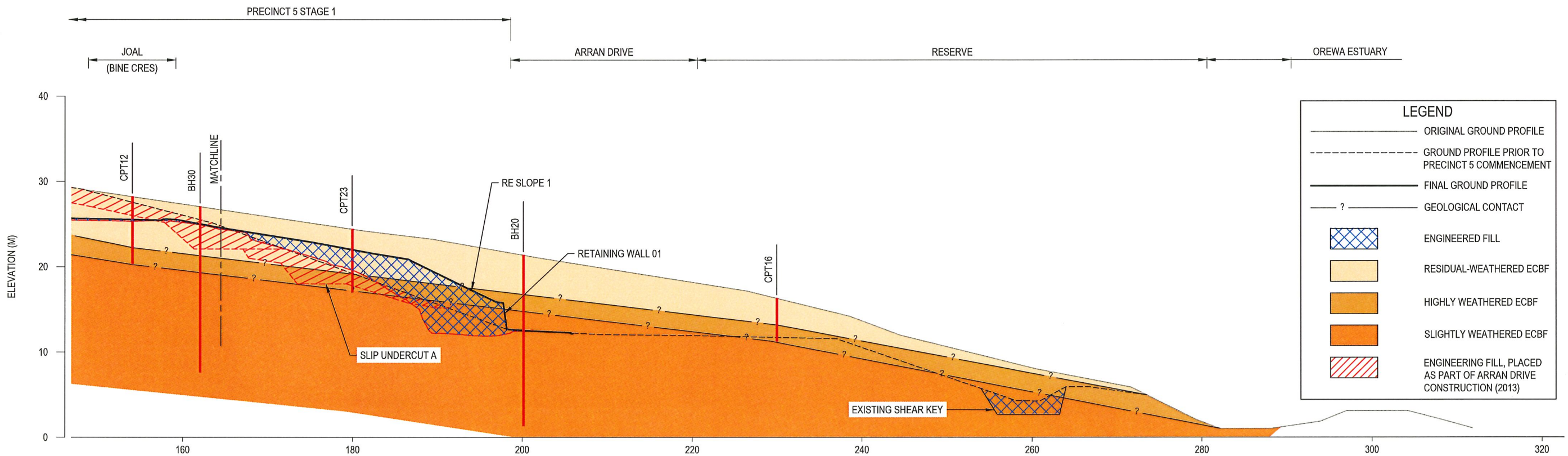

A3 SCALE 1:500

0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

SECTION 3 / 101

SCALE 1: 500

NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

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DRAWN	JC	Jun.18	
DESIGN CHECKED			
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PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 3

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-105 REV 1

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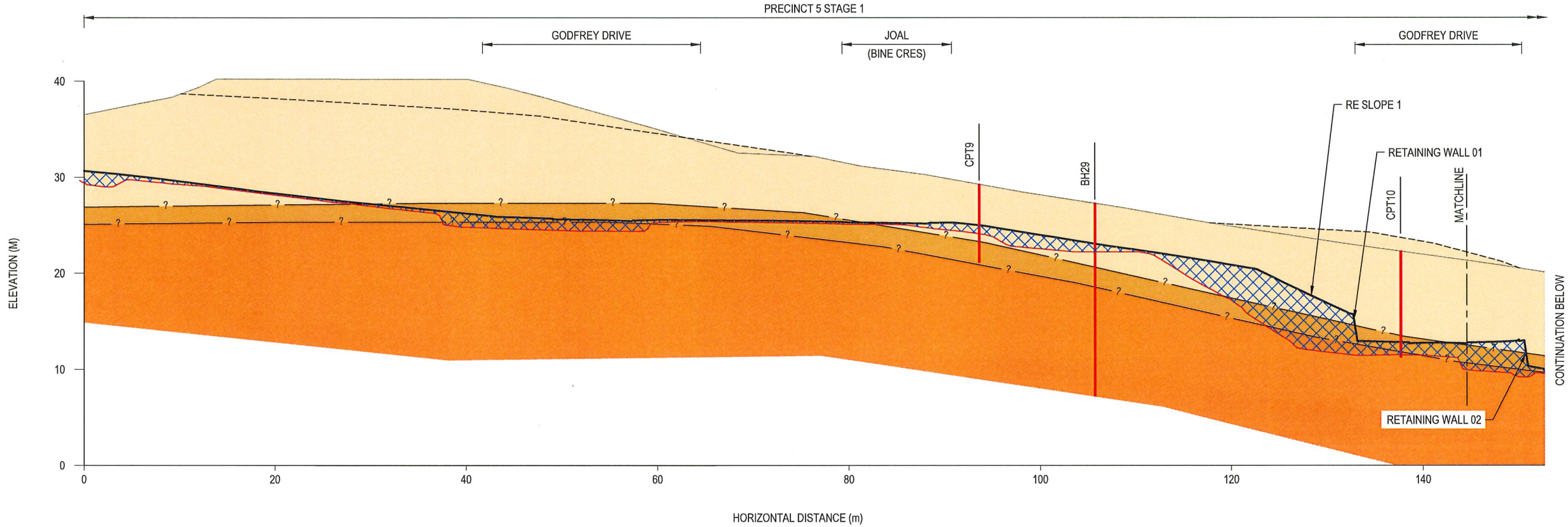

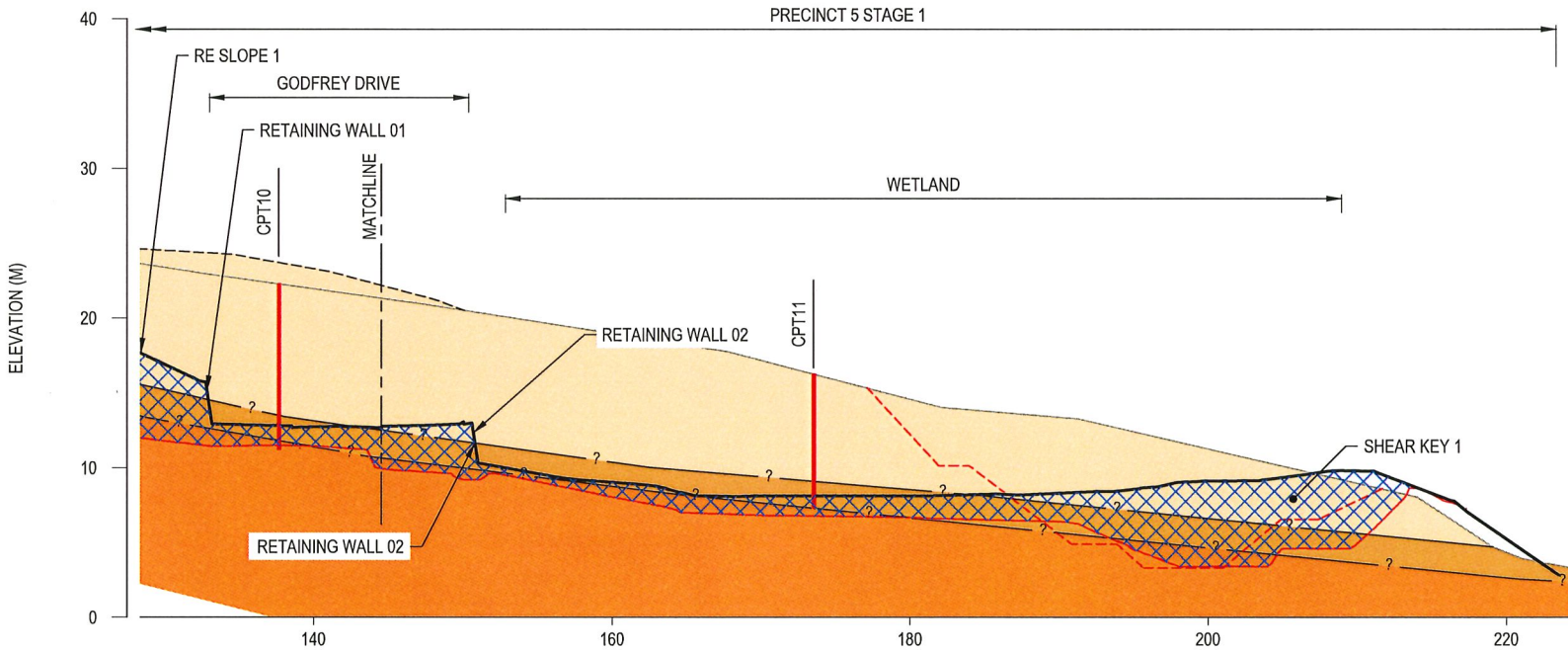

LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)

NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.

SECTION 4 / 101

SCALE 1: 500

A3 SCALE 1:500

0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
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DRAWING CHECKED			

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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 4

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-106 REV 1

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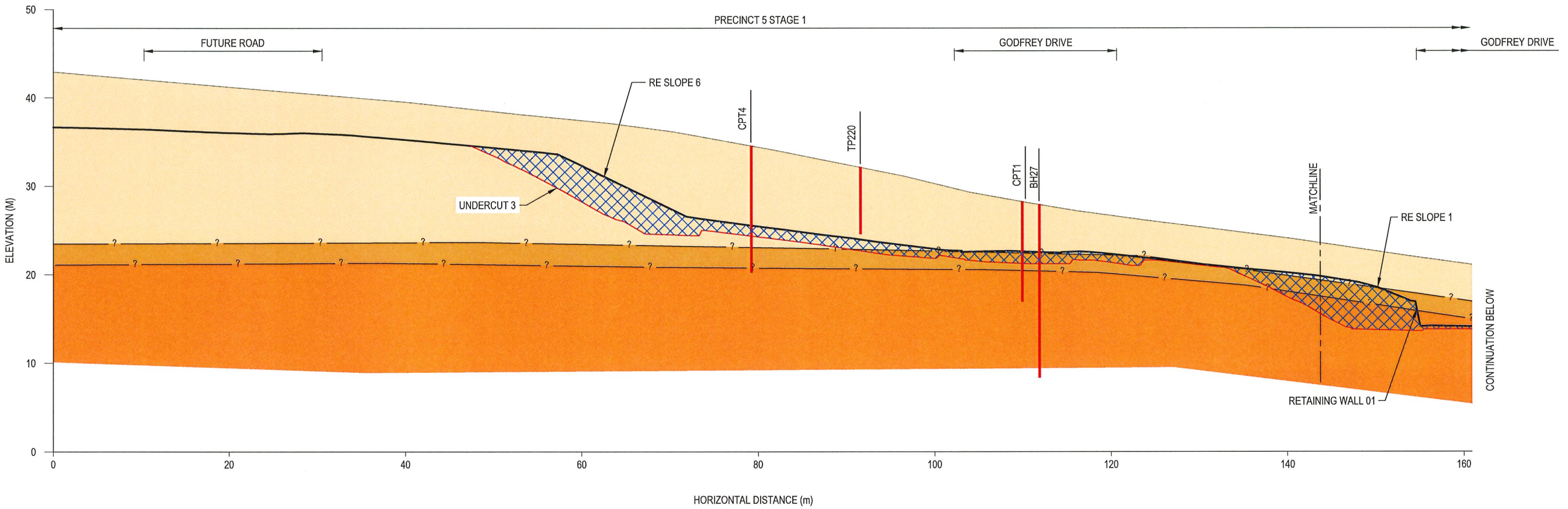

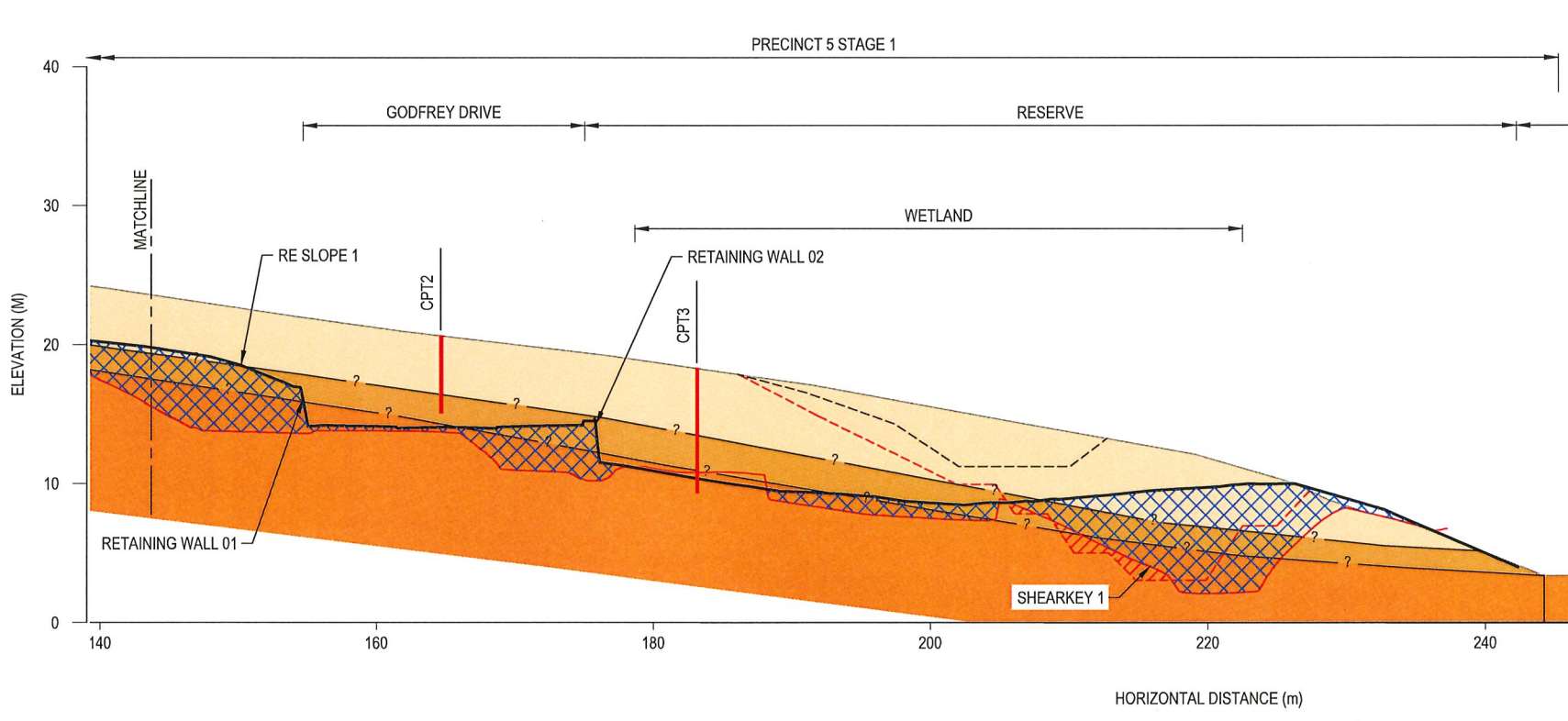

LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)

NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.

SECTION 5/101
SCALE 1: 500

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

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APPROVED DATE

CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 5
SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-107 REV 1

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LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)

NOTE:

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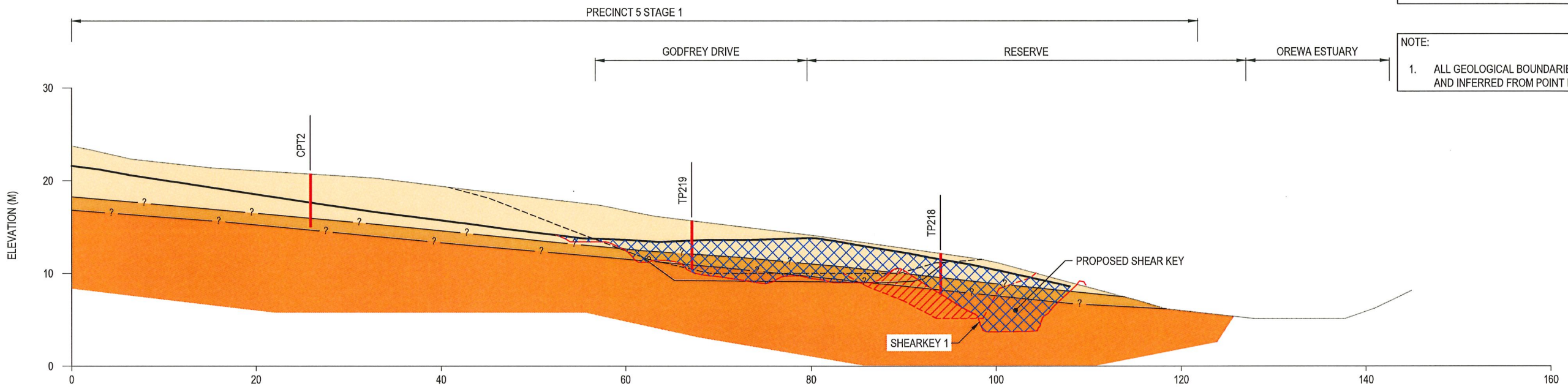

SECTION 6
SCALE 1: 500 101

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 6

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-108 REV 1

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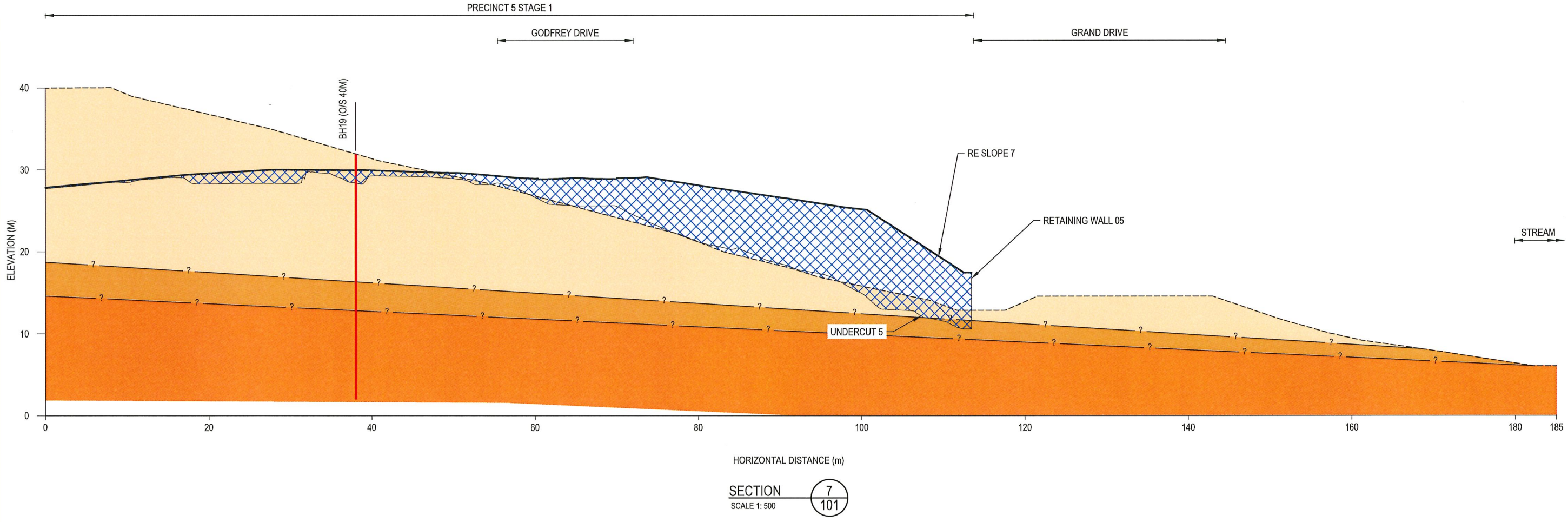
LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
- SLIGHTLY WEATHERED ECBF
- ENGINEERING FILL, PLACED AS PART OF ARRAN DRIVE CONSTRUCTION (2013)

NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.



SECTION 7
SCALE 1: 500 101

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 7

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-109 REV 1

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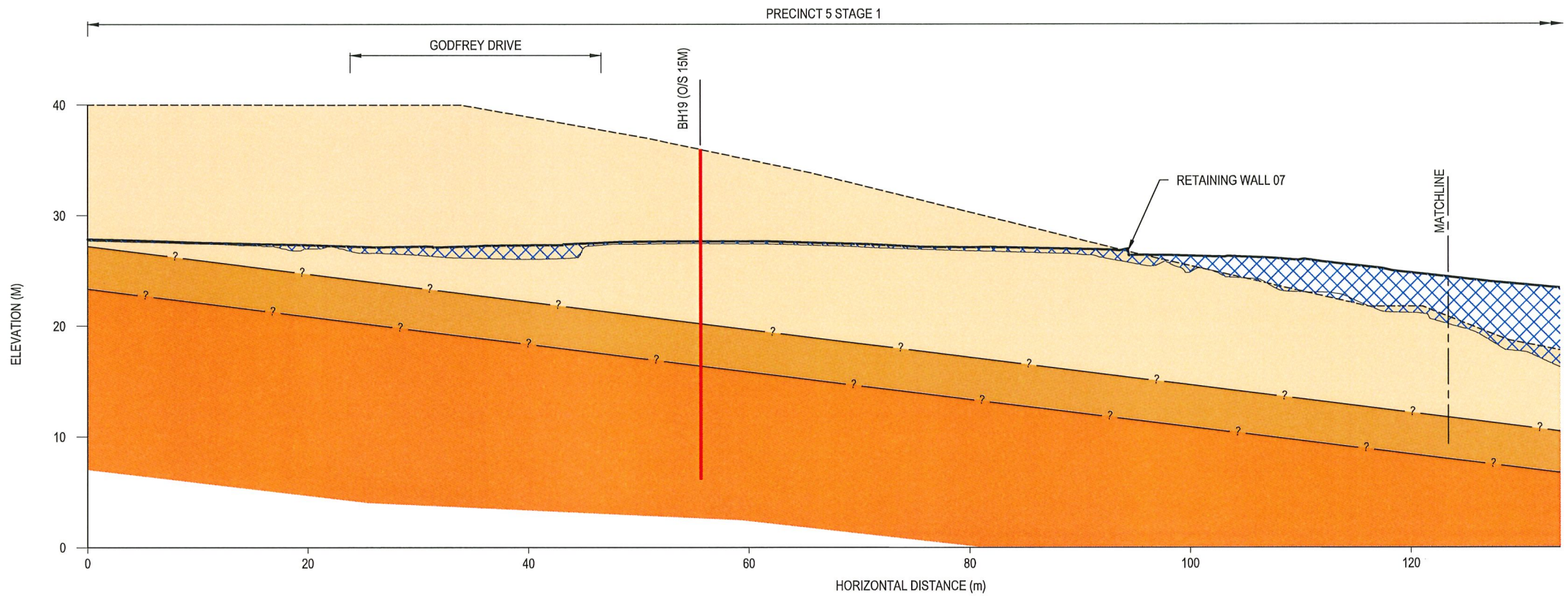

LEGEND

- ORIGINAL GROUND PROFILE
- GROUND PROFILE PRIOR TO PRECINCT 5 COMMENCEMENT
- FINAL GROUND PROFILE
- ? GEOLOGICAL CONTACT
- ENGINEERED FILL
- RESIDUAL-WEATHERED ECBF
- HIGHLY WEATHERED ECBF
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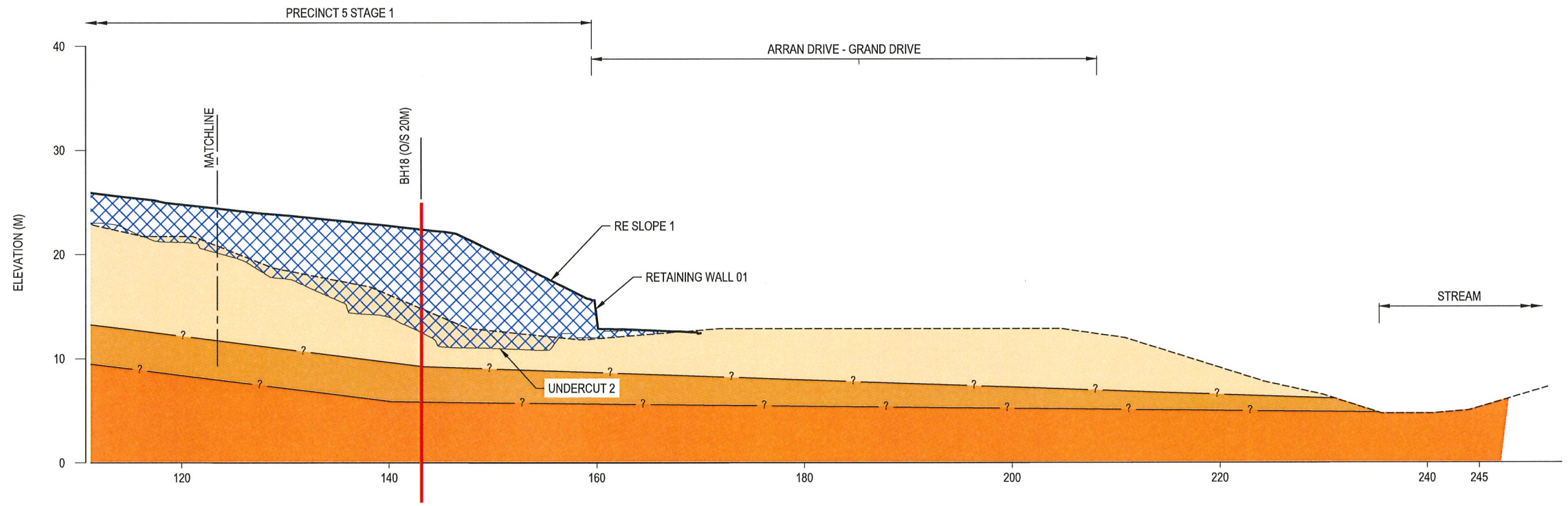
NOTE:

1. ALL GEOLOGICAL BOUNDARIES ARE APPROXIMATE AND INFERRED FROM POINT LOCATION DATA.



SECTION 8/101
SCALE 1: 500

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
GEOLOGICAL CROSS SECTION 8

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-110 REV 1

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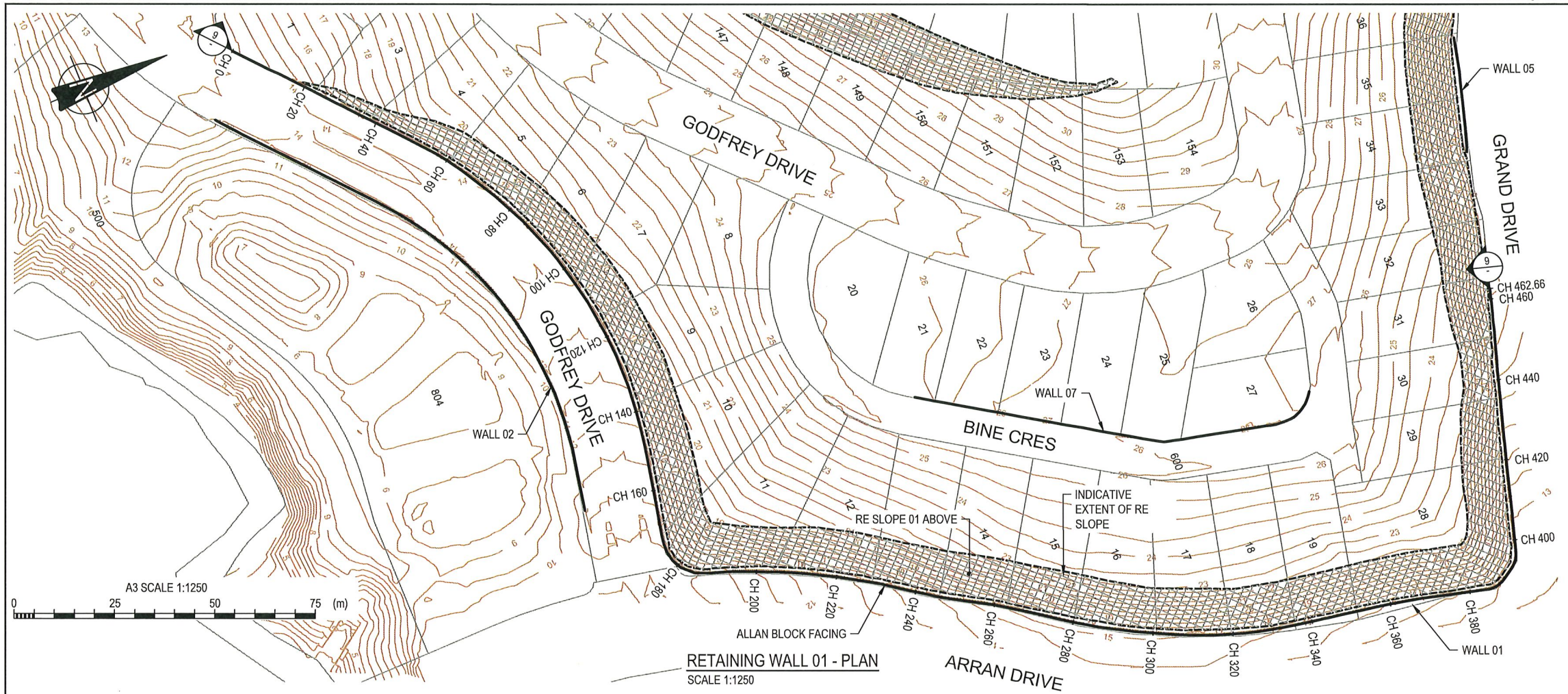


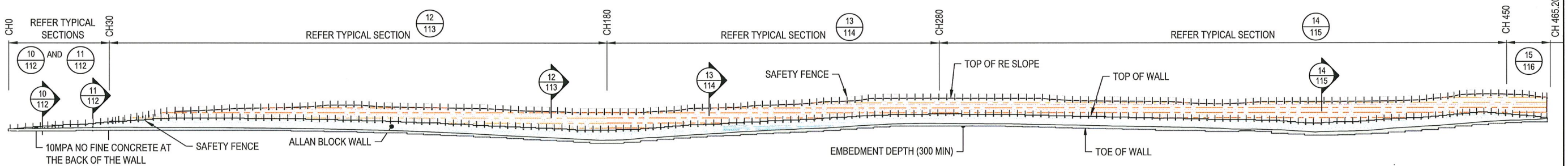
RETAINING WALL 01 - PLAN
SCALE 1:1250

LEGEND

- LOT LAYOUT (23)
- FINISHED GROUND PROFILE (0.5m INTERVAL) (11)
- RETAINING WALL CHAINAGE (m) (CH 40 / CH 20)
- RETAINING WALL ALIGNMENT
- RE SLOPE
- RE SLOPE GEOGRID TENSAR RESS20 (SECONDARY)
- RE SLOPE GEOGRID TENSAR RE570 (PRIMARY)
- GEOGRID STRATAGRID SG550 AT THE BACK OF ALLAN BLOCK WALL

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.



DATUM RL 0.00

CHAINAGE	TOP OF WALL	RETAINED HEIGHT	TOE OF WALL
0.00	14.54	-0.69	13.70
10.00	15.13	-1.10	13.85
20.00	15.93	-1.78	14.03
30.00	16.54	-2.38	14.15
40.00	17.13	-2.99	14.15
50.00	17.13	-3.05	14.15
60.00	17.13	-3.11	14.08
70.00	16.93	-2.99	14.03
80.00	16.72	-2.91	13.93
90.00	16.52	-2.91	13.81
100.00	16.33	-2.95	13.61
110.00	15.94	-2.87	13.38
120.00	15.54	-2.87	13.06
130.00	14.92	-2.68	12.66
140.00	14.53	-2.85	12.24
150.00	14.13	-2.93	11.68
160.00	13.73	-2.99	11.21
170.00	13.54	-3.18	10.73
180.00	13.77	-2.89	10.37
190.00	14.75	-3.23	10.88
200.00	15.36	-3.16	11.52
210.00	15.77	-2.93	12.19
220.00	16.38	-3.00	12.84
230.00	16.78	-2.99	13.38
240.00	17.40	-3.13	13.79
250.00	18.00	-3.13	14.27
260.00	18.19	-2.86	14.87
270.00	18.40	-3.02	15.33
280.00	18.22	-2.91	15.39
290.00	18.22	-3.01	15.31
300.00	18.00	-3.03	15.21
310.00	17.81	-3.00	14.98
320.00	17.40	-2.79	14.81
330.00	17.22	-2.79	14.60
340.00	17.02	-2.80	14.43
350.00	16.81	-2.87	14.21
360.00	16.62	-3.02	13.94
370.00	16.42	-3.01	13.80
380.00	15.60	-2.69	13.41
390.00	15.34	-3.03	12.91
400.00	16.33	-3.12	12.91
410.00	16.93	-2.83	13.21
420.00	17.57	-2.95	14.05
430.00	16.62	-3.17	14.61
440.00	16.25	-2.14	15.45
450.00	17.47	-1.06	16.11
460.00	16.42	-0.53	16.42
465.20	17.27		16.74

RETAINING WALL GEOGRID LENGTH	3.0m	6.0m	6.0m	7.0m FOR BASAL GEOGRID, 6m FOR REMAINING 3m
RE SLOPE GEOGRID LENGTH (PRIMARY)		6.0m	4.0m	
RE SLOPE GEOGRID LENGTH (SECONDARY)		2.0m		

(HORIZONTAL SCALE)
A3 SCALE 1:1250
0 25 50 75 (m)

ORIGINAL IN COLOUR

SECTION 9/- RETAINING WALL 01 - ELEVATION
SCALE 1: 1250(H)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
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DRAWING CHECKED			

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CLIENT: WFH PROPERTIES LTD
PROJECT: MILLWATER - ARRANS HILL
TITLE: PRECINCT 5 STAGE 1
RETAINING WALL 01 - PLAN AND ELEVATION
SCALE (A3): 1:1250 DWG No. 21854.0031-AHP5S1-111 REV 1

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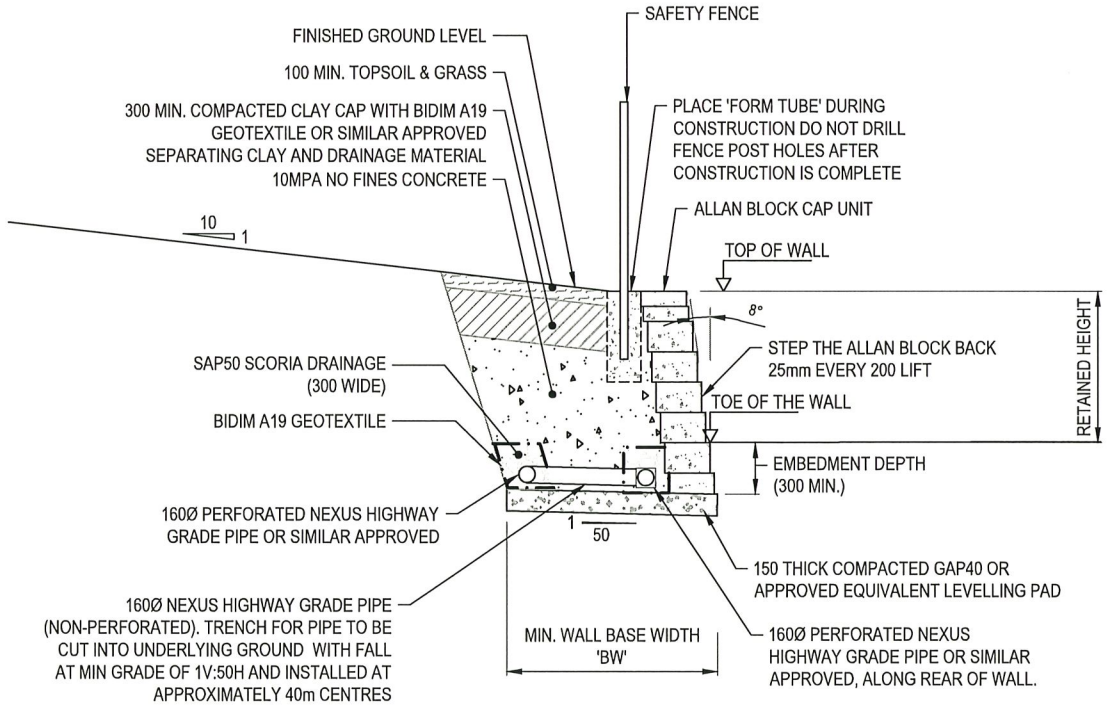
TABLE 1: REINFORCE DETAIL FOR CHAINAGE 0 TO 30m

					GEOGRID REQUIREMENT		
WALL TYPE	RE SLOPE / RETAINED HEIGHT (m)	MAX. BACK SLOPE	MAX. FORWARD SLOPE	MIN. WALL BASE WIDTH (BW)	GEOGRID TYPE	GEOGRID LENGTH (m)	MAX.VERTICAL SPACING
ALLAN BLOCK	<0.5	1V : 10H	0°	1.1	-	-	-
ALLAN BLOCK	0.5 TO 1.0	1V : 10H	0°	1.4	-	-	-
ALLAN BLOCK	1.0 TO 2.0	1V : 10H	0°	-	STRATAGRID SG550	3.0	4.0

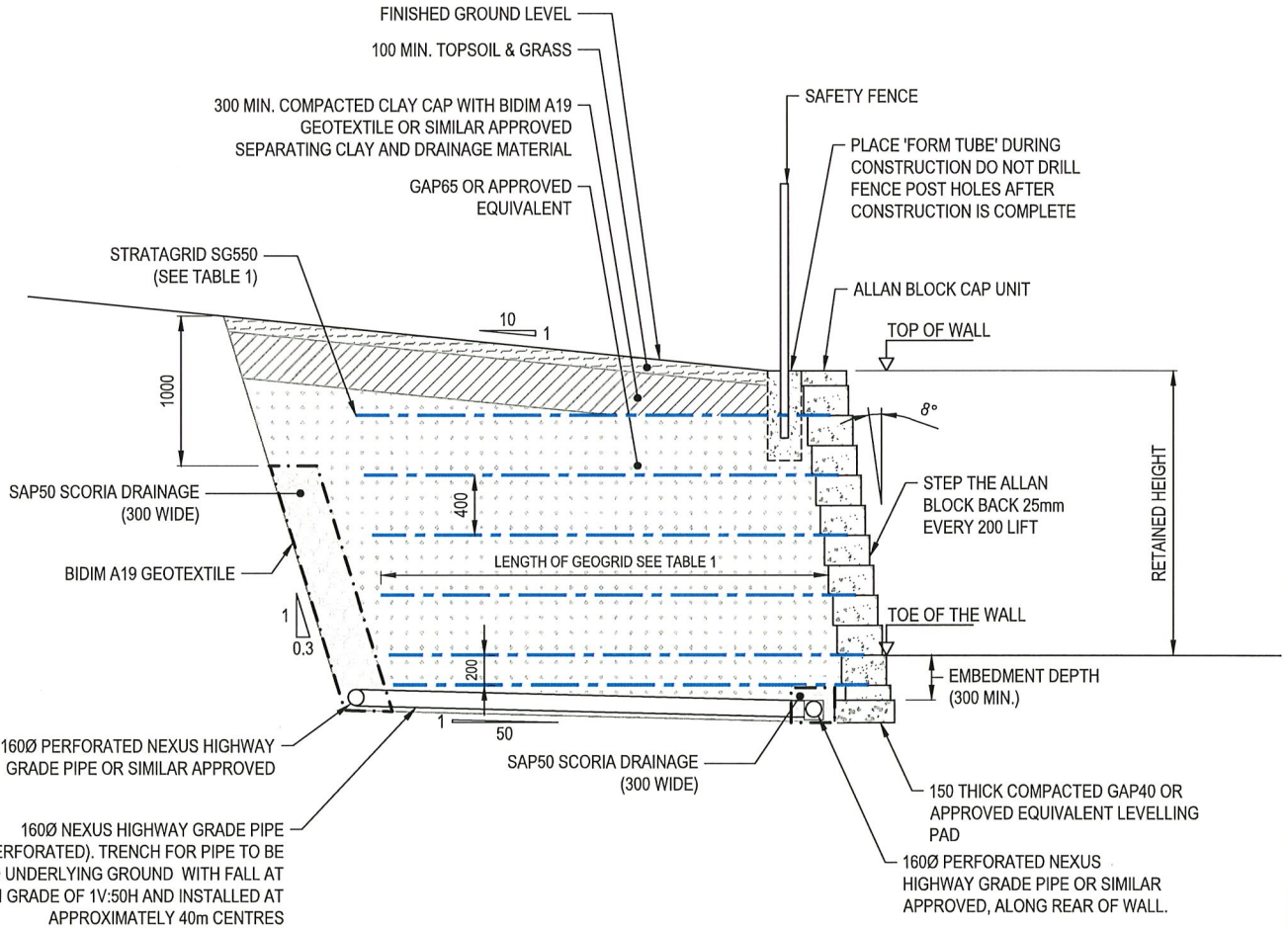
LEGEND

- BIDIM A19 GEOTEXTILE
- STRATAGRID SG550
- GAP40
- 10MPA NO FINES CONCRETE
- SAP50 SCORIA
- HARDFILL GAP65
- TOPSOIL & GRASS
- CLAY CAP

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-111 FOR WALL 01 PLAN AND LONGSECTION.



SECTION 10/111 TYPICAL ALLAN BLOCK WALL (FOR WALLS H≤1m)
SCALE 1:50 CHAINAGE 0 TO 15m



SECTION 11/111 TYPICAL ALLAN BLOCK WALL (FOR WALLS 1M<H<2m)
SCALE 1:50 CHAINAGE 15 TO 30m

SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 01 - TYPICAL SECTION (CH 0 TO 30m)
SCALE (A3) 1:50 DWG No. 21854.0031-AHP5S1-112 REV 1

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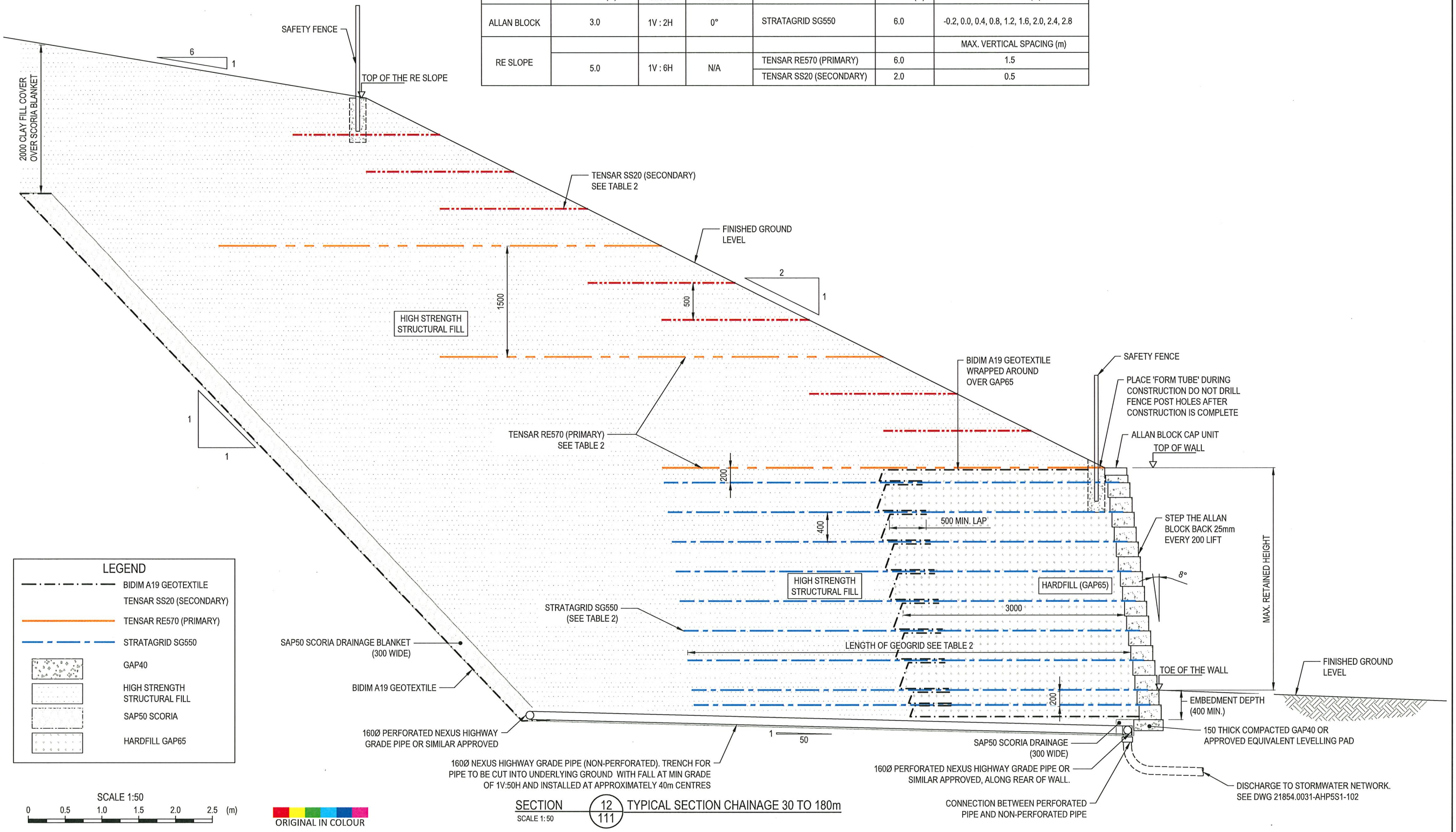
NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-111 FOR WALL 01 PLAN AND LONGSECTION.

TABLE 2: REINFORCE DETAIL FOR CHAINAGE 30 TO 180m

GEOGRID REQUIREMENT						
WALL TYPE	RE SLOPE / RETAINED HEIGHT (m)	MAX. BACK SLOPE	MAX. FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
ALLAN BLOCK	3.0	1V : 2H	0°	STRATAGRID SG550	6.0	-0.2, 0.0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8
RE SLOPE						MAX. VERTICAL SPACING (m)
	5.0	1V : 6H	N/A	TENSAR RE570 (PRIMARY)	6.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5



SECTION 12/111 TYPICAL SECTION CHAINAGE 30 TO 180m
SCALE 1:50

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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 01 - TYPICAL SECTION (CH 30 TO 180m)
SCALE (A3) 1:50 DWG No. 21854.0031-AHP5S1-113 REV 1

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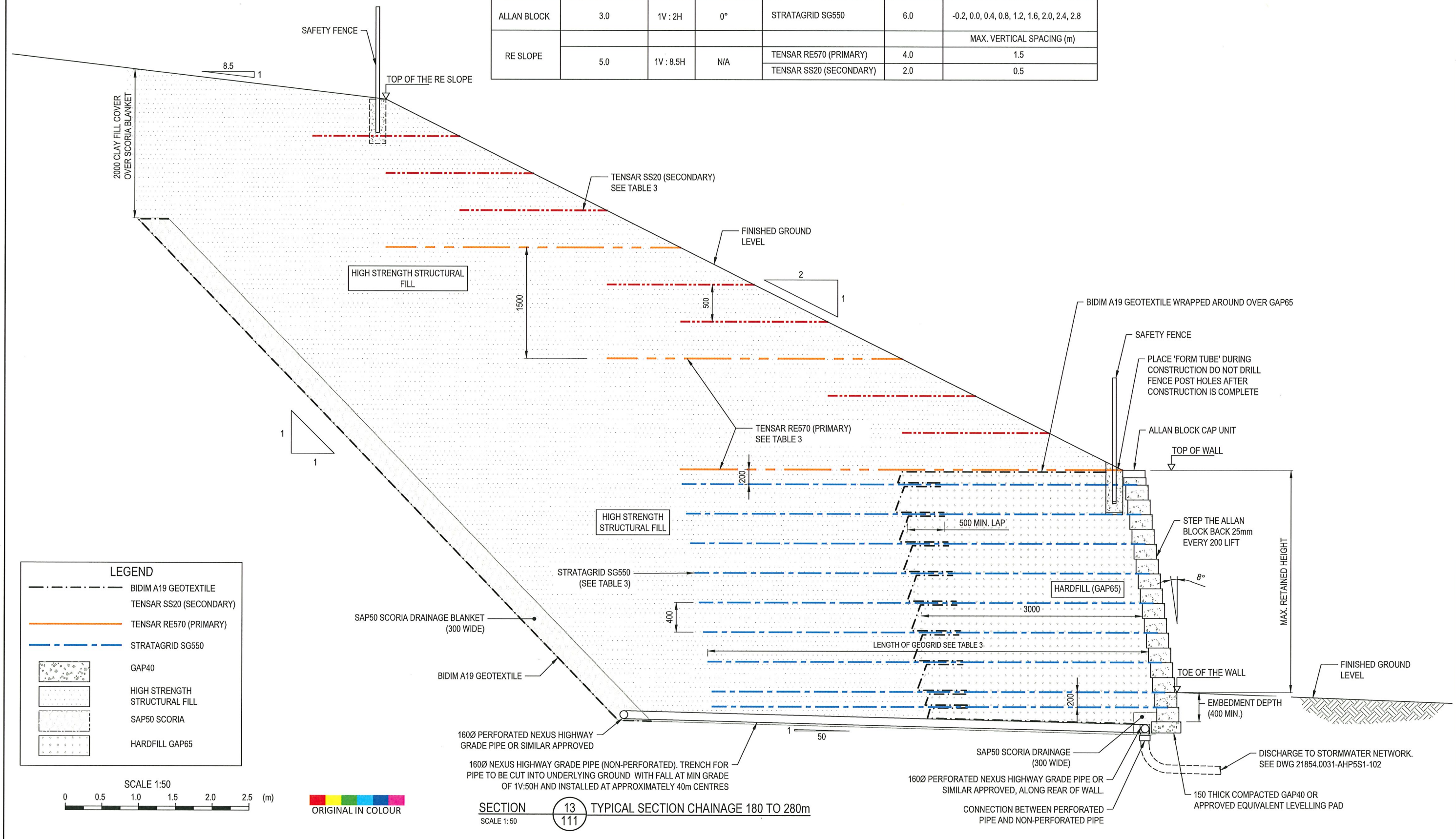
TABLE 3: REINFORCE DETAIL FOR CHAINAGE 180 TO 280m

GEOGRID REQUIREMENT						
WALL TYPE	RE SLOPE / RETAINED HEIGHT (m)	MAX. BACK SLOPE	MAX. FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
ALLAN BLOCK	3.0	1V : 2H	0°	STRATAGRID SG550	6.0	-0.2, 0.0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8
RE SLOPE						MAX. VERTICAL SPACING (m)
	5.0	1V : 8.5H	N/A	TENSAR RE570 (PRIMARY)	4.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-111 FOR WALL 01 PLAN AND LONGSECTION.



LEGEND
- BIDIM A19 GEOTEXTILE
- TENSAR SS20 (SECONDARY)
- TENSAR RE570 (PRIMARY)
- STRATAGRID SG550
- GAP40
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA
- HARDFILL GAP65

SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 (m)

ORIGINAL IN COLOUR

SECTION 13/111 TYPICAL SECTION CHAINAGE 180 TO 280m
SCALE 1:50

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CLIENT: WFH PROPERTIES LTD
PROJECT: MILLWATER - ARRANS HILL
TITLE: PRECINCT 5 STAGE 1
RETAINING WALL 01 - TYPICAL SECTION (CH 180 TO 280m)
SCALE (A3): 1:50 DWG No. 21854.0031-AHP5S1-114 REV 1

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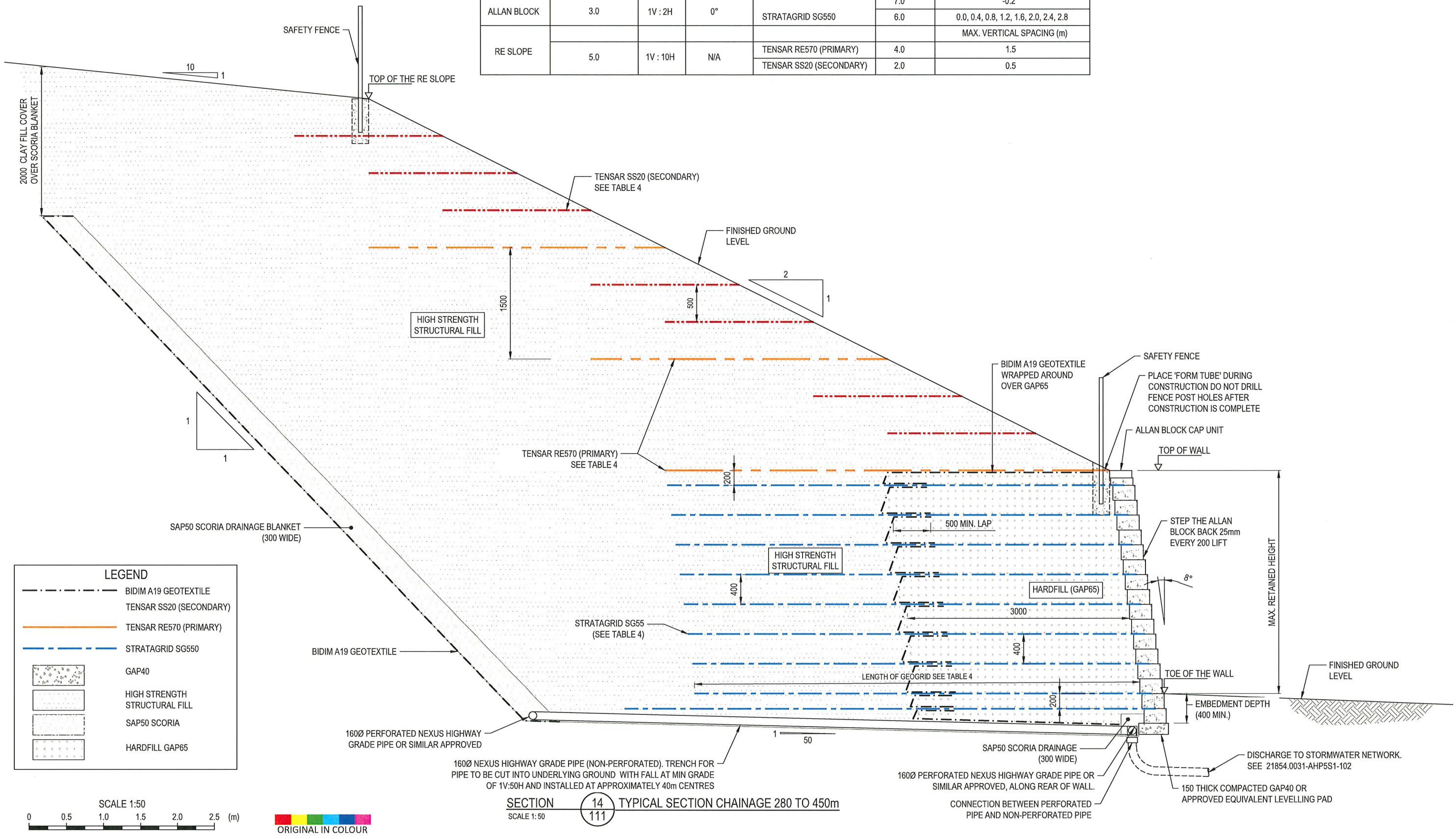
TABLE 4: REINFORCE DETAIL FOR CHAINAGE 280 TO 450m

GEOGRID REQUIREMENT						
WALL TYPE	RE SLOPE / RETAINED HEIGHT (m)	MAX. BACK SLOPE	MAX. FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
ALLAN BLOCK	3.0	1V : 2H	0°	STRATAGRID SG550	7.0	-0.2
					6.0	0.0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8
RE SLOPE						MAX. VERTICAL SPACING (m)
	5.0	1V : 10H	N/A	TENSAR RE570 (PRIMARY)	4.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-111 FOR WALL 01 PLAN AND LONGSECTION.



LEGEND
- BIDIM A19 GEOTEXTILE
- TENSAR SS20 (SECONDARY)
- TENSAR RE570 (PRIMARY)
- STRATAGRID SG550
- GAP40
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA
- HARDFILL GAP65

SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

ORIGINAL IN COLOUR

SECTION 14/111 TYPICAL SECTION CHAINAGE 280 TO 450m
SCALE 1:50

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

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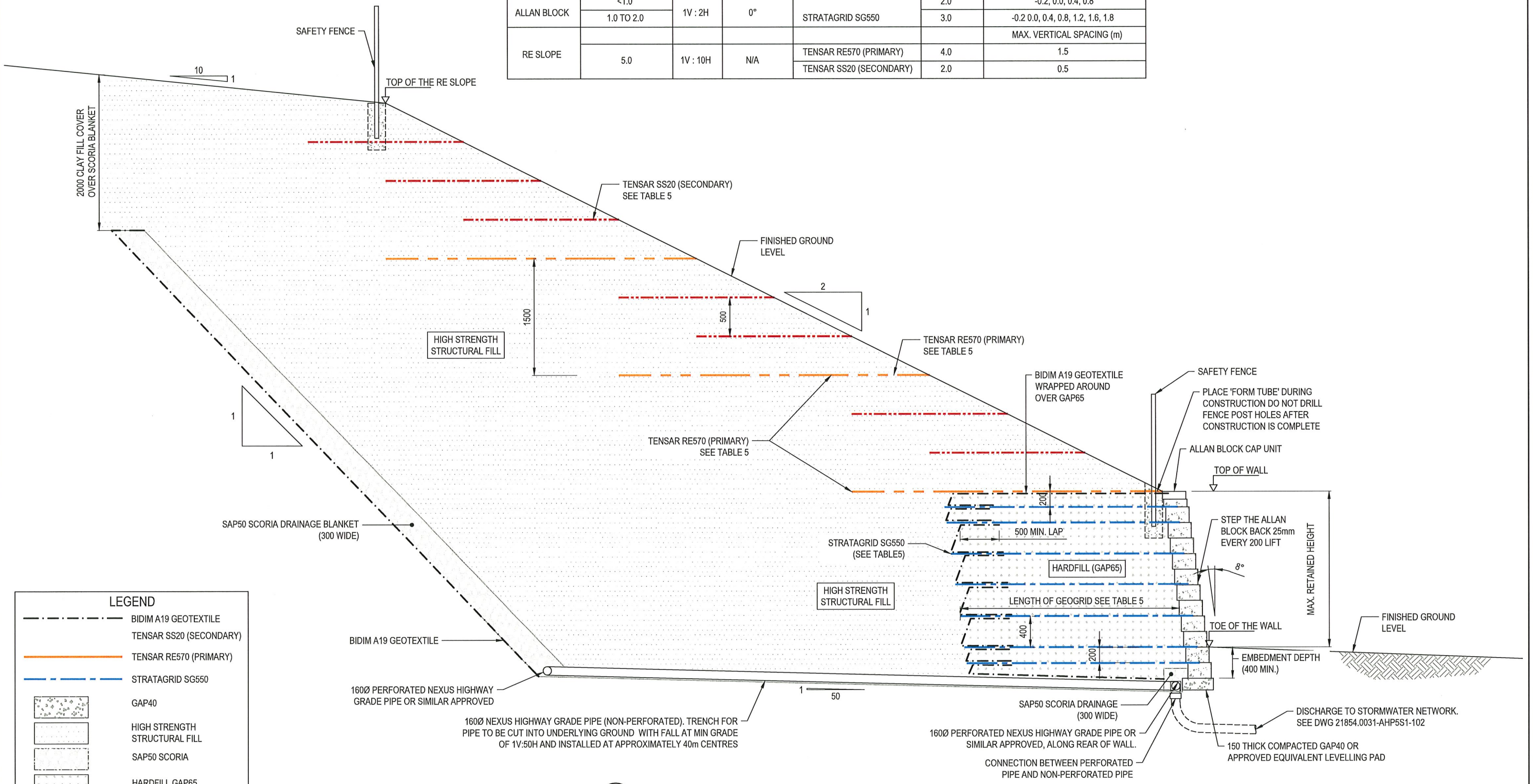
CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 01 - TYPICAL SECTION (CH 280 TO 450m)
SCALE (A3) 1:50 DWG No. 21854.0031-AHP5S1-115 REV 1

T:\CAD\21854\21854.0031 - Orewa West Precinct 5\WorkingMaterial\CAD\DWG\GCR\21854.0031-AHP5S1-112_116.dwg 2018-Jun-28 5:23:51 PM Plotted By: JONALD CASTRO

TABLE 5: REINFORCE DETAIL FOR CHAINAGE 450 TO 465m

GEOGRID REQUIREMENT						
WALL TYPE	RE SLOPE / RETAINED HEIGHT (m)	MAX. BACK SLOPE	MAX. FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
ALLAN BLOCK	<1.0	1V : 2H	0°	STRATAGRID SG550	2.0	-0.2, 0.0, 0.4, 0.8
	1.0 TO 2.0				3.0	-0.2 0.0, 0.4, 0.8, 1.2, 1.6, 1.8
RE SLOPE						MAX. VERTICAL SPACING (m)
	5.0	1V : 10H	N/A	TENSAR RE570 (PRIMARY)	4.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-111 FOR WALL 01 PLAN AND LONGSECTION.



LEGEND
- BIDIM A19 GEOTEXTILE
- TENSAR SS20 (SECONDARY)
- TENSAR RE570 (PRIMARY)
- STRATAGRID SG550
- GAP40
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA
- HARDFILL GAP65

SECTION 15/111 TYPICAL SECTION CHAINAGE 450 TO 465m
SCALE 1:50

SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 01 - TYPICAL SECTION (CH 450 TO 465m)
SCALE (A3) 1:50 DWG No. 21854.0031-AHP5S1-116 REV 1

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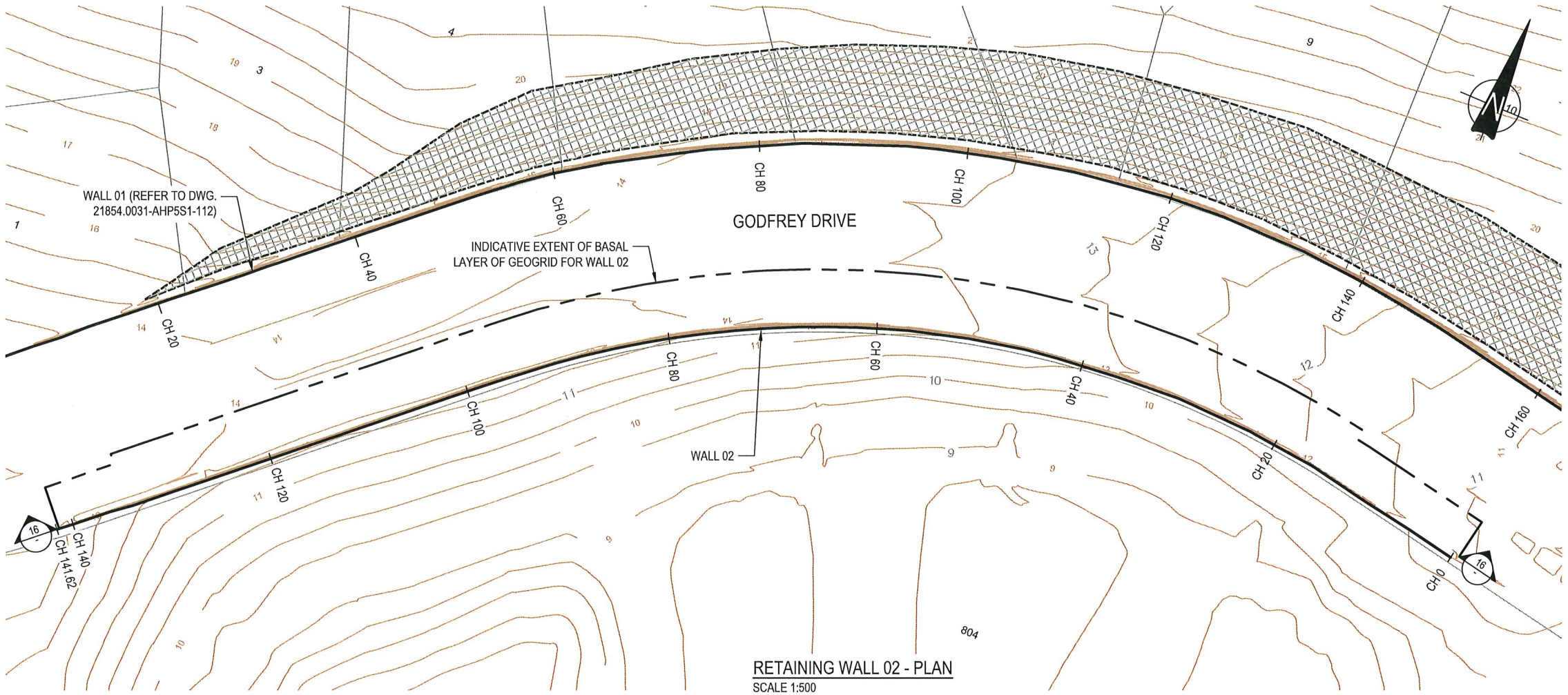


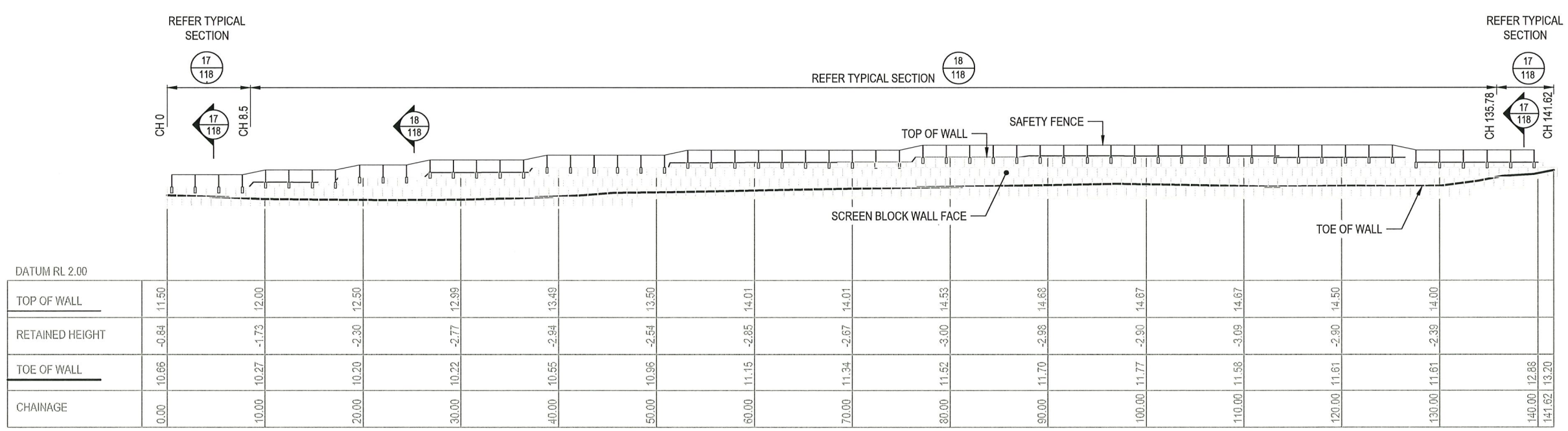
RETAINING WALL 02 - PLAN
SCALE 1:500

LEGEND

- 23 — LOT LAYOUT
- 11 — FINISHED GROUND PROFILE (0.5m INTERVAL)
- CH 40 / CH 20 — RETAINING WALL CHAINAGE (m)
- RETAINING WALL ALIGNMENT
- RE SLOPE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.



DATUM RL 2.00

TOP OF WALL	11.50	12.00	12.50	12.99	13.49	13.50	14.01	14.01	14.53	14.68	14.67	14.67	14.50	14.00	
RETAINED HEIGHT	-0.84	-1.73	-2.30	-2.77	-2.94	-2.54	-2.85	-2.67	-3.00	-2.98	-2.90	-3.09	-2.90	-2.39	
TOE OF WALL	10.66	10.27	10.20	10.22	10.55	10.96	11.15	11.34	11.52	11.70	11.77	11.58	11.61	11.61	12.88	13.20
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	141.62

SECTION 16 - RETAINING WALL 02 - ELEVATION
SCALE 1: 500

ORIGINAL IN COLOUR
A3 SCALE 1:500
0 5 10 15 20 25 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS
DRAWN	JC	Jun.18	COMPLETION REPORT
DESIGN CHECKED			
DRAWING CHECKED			

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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 02 - PLAN AND ELEVATION
SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-117 REV 1

T:\CAD\21854\21854.0031 - Orewa West Precinct 5\WorkingMaterial\CAD\DWG\GCR\21854.0031-AHP5S1-118.dwg 2018-Jun-28 5:35:41 PM Plotted By: JONALD CASTRO

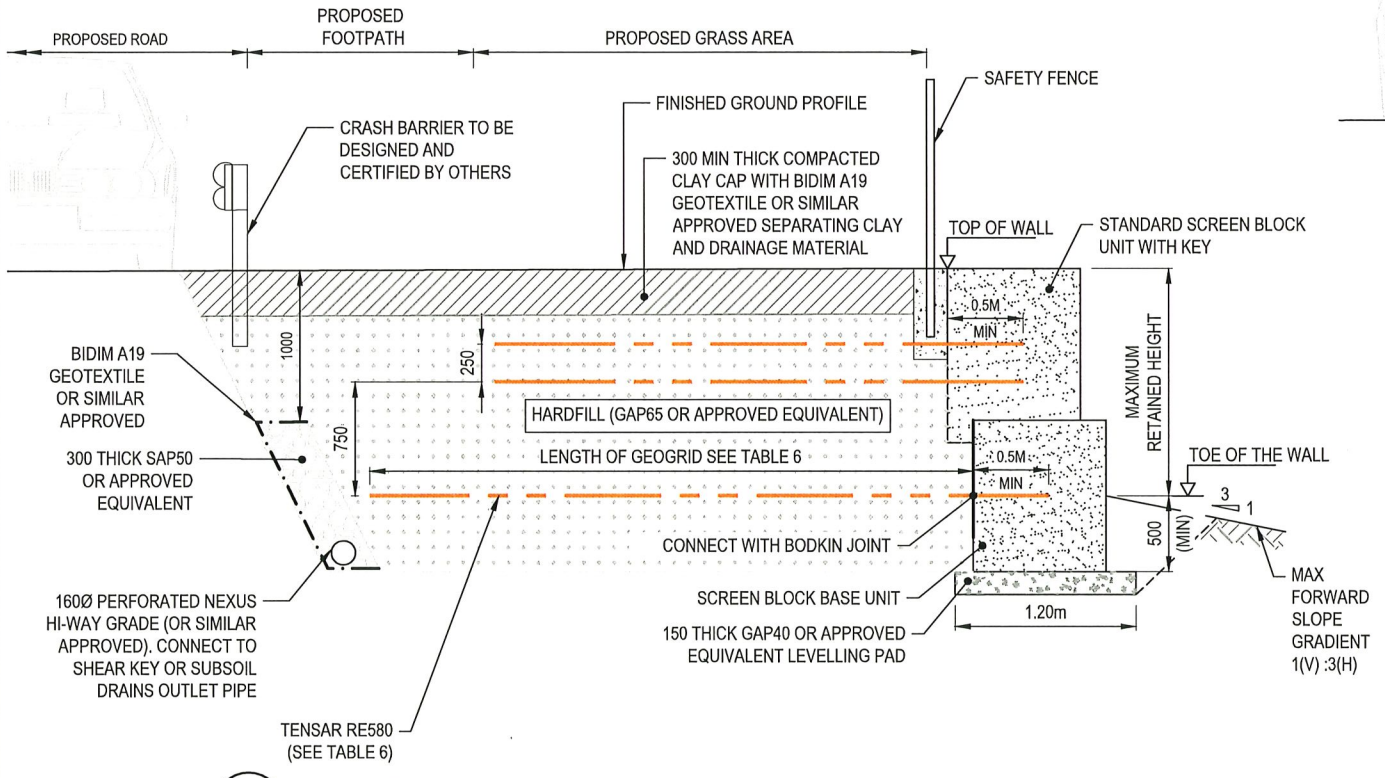
TABLE 6: RETAINING WALL 2 DETAIL TABLE

WALL SPECIFICATION				
MAX. RETAINED HEIGHT	MIN. EMBEDMENT DEPTH	GEOGRID TYPE	MIN. LENGTH OF GEOGRID	VERTICAL LOCATION ABOVE TOE OF WALL (m)
H ≤ 1.5m	0.5m	TENSAR RE580	4.0m	0.0
		TENSAR RE580	3.0m	0.75, 1.0
1.5m < H ≤ 2.5m	0.5m	TENSAR RE580	5.0m	0.75, 1.0
		TENSAR RE580	3.0m	1.75, 2.0

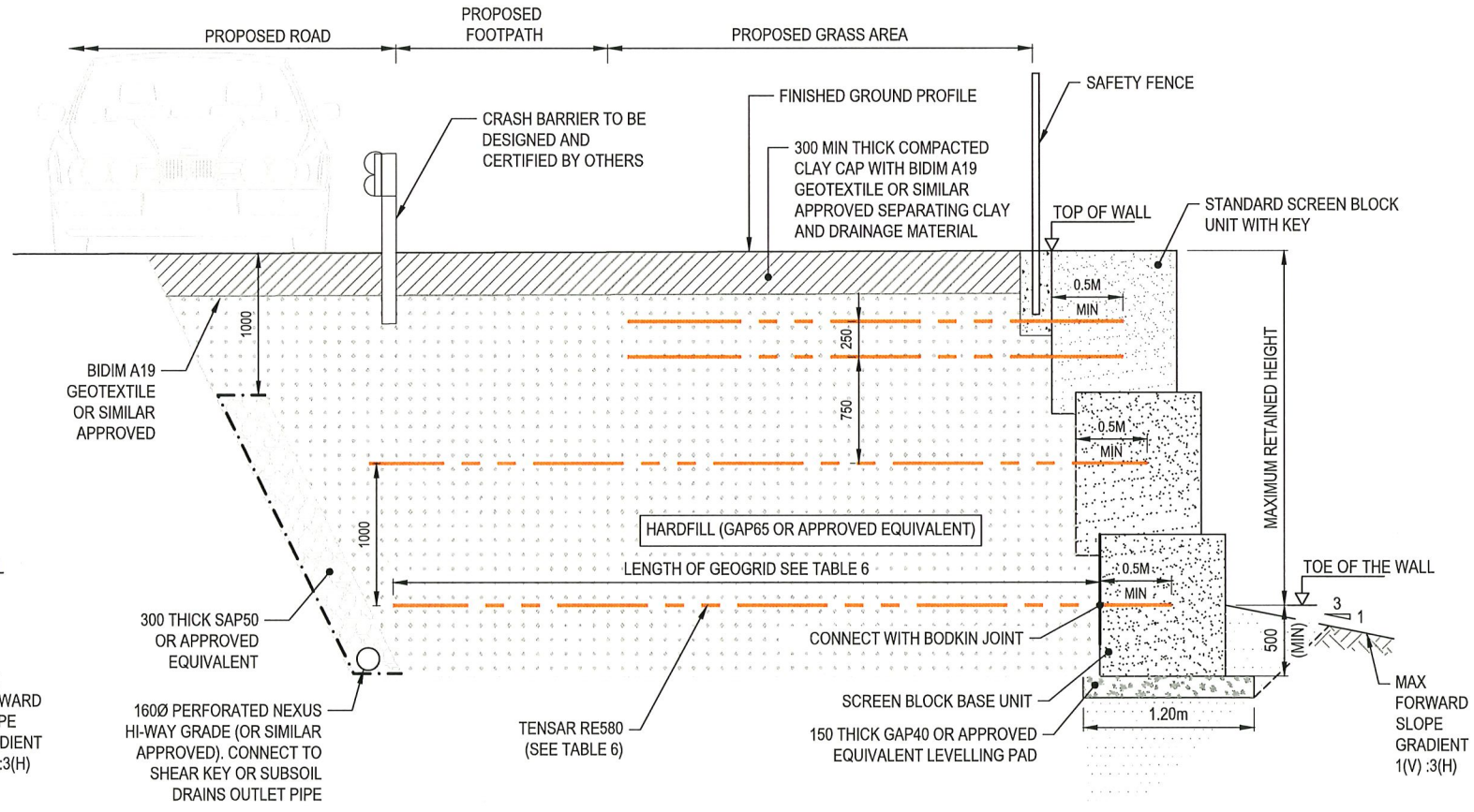
LEGEND

- BIDIM A19 GEOTEXTILE
- TENSAR RE580
- COMPACTED CLAY CAP
- GAP40
- SAP50 SCORIA
- HARDFILL (GAP65 OR APPROVED EQUIVALENT)

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. SEE DWG.21854.0031-AHP5S1-117 FOR WALL 02 PLAN AND LONGSECTION.



SECTION 17 / 117 SCREEN BLOCK WALL TYPICAL SECTION - H≤1.5M
RETAINING WALL 02
SCALE 1: 50



SECTION 18 / 117 SCREEN BLOCK WALL TYPICAL SECTION - 1.5M≤H≤2.6M
RETAINING WALL 02
SCALE 1: 50

A3 SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS	COMPLETION REPORT
DRAWN	JC	Jun.18		
DESIGN CHECKED				
DRAWING CHECKED				

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APPROVED DATE

CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 02 - TYPICAL SECTIONS
SCALE (A3) 1:50 DWG No. 21854.0031-AHP5S1-118 REV 1

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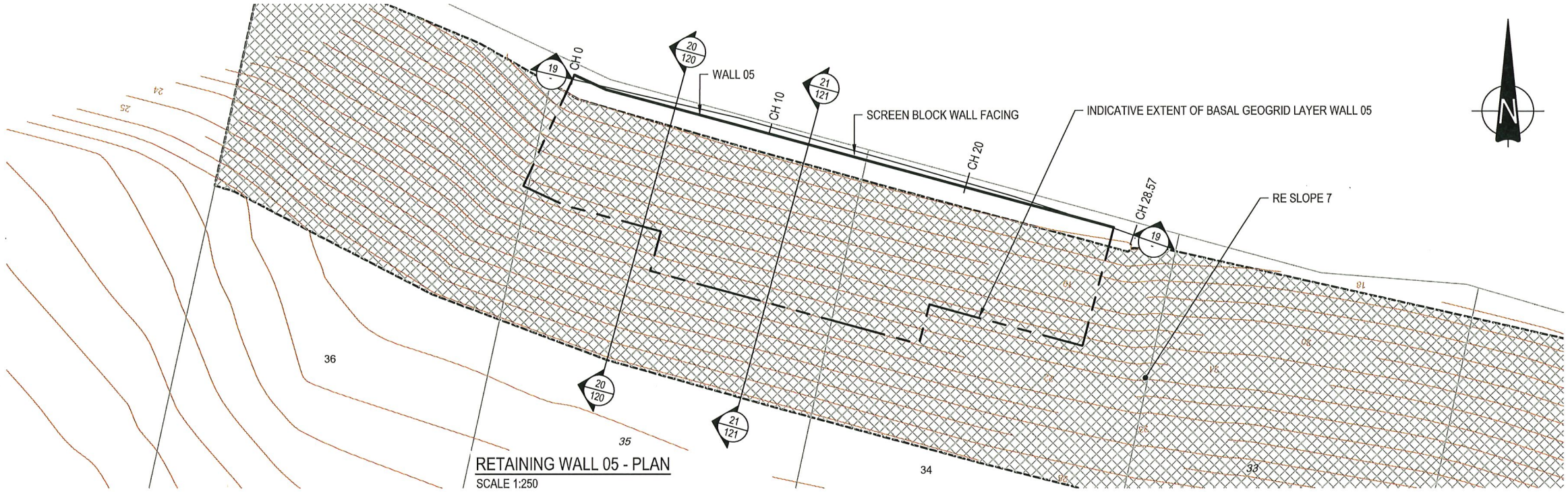
LEGEND

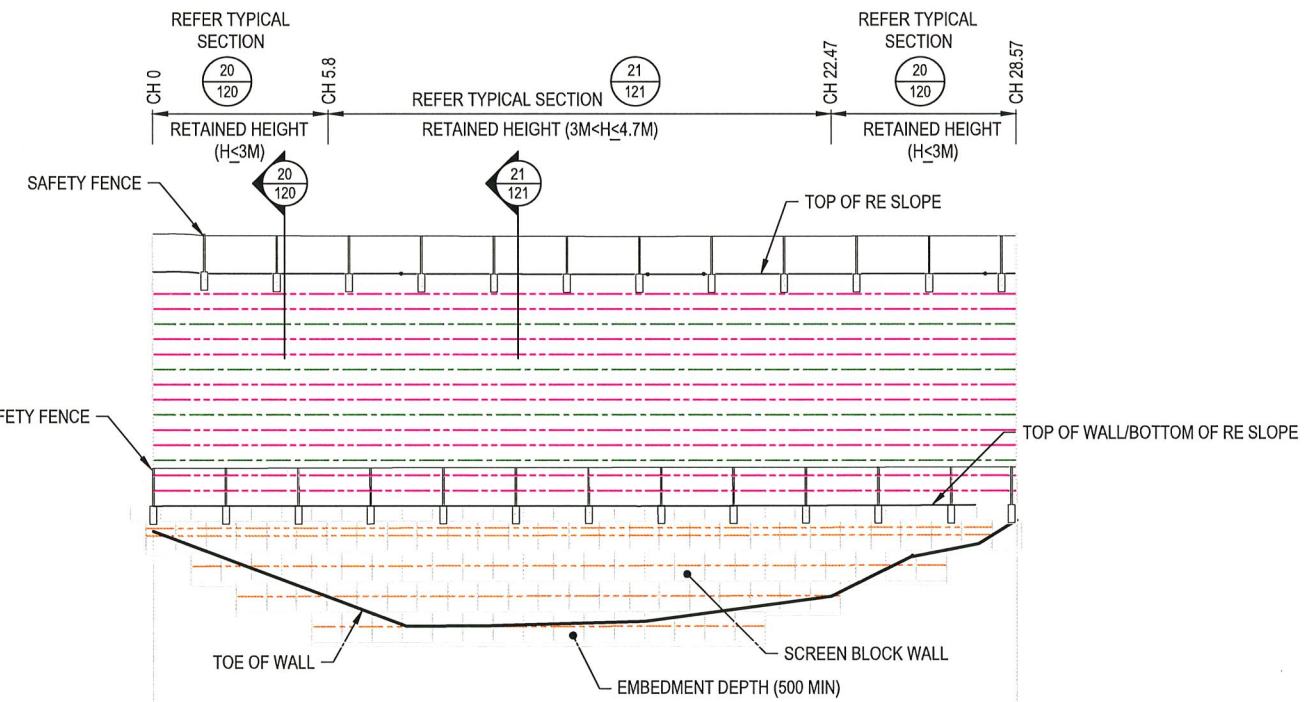
- 23 — LOT LAYOUT
- 11 — FINISHED GROUND PROFILE (0.5m INTERVAL)
- CH 40 / CH 20 — RETAINING WALL CHAINAGE (m)
- RETAINING WALL ALIGNMENT
- RE SLOPE
- GEOGRID TENSAR RE580 AT THE BACK OF SCREEN BLOCK WALL
- RE SLOPE GEOGRID TENSAR RE540 (PRIMARY)
- RE SLOPE GEOGRID TENSAR SS20 (SECONDARY)



RETAINING WALL 05 - PLAN
SCALE 1:250

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.



DATUM RL 10.00				
TOP OF WALL	17.43	17.43	17.44	
RETAINED HEIGHT	-0.84	-3.96	-3.32	
TOE OF WALL	16.59	13.47	14.12	16.96
CHAINAGE	0.00	10.00	20.00	28.57

SECTION 19/- RETAINING WALL 05 - ELEVATION
SCALE 1: 250

ORIGINAL IN COLOUR

A3 SCALE 1:250

0 5 10 15 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

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CLIENT: WFH PROPERTIES LTD
PROJECT: MILLWATER - ARRANS HILL
TITLE: PRECINCT 5 STAGE 1
RETAINING WALL 05 - PLAN AND ELEVATION
SCALE (A3): 1:250 DWG No. 21854.0031-AHP5S1-119 REV 1

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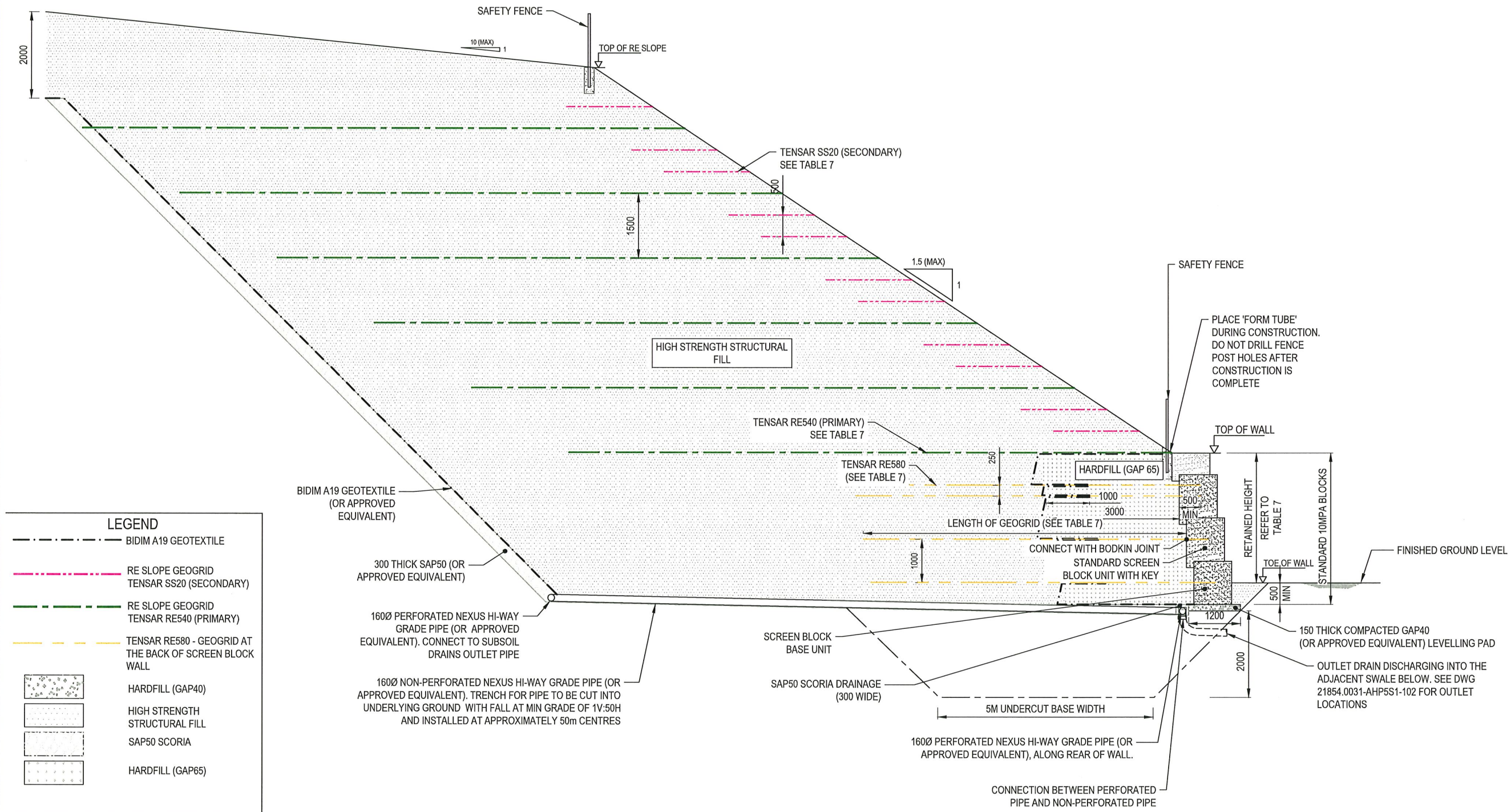
NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-119 FOR WALL 05 PLAN AND LONGSECTION.

TABLE 7: RETAINING WALL 05 (H≤3m) DETAIL TABLE

GEOGRID REQUIREMENTS						
WALL TYPE	TOTAL SLOPE/ RETAINED HEIGHT (m)	MAX BACKSLOPE	MAX FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
SCREEN BLOCK	H ≤ 3	1V:1.5H	0°	TENSAR RE580	8.0	0.0, 1.0, 2.0, 2.25
RE SLOPE						MAX VERTICAL SPACING (m)
	8 < H ≤ 9	1V:10H	N/A	TENSAR RE540 (PRIMARY)	14.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5



LEGEND
- BIDIM A19 GEOTEXTILE
- RE SLOPE GEOGRID TENSAR SS20 (SECONDARY)
- RE SLOPE GEOGRID TENSAR RE540 (PRIMARY)
- TENSAR RE580 - GEOGRID AT THE BACK OF SCREEN BLOCK WALL
- HARDFILL (GAP40)
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA
- HARDFILL (GAP65)

A3 SCALE 1:100
0 1 2 3 4 5 (m)

SECTION 20/119 SCREEN BLOCK WALL TYPICAL SECTION (H≤3m) RETAINING WALL 05
SCALE 1: 100

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS	COMPLETION REPORT
DRAWN	JC	Jun.18		
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DRAWING CHECKED				

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CLIENT	WFH PROPERTIES LTD
PROJECT	MILLWATER - ARRANS HILL
TITLE	PRECINCT 5 STAGE 1 RETAINING WALL 05 - TYPICAL SECTION (H≤3m)
SCALE (A3)	1:100
DWG No.	21854.0031-AHP5S1-120
REV	1

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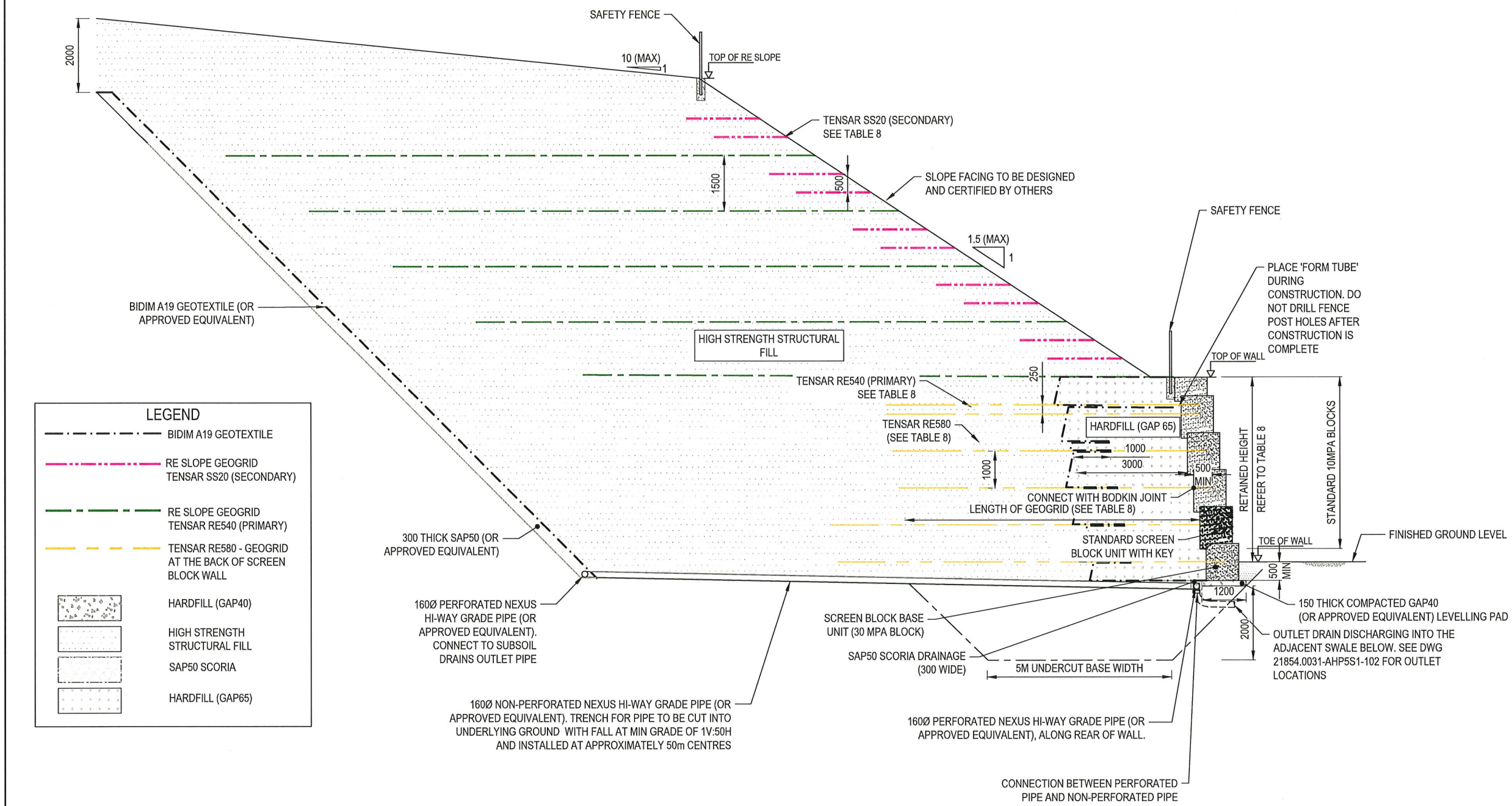
NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-119 FOR WALL 05 PLAN AND LONGSECTION.

TABLE 8: RETAINING WALL 05 (3m<H≤4.7m) DETAIL TABLE

GEOGRID REQUIREMENTS						
WALL TYPE	TOTAL SLOPE/ RETAINED HEIGHT (m)	MAX BACKSLOPE	MAX FORWARD SLOPE	GEOGRID TYPE	GEOGRID LENGTH (m)	VERTICAL LOCATION ABOVE TOE OF WALL (m)
SCREEN BLOCK	H ≤ 4.7	1V:1.5H	0°	TENSAR RE580	10.0	-0.5, 0.5, 1.5, 2.5
					8.0	3.25, 3.75, 4.5
RE SLOPE						MAX VERTICAL SPACING (m)
	8 < H ≤ 9	1V:10H	N/A	TENSAR RE540 (PRIMARY)	16.0	1.5
				TENSAR SS20 (SECONDARY)	2.0	0.5



LEGEND
- BIDIM A19 GEOTEXTILE
- RE SLOPE GEOGRID TENSAR SS20 (SECONDARY)
- RE SLOPE GEOGRID TENSAR RE540 (PRIMARY)
- TENSAR RE580 - GEOGRID AT THE BACK OF SCREEN BLOCK WALL
- HARDFILL (GAP40)
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA
- HARDFILL (GAP65)

SECTION 21/119 SCREEN BLOCK WALL TYPICAL SECTION (3m≤H≤ 4.7m)
RETAINING WALL 05
SCALE 1: 125

A3 SCALE 1:125
0 1 2 3 4 5 6 7 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS	COMPLETION REPORT
DRAWN	JC	Jun.18		
DESIGN CHECKED				
DRAWING CHECKED				

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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 05 - TYPICAL SECTION (3m<H≤4.7m)
SCALE (A3) 1:125 DWG No. 21854.0031-AHP5S1-121 REV 1

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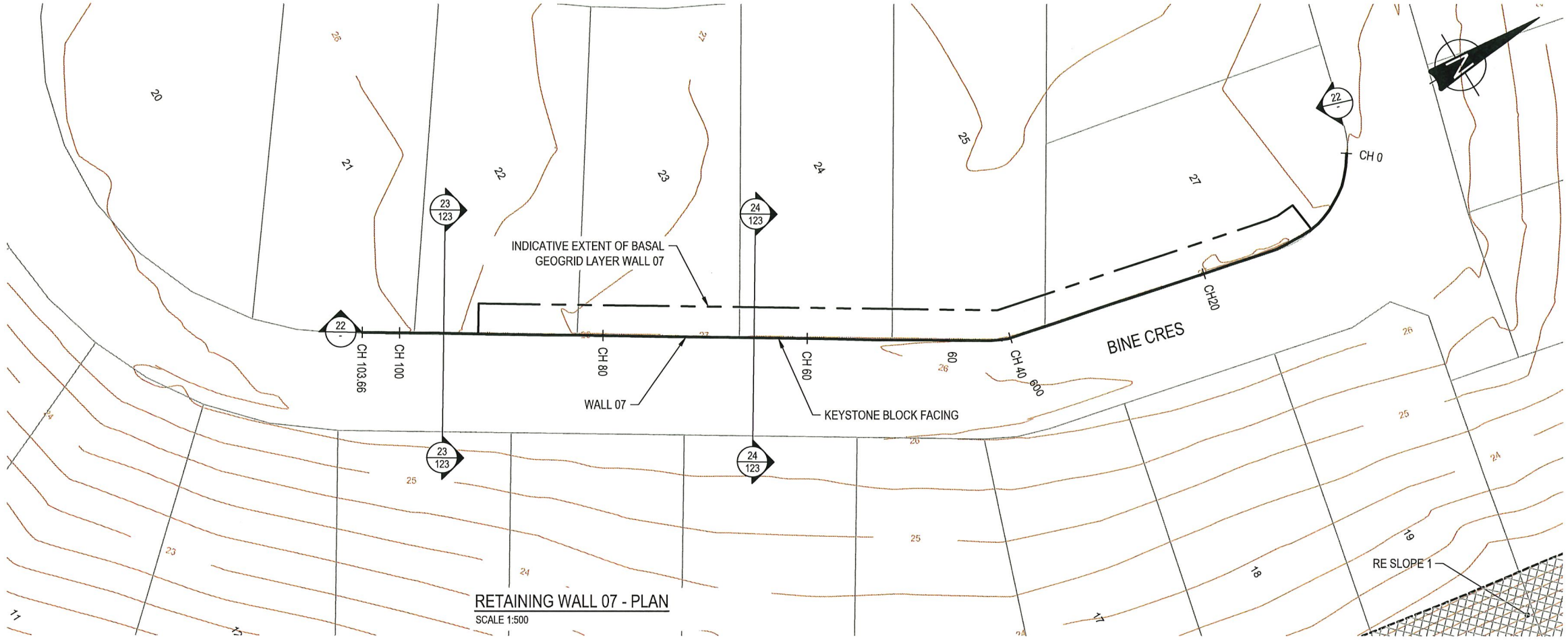
LEGEND

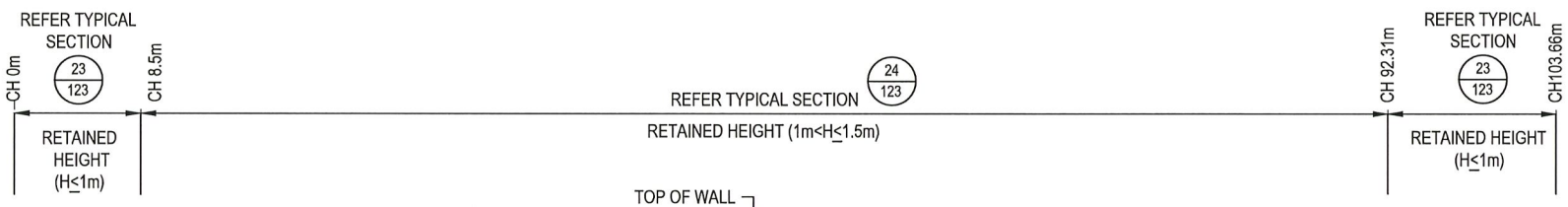
- 23 — LOT LAYOUT
- 11 — FINISHED GROUND PROFILE (0.5m INTERVAL)
- CH 40 / CH 20 — RETAINING WALL CHAINAGE (m)
- RETAINING WALL ALIGNMENT
- RE SLOPE
- GEOGRID STRATAGRID SG550 AT THE BACK OF KEYSTONE BLOCK WALL

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.



RETAINING WALL 07 - PLAN
SCALE 1:500



DATUM RL 20.00												
TOP OF WALL		27.36	27.37	27.37	27.38	27.16	27.17	27.19	27.17	26.76	25.96	25.98
RETAINED HEIGHT		-1.09	-1.20	-1.21	-1.29	-1.18	-1.26	-1.33	-1.34	-1.07	-0.27	-0.25
TOE OF WALL	26.38	26.27	26.17	26.15	26.09	25.98	25.92	25.86	25.83	25.69	25.69	25.73
CHAINAGE	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	103.66

SECTION 22 - RETAINING WALL 07 - ELEVATION
SCALE 1: 500

ORIGINAL IN COLOUR

A3 SCALE 1:500

0 5 10 15 20 25 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

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CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
RETAINING WALL 07 - PLAN AND ELEVATION

SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-122 REV 1

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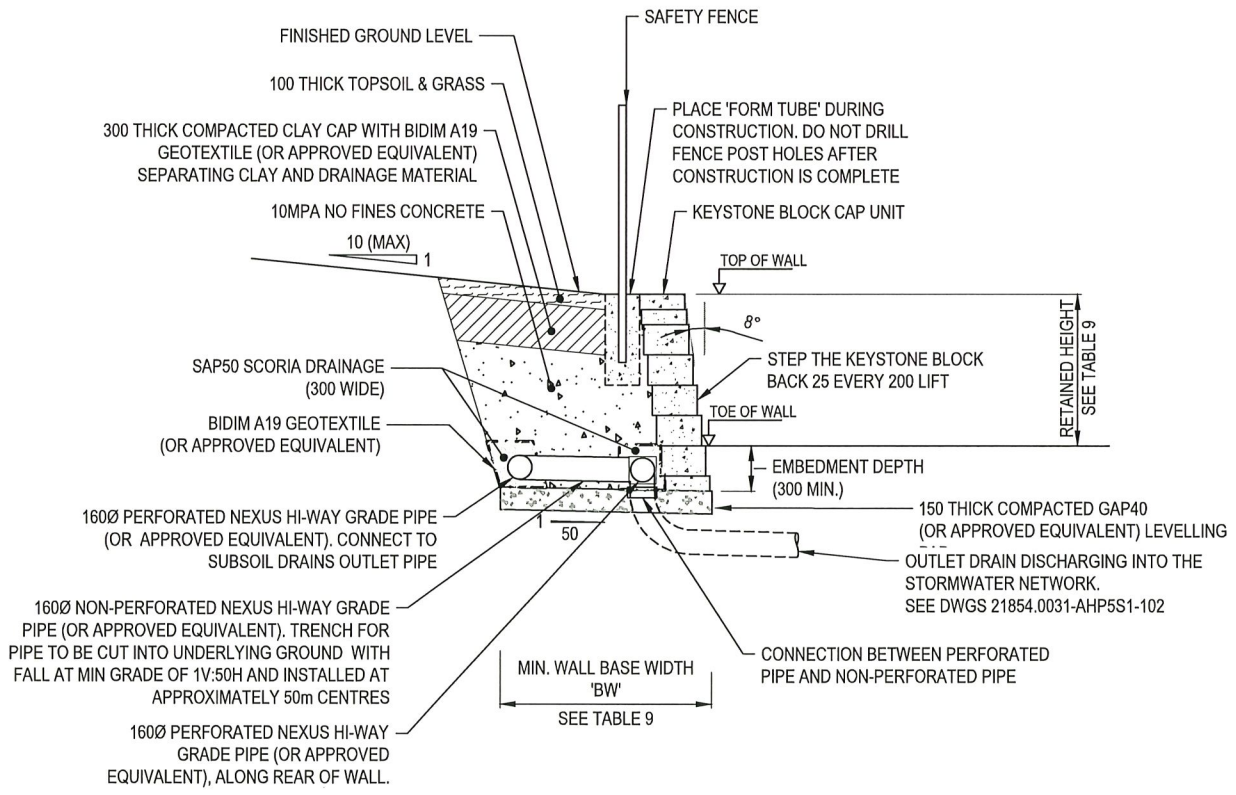
TABLE 9: RETAINING WALL 07 DETAIL TABLE

WALL TYPE	RETAINED HEIGHT (m)	MAX BACK SLOPE	MAX FORWARD SLOPE	MIN. WALL BASE WIDTH (BW) (m)	GEOGRID REQUIREMENTS		
					GEOGRID TYPE	MIN. LENGTH OF GEOGRID (m)	VERTICAL HEIGHT ABOVE TOE OF WALL (m)
KEYSTONE BLOCK	H ≤ 1	1V:10H	0°	1.4	-	-	-
KEYSTONE BLOCK	1 < H ≤ 1.5	1V:10H	0°	-	STRATAGRID SG550	3.0	-0.2, 0.0,
						2.0	0.4, 0.8,1.0

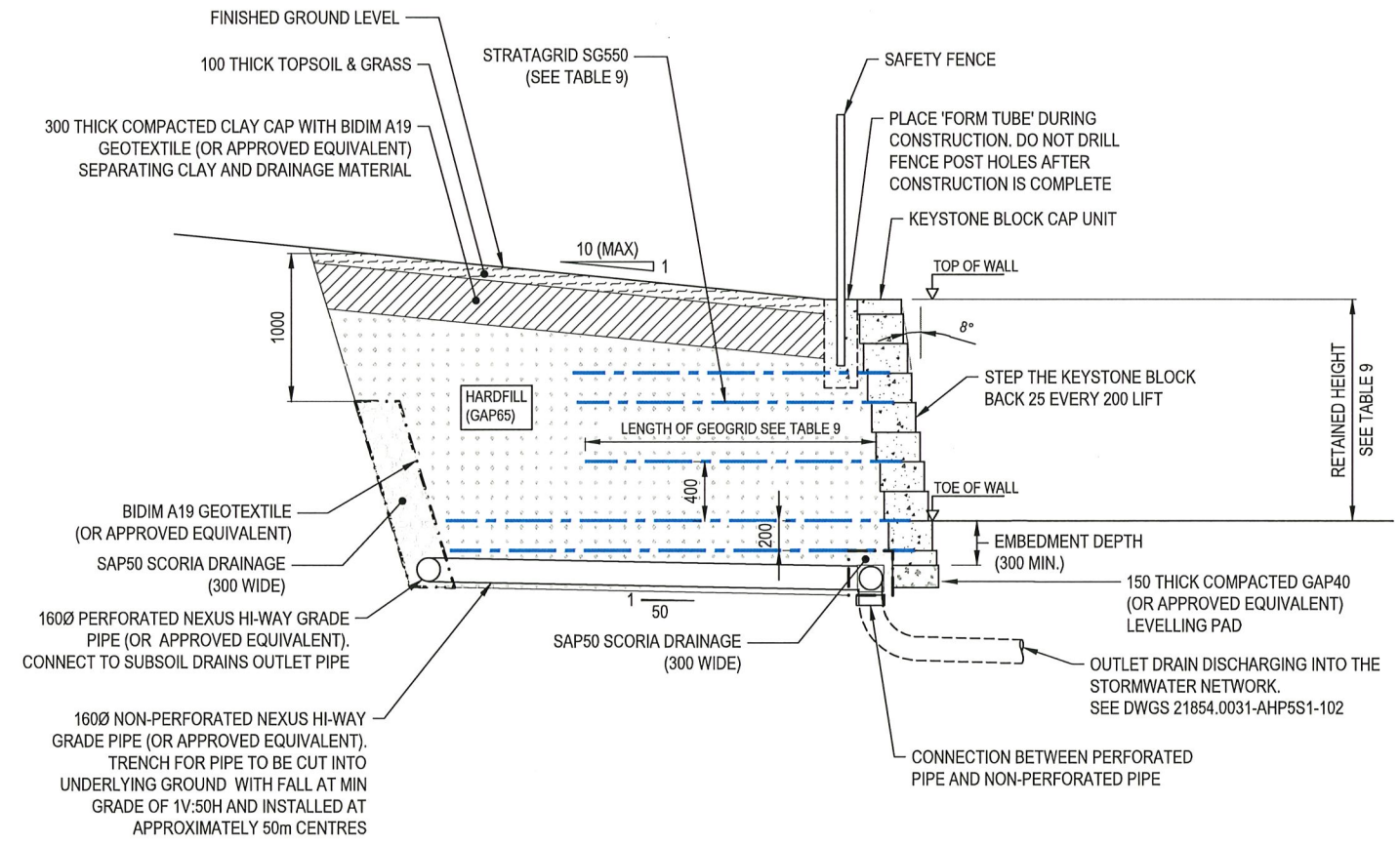
LEGEND

- BIDIM A19 GEOTEXTILE
- STRATAGRID SG550
- HARDFILL (GAP40)
- 10MPA NO FINES CONCRETE
- SAP50 SCORIA
- HARDFILL (GAP65)
- TOPSOIL & GRASS
- COMPACTED CLAY CAP

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-P5S1-127 FOR WALL 07 PLAN AND LONGSECTION.



SECTION 23 / 122 KEYSTONE BLOCK WALL TYPICAL SECTION (H≤1m)
SCALE 1: 50
CHAINAGE 0 TO 10.5m & CHAINAGE 92.31 TO 10103.66m



SECTION 24 / 122 KEYSTONE BLOCK WALL TYPICAL SECTION (1m<H≤1.5m)
SCALE 1: 50
CHAINAGE 10.5 TO 92.31m

A3 SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS	COMPLETION REPORT
DRAWN	JC	Jun.18		
DESIGN CHECKED				
DRAWING CHECKED				

NOT FOR CONSTRUCTION
APPROVED DATE

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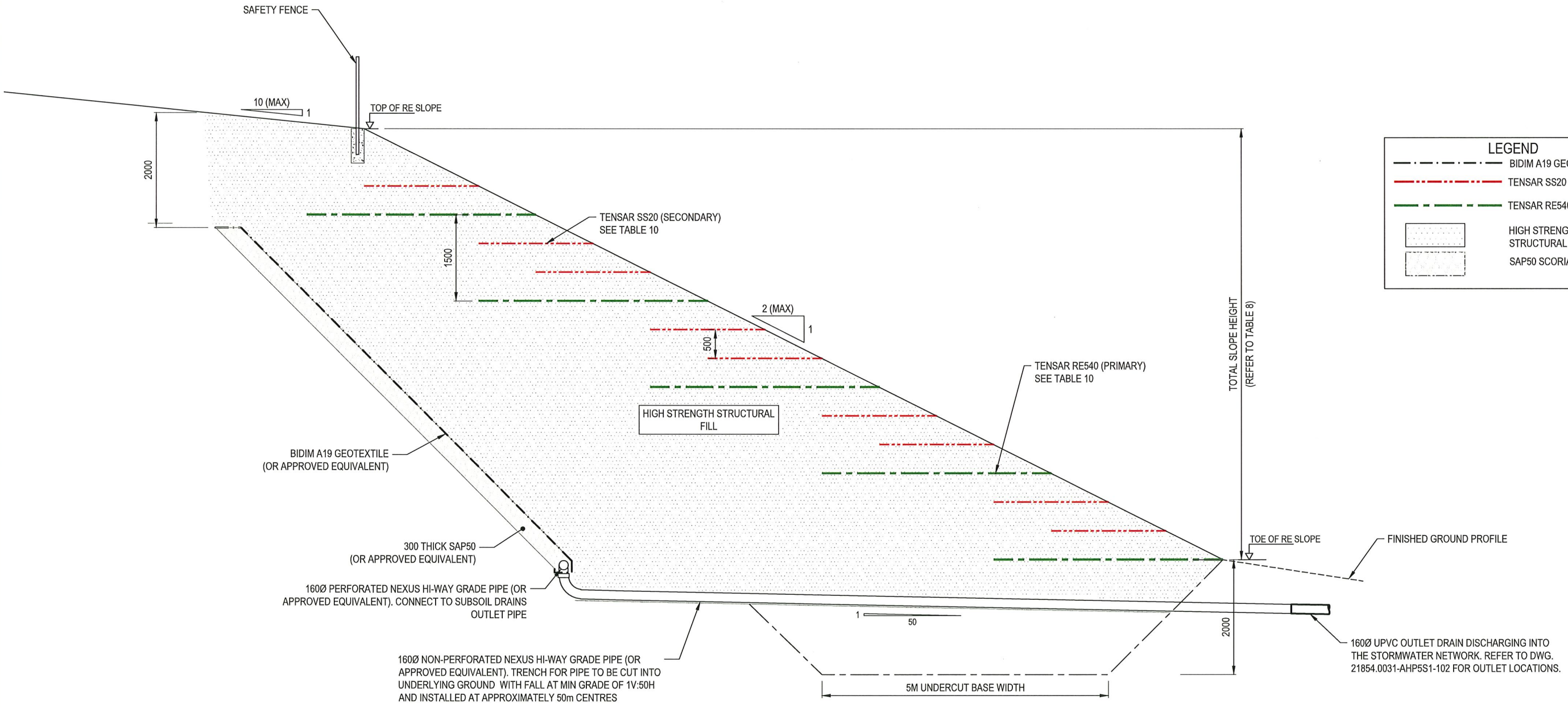
CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RETAINING WALL 07 - TYPICAL SECTION
SCALE (A3) 1:500 DWG No. 21854.0031-AHP5S1-123 REV 1

L:\21854\21854.0031 - Orewa West Precinct 5\WorkingMaterial\CAD\DWG\GCR\21854.0031-AHP5S1-124.dwg 2018-Jun-28 9:23:31 PM Plotted By: JONALD CASTRO

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-101 FOR RE SLOPE 6 PLAN.

TABLE 10: REINFORCEMENT DETAIL FOR RE SLOPES 4, 5 AND 6

WALL TYPE	MAXIMUM TOTAL SLOPE HEIGHT (m)	MAX SLOPE	MAX FORWARD SLOPE	MAX BACK SLOPE	GEOGRID REQUIREMENTS		
					GEOGRID TYPE	GEOGRID LENGTH (m)	MAX VERTICAL SPACING (m)
RE SLOPES 6	H ≤ 8	1V:2H	1V:10H	1V:10H	TENSAR RE540	4.0	1.5
					TENSAR SS20	2.0	0.5



SECTION 25/101 RE SLOPE 6 TYPICAL DETAILS
SCALE 1: 75

A3 SCALE 1:75
0 1 2 3 4 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RE SLOPE 6 - TYPICAL SECTION
SCALE (A3) 1:75 DWG No. 21854.0031-AHP5S1-124 REV 1

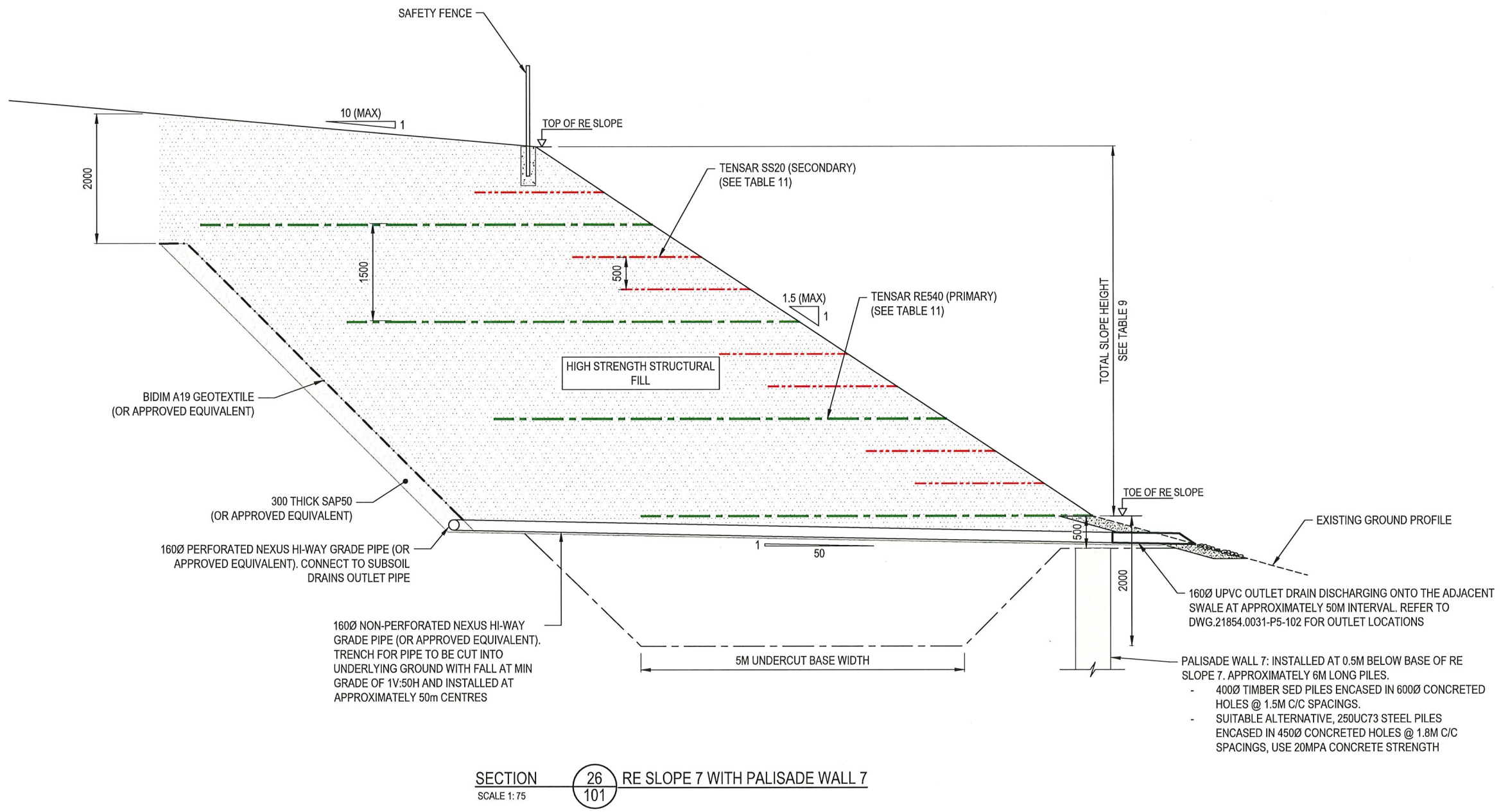
L:\21854\21854.0031 - Orewa West Precinct 5\WorkingMaterial\CAD\DWG\GCR\21854.0031-AHP5S1-125_126.dwg 2018-Jun-28 9:23:42 PM Plotted By: JONALD CASTRO

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-101 FOR RE SLOPES 7 PLAN.

TABLE 11: REINFORCEMENT DETAIL FOR RE SLOPE 7

WALL TYPE	MAXIMUM TOTAL SLOPE HEIGHT (m)	MAX SLOPE	MAX BACK SLOPE	GEOGRID REQUIREMENTS		
				GEOGRID TYPE	GEOGRID LENGTH (m)	MAX VERTICAL SPACING (m)
RE SLOPE 7	H ≤ 5	1V:1.5H	1V:10H	TENSAR RE540	4.0	1.5
				TENSAR SS20	2.0	0.5
	5 < H ≤ 7	1V:1.5H	1V:10H	TENSAR RE540	7.0	1.5
				TENSAR SS20	2.0	0.5
	7 < H ≤ 9	1V:1.5H	1V:10H	TENSAR RE540	11.0	1.5
				TENSAR SS20	2.0	0.5
	9 < H ≤ 11	1V:1.5H	1V:10H	TENSAR RE540	14.0	1.5
				TENSAR SS20	2.0	0.5

LEGEND
- BIDIM A19 GEOTEXTILE
- TENSAR SS20 (SECONDARY)
- TENSAR RE540 (PRIMARY)
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA



SECTION 26/101 RE SLOPE 7 WITH PALISADE WALL 7
SCALE 1:75

A3 SCALE 1:75
0 1 2 3 4 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RE SLOPE 7 - TYPICAL SECTION (SHEET 1 OF 2)
SCALE (A3) 1:75 DWG No. 21854.0031-AHP5S1-125 REV 1

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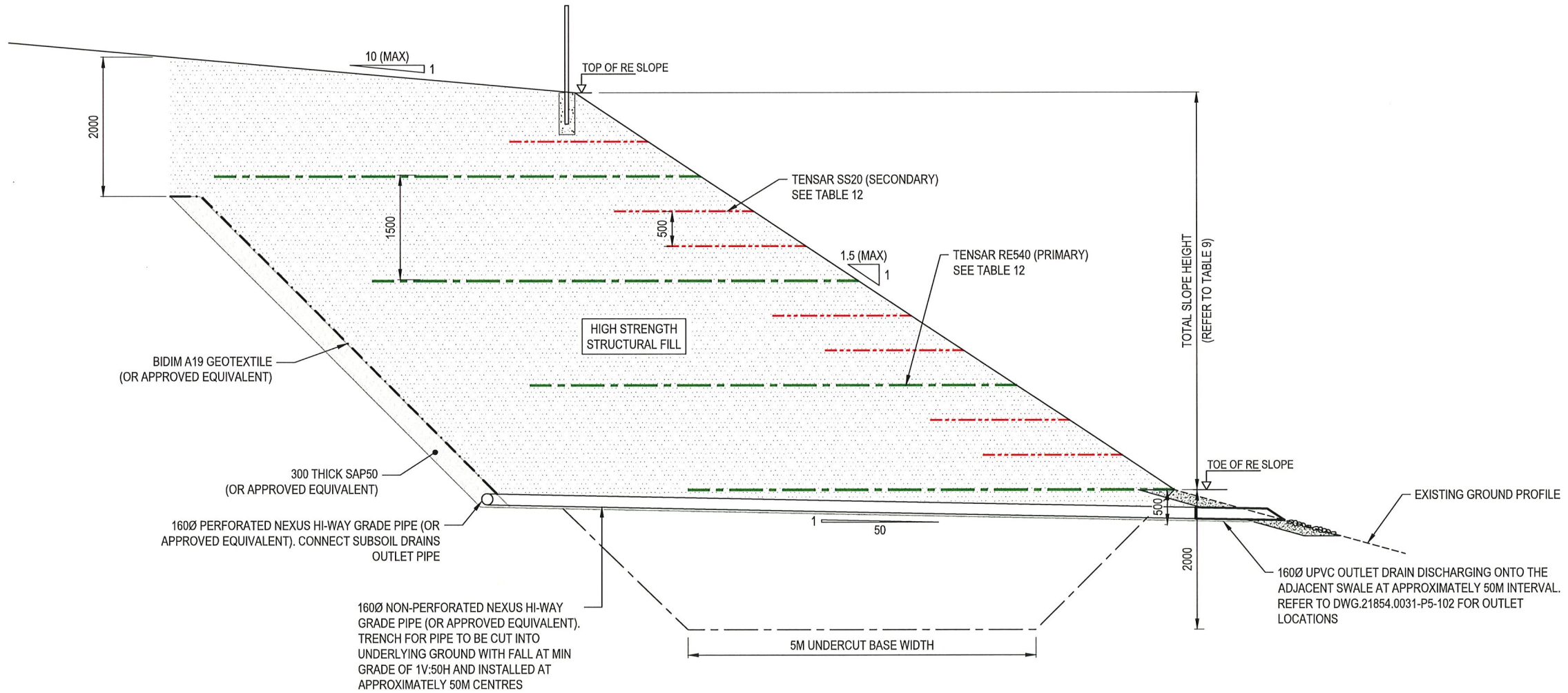
TABLE 12: REINFORCEMENT DETAIL FOR RE SLOPES 7

WALL TYPE	MAXIMUM TOTAL SLOPE HEIGHT (m)	MAX SLOPE	MAX BACK SLOPE	GEOGRID REQUIREMENTS		
				GEOGRID TYPE	GEOGRID LENGTH (m)	MAX VERTICAL SPACING (m)
RE SLOPES 7	H ≤ 5	1V:1.5H	1V:10H	TENSAR RE540	4.0	1.5
				TENSAR SS20	2.0	0.5
	5 < H ≤ 7	1V:1.5H	1V:10H	TENSAR RE540	7.0	1.5
				TENSAR SS20	2.0	0.5
	7 < H ≤ 9	1V:1.5H	1V:10H	TENSAR RE540	11.0	1.5
				TENSAR SS20	2.0	0.5
	9 < H ≤ 11	1V:1.5H	1V:10H	TENSAR RE540	14.0	1.5
				TENSAR SS20	2.0	0.5

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. WALL SETOUT AS PROVIDED BY WOODS AND CONFIRMED ON SITE BY THE ENGINEER.
3. SEE DWG.21854.0031-AHP5S1-101 FOR RE SLOPES 7 PLAN.

LEGEND
- BIDIM A19 GEOTEXTILE
- TENSAR SS20 (SECONDARY)
- TENSAR RE540 (PRIMARY)
- HIGH STRENGTH STRUCTURAL FILL
- SAP50 SCORIA



SECTION 27/101 RE SLOPES 7 TYPICAL DETAILS
SCALE 1: 75

A3 SCALE 1:75
0 1 2 3 4 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
RE SLOPE 7 - TYPICAL SECTION (SHEET 2 OF 2)
SCALE (A3) 1:75 DWG No. 21854.0031-AHP5S1-126 REV 1

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1	COMPLETION REPORT ISSUE			

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PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
SHEAR KEY 01 AND 02 PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-127 REV 1

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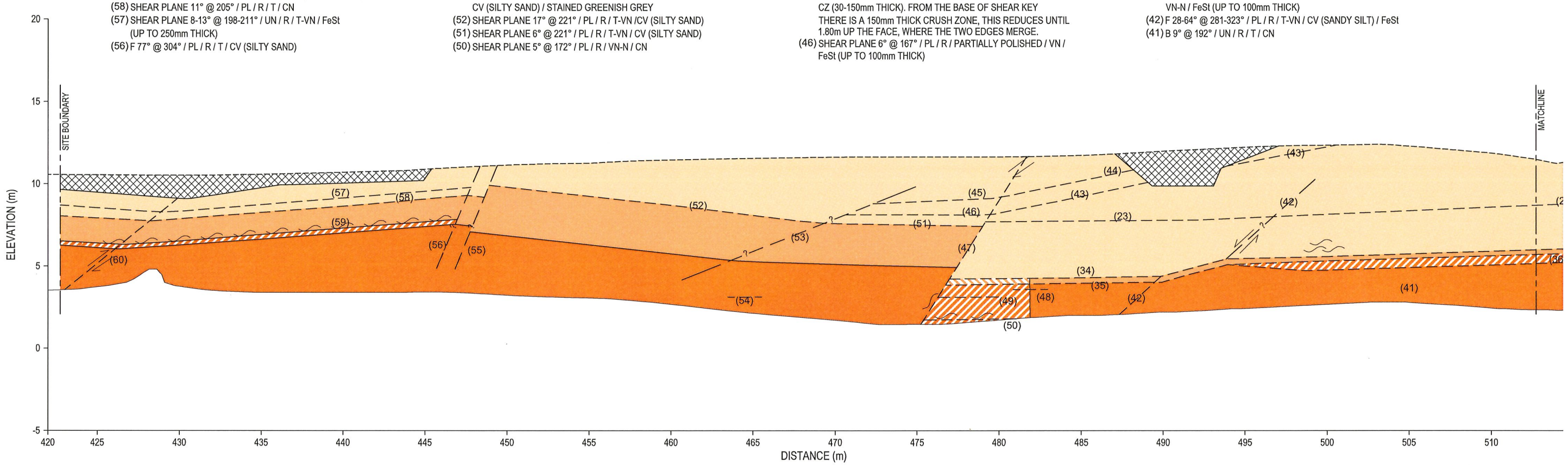
(60) F 57-63° @ 308° / UN / R / T-VN / CV (SILTY SAND)
(59) SHEAR PLANE 10° @ 180° / PL /SM / PARTIALLY POLISHED / VN-MN CC (15mm THICK, GREY CLAYEY SILT) / CZ (250mm THICK)
(58) SHEAR PLANE 11° @ 205° / PL / R / T / CN
(57) SHEAR PLANE 8-13° @ 198-211° / UN / R / T-VN / FeSt (UP TO 250mm THICK)
(56) F 77° @ 304° / PL / R / T / CV (SILTY SAND)

(55) F 77° @ 299° / PL / R / T / CV (SILTY SAND)
(54) J 82° @ 346° / UN / R / VN / CV (SILT) / FeSt
(53) F 83° @ 331° / PL / R / PARTIALLY POLISHED / VN-N / CV (SILTY SAND) / STAINED GREENISH GREY
(52) SHEAR PLANE 17° @ 221° / PL / R / T-VN /CV (SILTY SAND)
(51) SHEAR PLANE 6° @ 221° / PL / R / T-VN / CV (SILTY SAND)
(50) SHEAR PLANE 5° @ 172° / PL / R / VN-N / CN

(49) J 73° @ 338° / UN / R / VN / CV (SANDY SILT)
(48) J 80° @ 344° / UN / R / VN / CV (SANDY SILT)
(47) F 69-71° @ 299° / UN / R / T-VN / CV (CLAYEY SILT) / CZ (30-150mm THICK). FROM THE BASE OF SHEAR KEY THERE IS A 150mm THICK CRUSH ZONE, THIS REDUCES UNTIL 1.80m UP THE FACE, WHERE THE TWO EDGES MERGE.
(46) SHEAR PLANE 6° @ 167° / PL / R / PARTIALLY POLISHED / VN / FeSt (UP TO 100mm THICK)

(45) SHEAR PLANE 7° @ 169° / PL / SM / T-VN / CV (SILTY CLAY)
(44) SHEAR PLANE 14° @ 174° / PL / SM / T-VN / CV (SILTY CLAY)
(43) SHEAR PLANE 13-29° @ 169-197° / PL / R / PARTIALLY POLISHED / VN-N / FeSt (UP TO 100mm THICK)
(42) F 28-64° @ 281-323° / PL / R / T-VN / CV (SANDY SILT) / FeSt
(41) B 9° @ 192° / UN / R / T / CN



LONGSECTION 28/127
SCALE 1: 250

ORIGINAL IN COLOUR

A3 SCALE 1:2000
0 20 40 60 80 100 (m)

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PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
SHEAR KEY 01 LONGSECTION (SHEET 1 OF 2)
SCALE (A3) 1:250 DWG No. 21854.0031-AHP5S1-128 REV 1

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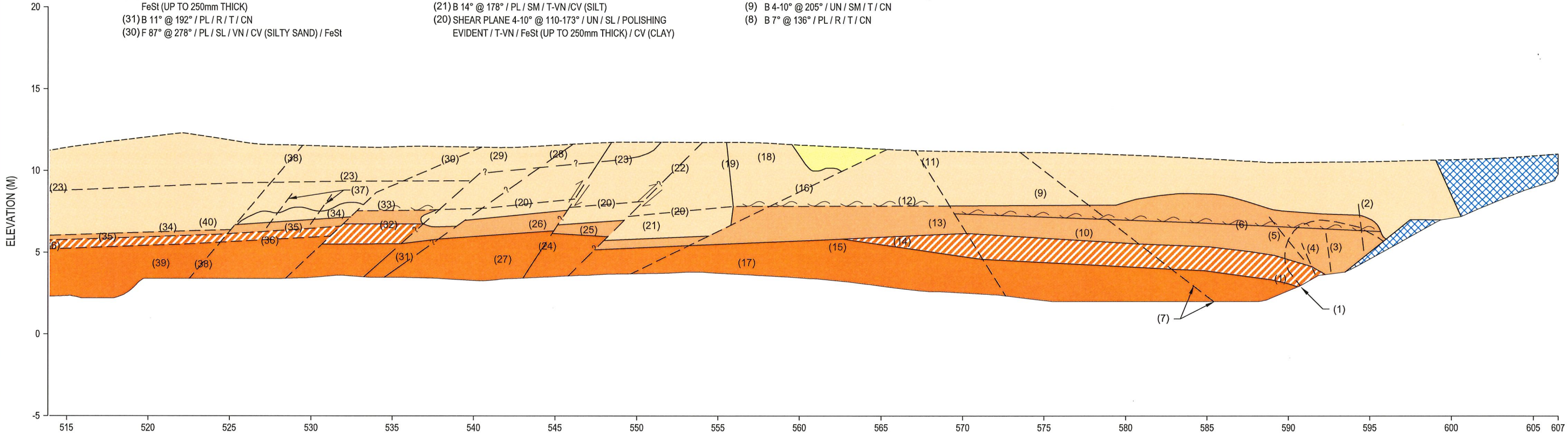
(40) ZONE OF MULTIPLE LIMONITE VEINS 5° @ 210° / UN
(39) B 5° @ 187° / PL / SM / VN / CV (SILT)
(38) F 28° @ 294° / UN / R/ T-N / CV (SANDY SILT)
(37) TWO FAULTS. F 53° @ 287° / PL / R / T-VN / FeSt
(36) SHEAR PLANE 8° @ 200° / UN / SM / T-VN / CV (CLAY) / FeSt
(35) SHEAR PLANE 10° @ 195° / UN / SM / T-VN / CV (CLAY) / CZ (MULTIPLE SHEAR PLANES WITHIN A 40mm THICK ZONE)
(34) SHEAR PLANE 7° @ 191° / UN / R / T-VN / FeSt (UP TO 250mm THICK)
(33) SHEAR PLANE 4-7° @ 213° / UN / SM / T-VN / CV (CLAY)
(32) SHEAR PLANE 4° @ 210° / UN / R / T-VN / FeSt (UP TO 250mm THICK)
(31) B 11° @ 192° / PL / R / T / CN
(30) F 87° @ 278° / PL / SL / VN / CV (SILTY SAND) / FeSt

(29) F 83° @ 263° / PL / SL / VN / CV (SILTY SAND) / FeSt
(28) F 67° @ 290° / PL / R / T-VN / FeSt
(27) B 11° @ 170° / PL / R / T / CN
(26) B 8° @ 152° / PL / SM / T / CN
(25) B 12° @ 170° / PL / SM / T / CN
(24) F 72° @ 301° / PL / R / T-VN / FeSt
(23) SHEAR PLANE 9-57° @ 203° / UN / SM / T / CZ (MULTIPLE SHEAR PLANES WITHIN A PINKISH GREY CLAY SEAM, UP TO 300mm THICK) / FeSt
(22) F 35° @ 289° / PL / R / T-VN / CV (SAND) / FeSt / UP TO 300mm MEASURABLE OFFSET
(21) B 14° @ 178° / PL / SM / T-VN /CV (SILT)
(20) SHEAR PLANE 4-10° @ 110-173° / UN / SL / POLISHING EVIDENT / T-VN / FeSt (UP TO 250mm THICK) / CV (CLAY)

(19) F 77° @ 211° / PL / R / T / FeSt
(18) B 2-14° @ 134° / PL / R / T / CV (SILTY SAND)
(17) B 9° @ 186° / PL / R / T / CV (SAND)
(16) F 32-48° @ 261° / UN / R / T-N / CV (SILTY SAND) / FeSt
(15) B 10° @ 176° / PL / SM / T / CN
(14) B 6° @ 178° / PL / R / T-VN / CV (SILT)
(13) B 12° @ 181° / PL / R / T / CN
(12) SHEAR PLANE 2° @ 128° / PL / SL / PARTIALLY POLISHED / VN / FeSt (UP TO 90mm THICK) / CV (SILTY CLAY)
(11) F 62° @ 233° / UN / R / VN / CV (SILTY SAND)
(10) B 10° @ 217° / PL / R / T / CV (SANDY SILT)
(9) B 4-10° @ 205° / UN / SM / T / CN
(8) B 7° @ 136° / PL / R / T / CN

(7) F 49° @ 217° / PL / R / T-VN / CV (SILT)
(6) SILTSTONE UNIT WITH HEAVY SEEPAGE ALONG THE UPPER CONTACT. B 3-10° @ 133° / PL / SM / T-VN / CV (SILTY CLAY)
(5) F 51° @ 230° / PL / SM / T-VN / CV (SILTY CLAY)
(4) F 42° @ 227° / PL / SM / T-VN / CN
(3) F 54-60° @ 270° / UN / SM / T-VN / CN
(2) F 84° @ 045° / PL / SM / T-VN / CV (SILT)
(1) ZONE OF FAULTS, FEATURES 9, 10, 11 AND 12 ARE THE MAJOR FAULTS OBSERVED WITHIN THIS ZONE.



LONGSECTION 28 CONTINUED
127
SCALE 1:250

ORIGINAL IN COLOUR

A3 SCALE 1:2000
0 20 40 60 80 100 (m)

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CLIENT **WFH PROPERTIES LTD**
PROJECT **MILLWATER - ARRANS HILL**
TITLE PRECINCT 5 STAGE 1
SHEAR KEY 01 LONGSECTION (SHEET 2 OF 2)
SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-129 REV 1

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LEGEND

- STAGE 1 BOUNDARY
- 23 — LOT BOUNDARIES
- 22 — FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALLS
- 400 SED OR 250UC73 PILES
- GABION WALLS
- RE SLOPE EXTENT
- 2.0 — FILL CONTOURS
- 0.0 — ZERO CONTOURS
- -2.0 — CUT CONTOURS
- S16 08116 — EARTHWORKS TESTING LOCATION (URN NUMBER)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

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PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
EARTHWORKS TESTING LOCATION PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-134 REV 1

LONGSECTION MATERIAL LEGEND

- ALLUVIUM
  SILTY CLAY AND CLAYEY SILT, FIRM TO STIFF, MOIST TO WET, LIGHT GREY TO WHITE, ORGANIC LAYERS, GENERALLY THINLY BEDDED (SUBHORIZONTAL)
- RESIDUAL EAST COAST BAYS FORMATION SOILS
- HW-MW EAST COAST BAYS FORMATION SOILS
- HW-MW EAST COAST BAYS FORMATION (SHEARED)
- SW-UW EAST COAST BAYS FORMATION (SHEARED)
  INTERBEDDED SANDSTONE, SILTSTONE AND MUDSTONE.
  SANDSTONE, SILTY, VERY WEAK, DARK GREY.
  SILTSTONE AND MUDSTONE, EXTREMELY WEAK TO VERY WEAK, DARK GREY
- SW-UW EAST COAST BAYS FORMATION
  INTERBEDDED SANDSTONE, SILTSTONE AND MUDSTONE.
  SANDSTONE, SILTY, VERY WEAK, DARK GREY.
  SILTSTONE AND MUDSTONE, EXTREMELY WEAK TO VERY WEAK, DARK GREY
- ENGINEERED FILL
- PREVIOUS SHEARKEY (FILL)
- SHEAR SURFACE
- EXISTING GROUND LEVEL
- UNDERCUT LEVEL
- SEEPAGE

DEFECT CODE LEGEND

SHAPE		ROUGHNESS	
TERM	CODE	DESCRIPTION OF JOINT SURFACE	CODE
STEPPED	ST	SLICKENSIDED	SL
UNDULATING	UN	SMOOTH	SM
PLANAR	PL	ROUGH	R

APERTURE		
TERM	SYMBOL	DESCRIPTION (SEPERATION)
TIGHT	T	NIL
VERY NARROW	VN	0 TO 2mm
NARROW	N	2 TO 6mm
MODERATELY NARROW	MN	6 TO 20mm
MODERATELY WIDE	MW	20 TO 60mm
WIDE	W	60 TO 200mm
VERY WIDE	VW	>200mm

INFILLINGS AND COATINGS

CLAY GOUGE	CG	JOINTS HAVE OPENINGS BETWEEN OPPOSING FACES OF INTACT ROCK SUBSTANCE IN EXCESS OF 1MM FILLED WITH CLAY GOUGE. CLAY IS GENERALLY DESCRIBED IN TERMS OF SOIL PROPERTIES.
CLAY VENEERS	CV	JOINTS CONTAIN CLAY COATING WHOSE MAXIMUM THICKNESS DOES NOT EXCEED 1MM. NOTE: DESCRIBE CLAY IN TERMS OF SOIL PROPERTIES.
PENETRATIVE LIMONITE	PL	JOINT TRACES ARE MARKED IN TERMS OF WELL DEFINED ZONES OF SLIGHTLY TO MODERATELY WEATHERED FERRUGINISED ROCK-SUBSTANCE WITHIN THE ADJACENT ROCK.
LIMONITE STAINED	FeSt	JOINT SURFACES ARE STAINED OR COATED WITH LIMONITE, ALTHOUGH THE ROCK SUBSTANCE IMMEDIATELY ADJACENT TO THE JOINTS IS FRESH.
COATED	CT SC	JOINTS EXHIBIT COATINGS OTHER THAN CLAY OR LIMONITE, EG. CARBONATE (CT) OR SILICA (SC)
CEMENTED	CL CS CC	JOINTS ARE CEMENTED WITH LIMONITE (CL), SILICA (CS), OR CARBONATES (CC)
CLEAN	CN	JOINT SURFACES SHOW NO TRACE OF CLAY, LIMONITE, OR OTHER COATINGS

TYPE		
TERM	CODE	SYMBOL
BEDDING	B	15° DIP ANGLE / STRIKE
JOINT	J	55° DIP ANGLE / STRIKE
SHEAR ZONE	SZ	20° DIP ANGLE / STRIKE
FAULT TRACE	F	40° DIP ANGLE / STRIKE

TYPICAL EXAMPLE:

(5) F 51° @ 230° / PL / SM / T-VN / CV (SILTY CLAY)

- (5) — NO. IN DEFECT SET
- F — TYPE
- 51° — DIP ANGLE
- 230° — DIP DIRECTION
- PL — SHAPE
- SM — ROUGHNESS
- T-VN — APERTURE
- CV — INFILLING/COATING TYPE
- (SILTY CLAY) — INFILLING DESCRIPTION (AS PER SOIL DESCRIPTION)

ORIGINAL IN COLOUR

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PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STGE 1
GEOLOGY LEGEND AND DEFINITION OF TERMS

SCALE (A3) NTS DWG No. 21854.0031-AHP5S1-130 REV 1

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LEGEND

- STAGE 1 BOUNDARY
- 1012 — LOT BOUNDARIES
- 22 — FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALLS
- PROPOSED 400 SED OR 250UC73 PILES
- BUILDING LIMITATION ZONE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

			APPROVED	DATE
DESIGNED	JXXL	Jun.18	NOT FOR CONSTRUCTION	
DRAWN	JC	Jun.18		
DESIGN CHECKED				
DRAWING CHECKED				

DRAWING STATUS: COMPLETION REPORT

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT: **WFH PROPERTIES LTD**

PROJECT: **MILLWATER - ARRANS HILL**

TITLE: PRECINCT 5 STAGE 1
BUILDING LIMITATION PLAN

SCALE (A3): 1:2000 DWG No. 21854.0031-AHP5S1-131 REV 1

T:\CAD\21854\21854.0031 - Orewa West Precinct 5\WorkingMaterial\CAD\DWG\GCR\21854.0031-AHP5S1-132.dwg 2018-Jun-28 5:26:27 PM Plotted By: JONALD CASTRO

LEGEND

- STAGE 1 BOUNDARY
- 23 — LOT BOUNDARIES
- RETAINING WALLS
- 400 SED OR 250UC73 PILES
- GABION WALLS
- RE SLOPE EXTENT
- 2.0 — FILL CONTOURS
- 0.0 — ZERO CONTOURS
- -2.0 — CUT CONTOURS
- C3 — EXPANSIVE SOIL TEST SAMPLES @ 0.5M AND 1.0M DEPTH
- HA03 — HAND AUGER TO 3M DEPTH (FULLY LOGGED)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

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REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
POST EARTHWORKS INVESTIGATION PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-132 REV 1

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LEGEND

- STAGE 1 BOUNDARY
- 23 — LOT BOUNDARIES
- 22 — FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALLS
- 400 SED OR 250UC73 PILES
- GABION WALLS
- RE SLOPE EXTENT
- UNDERCUT EXTENT
- SHEAR KEY EXTENT
- 200 — TOPSOIL DEPTH (MM) TAKEN AT CENTRE OF EACH LOT

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT COORDINATES.
   ORIGIN: LAT 36 52 47S 174 45 51E 800,000MN 400,000ME
   LEVEL DATUM: LINZ (MSL) AUCKLAND VERTICAL DATUM 1946
3. LOT BOUNDARY AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE "37501-01-100-AB-FINAL CONTOURS.DWG", DATED JUNE 2018.
4. UNDERCUT, SHEARKEY AND SUBSOIL DRAINS SUPPLIED BY WOODS, REFERENCE "37501-01-120-AB-SK UC & SUBSOIL.DWG", DATED JUNE 2018.

Tonkin+Taylor

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1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Jun.18	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Jun.18	
DESIGN CHECKED			
DRAWING CHECKED			

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT **WFH PROPERTIES LTD**

PROJECT **MILLWATER - ARRANS HILL**

TITLE PRECINCT 5 STAGE 1
TOPSOIL DEPTHS PLAN

SCALE (A3) 1:2000 DWG No. 21854.0031-AHP5S1-133 REV 1

Appendix B: Contractors Certificates

- Hick Bros Civil Construction Ltd – Producer Statement PS3 – Contract 37501–01 (Stage 1 Bulk Earthworks)
- Hick Bros Civil Construction Ltd – Producer Statement PS3 – Contract 37501–01 (Stage 1 Civil works)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Allan Block Wall 01 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Screen Block Wall 02 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Screen Block Wall 05 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Allan Block Wall 07 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Wetland Gabion Wall Construction)
- North Harbour Fencing Ltd – Producer Statement 3 (Walls 01, 02, 05 & 07, Wetland Gabion Wall, and RE Slope 1 Fences)

PS3 - FORM OF PRODUCER STATEMENT- CONSTRUCTION

ISSUED BY: HICK BROS CIVIL CONSTRUCTION LIMITED

TO: WFH Development Ltd

IN RESPECT OF: Precinct 5 Stage 1 Earthworks
AT: 157 Grand Drive, Orewa

HICK BROS CIVIL CONSTRUCTION LTD has contracted to WFH Development Ltd to carry out and complete certain building works in accordance with a contract, titled Precinct 5 Stage 1 Earthworks ("the contract")

I JAMES BILKEY a duly authorized representative of HICK BROS CIVIL CONSTRUCTION LIMITED believe on reasonable grounds that HICK BROS CIVIL CONSTRUCTION LIMITED has carried out and completed all of the contract works in in accordance with the contract.

Date: 16th May 2018

(Signature of Authorized Agent on behalf of)

HICK BROS CIVIL CONSTRUCTION LIMITED
(Contractor)

42 FORGE ROAD, SILVERDALE
(Address)

PS3 - FORM OF PRODUCER STATEMENT- CONSTRUCTION

ISSUED BY: HICK BROS CIVIL CONSTRUCTION LIMITED

TO: WFH Development Ltd

IN RESPECT OF: Precinct 5 Stage 1 Civils
AT: 157 Grand Drive, Orewa

HICK BROS CIVIL CONSTRUCTION LTD has contracted to WFH Development Ltd to carry out and complete certain building works in accordance with a contract, titled Precinct 5 Stage 1 Civils ("the contract")

I JAMES BILKEY a duly authorized representative of HICK BROS CIVIL CONSTRUCTION LIMITED believe on reasonable grounds that HICK BROS CIVIL CONSTRUCTION LIMITED has carried out and completed all of the contract works in in accordance with the contract.

Date: 31st May 2018

(Signature of Authorized Agent on behalf of)

HICK BROS CIVIL CONSTRUCTION LIMITED
(Contractor)

42 FORGE ROAD, SILVERDALE
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers Construction.**
(Principal)

IN RESPECT OF **Allan Block wall No. 1, Precent 5, Orewa West, Auckland, Lot 805 DP463561**
(Description of Contract Works)

AT **157 Grand Drive, Orewa, Auckland**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers Construction**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Supply and Installation of Allan Block wall to Precent 5, Orewa West (Arran Hill) – for WFH Properties Ltd
(The Contract)

(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. REG66652, REG66703 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

23 September 2017
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers Construction.**
(Principal)

IN RESPECT OF **Mass Block Walls 02, 5 and 4B, Precent 5, Orewa West, Auckland, Lot 805 DP463561**
(Description of Contract Works)

AT **157 Grand Drive, Orewa, Auckland**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers Construction**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Supply and Installation of Mass Block Walls 2, 4A, 4B, 5 and 6 to Precent 5, Orewa West (Arran Hill) – for WFH Properties Ltd
(The Project) *(The Contract)*

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. REG66652, REG66703 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

23 November 2017
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers Construction.**
(Principal)

IN RESPECT OF **Mass Block wall No. 7, Precent 5, Orewa West, Auckland, Lot 805 DP463561**
(Description of Contract Works)

AT **157 Grand Drive, Orewa, Auckland**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers Construction**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Supply and Installation of Mass Block wall to Precent 5, Orewa West (Arran Hill) – for WFH Properties Ltd
(The Project) *(The Contract)*

I, ***Regan Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:

☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. REG66652, REG66703 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

9 April 2018
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hicks Bros Civil Contractors Ltd**
(Principal)

IN RESPECT OF **Gabion Basket Weir**
(Description of Contract Works)

AT **Arran Hills, P5, SW Outlet**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hicks Bros Civil Contractors Ltd**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Gabion Basket Weir *(The Contract)*
(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. ABA 2016198 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

24th May 2018
(Date)

ICB Retaining & Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: HICK BROS CIVIL
(Owner/Principal)

IN RESPECT OF: FENCING – WALL 1
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewa
(Address)

T/A: ..... **BUILDING CONSENT No:** ROC21603
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I ROY HERBERT a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11.05.18
(Date)

2a AMANGA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: Hick Bros Civil
(Owner/Principal)

IN RESPECT OF: FENCING - WALL 2
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewa
(Address)

T/A: ..... **BUILDING CONSENT No:** ROC21638
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I Roy Harbert a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11.05.18
(Date)

2a MANGA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: Hick Bros Civil
(Owner/Principal)

IN RESPECT OF: FENCING - WALL 5
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewa
(Address)

T/A: ..... **BUILDING CONSENT No:** BC0266162
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I Roy Harbert a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11:05:18
(Date)

20 MANUKA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: HICK BROS CIVIL
(Owner/Principal)

IN RESPECT OF: FENCING - WALL 7
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewa
(Address)

T/A: ..... **BUILDING CONSENT No:** BC 10266162
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I ROY HARBERT a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11.05.18
(Date)

20 MANGA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: Hick Bros Civil
(Owner/Principal)

IN RESPECT OF: FENCING - GABION WALL
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewA
(Address)

T/A: ..... **BUILDING CONSENT No:** EN66006 8239
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I Roy HARBERT a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11.05.18
(Date)

20 MANGA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

FORM OF PRODUCER STATEMENT PS3 – CONSTRUCTION
At project completion, this form shall be completed by the building contractor and supplied to the Engineer.

ISSUED BY: NORTH HARBOUR FENCING
(Building Contractor)

TO: Hick Bros Civil
(Owner/Principal)

IN RESPECT OF: FENCING - RE SLOPE 1
(Description of Contract Works)

AT: 157 GRAND DRIVE ORewa
(Address)

T/A: ..... **BUILDING CONSENT No:** EN6.21603
(Territorial Authority / Building Consent Authority)

The above Building Contractor has contracted to the above Owner/Principal to carry out and complete certain building works in accordance with the contract, titled

..... ("the contract")
(Title of building contract)

I Roy Herbert a duly authorised representative of the
(Builder's Authorised Agent)

above building contractor, believe on reasonable grounds that the above building contractor has carried out and completed

☐All ☐Part only as specified in the attached particulars

of the building works in accordance with the contract.

.....
(Signature of Authorised Agent on behalf of the Building Contractor)

11:05:18
(Date)

20 MANGA ROAD
SILVERDALE
(Address)

This producer statement is confirmation by the builder(s) that they have carried out the building work in accordance with the drawings, specifications (and site amendments) that are part of the contract / building consent documents.

Work covered by this statement should have been supervised and checked by suitably qualified trades-persons.

The Engineer requires this producer statement and a copy of the T/A's building consent conditions, to confirm that items of the contract that he has not personally examined, have in fact been built according to the documents, so that the Engineer may issue appropriate documents to the T/A for it to release the Code Compliance Certificate.

Appendix C: NZS 3604:2011 Expansive Soils (Extract)

NZS 3604:2011 Expansive Soils (Extract)

Expansive soils tend to be moderately to highly plastic clays that undergo appreciable volume change upon changes in moisture content. Technically, they are defined in NZS 3604:2011 as those soils having a liquid limit of more than 50% and a linear shrinkage of more than 15%. Where soils are quite silty or sandy, shrink and swell is less of a problem, due to the lower clay contents.

Building damage resulting from expansive soil movement can range from relatively minor brick veneer cracking and internal cracking on wall corners and wall ceiling corners with attendant door and windows jamming, through to extensive cracking of foundation block framework, extensive internal visual cracking and significant warping of building frames. Damage is dependent on building construction and materials and is rarely of structural concern.

NZS 3604:2011 "Timber Framed Buildings" defines good ground as follows:

"Any soil or rock capable of permanently withstanding an ultimate bearing capacity of 300 kPa (i.e. an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

a) Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids;

b) Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested in accordance with NZS 4402 Test 2.6, and

c) Any ground which could forseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots."

Foundations on expansive soils are outside the scope of NZS 3604:2011 as an acceptable solution to the New Zealand Building Code (NZBC). Specific engineering design of foundation elements is involved where expansive soils are present with a recommendation that AS 2870:2011 is used for building design. While not mandatory, AS 2870 designs will allow for a non-specific design foundation to be used without resorting to further ongoing investigation or design.

This geotechnical completion report has classified the soils present on this subdivision to be in Site Class M as per the requirements of AS 2870:2011. Descriptions of the various site classes, together with characteristic surface ground movements are outlined below.

Allowing for some correlation with NZS 3604, the various site classes applicable to NZ conditions are considered to be:

Characteristic Surface Movements	Site Class	Description
a) 20 mm (Note NZS 3604:2011 assumes movement of 25 mm as part of underlying design.	Class A (sand) and/or Class S (Silts) Equivalent to NZS 3604:2011 "Good Ground" sites	Poor to slightly expansive
b) 20 mm – 40 mm	Class M	Moderately expansive
c) 40 mm – 60 mm	Class H1	Highly expansive
d) 60 mm – 75mm	Class H2	Highly expansive
e) > 75 mm	Class E	Extremely expansive

AS 2870 uses a range of factors to assess characteristic soil movement including:

i. Building distress due to ground movement visible on adjacent structures,

ii. Known soil properties and site specific testing to determine the shrink / swell index of a soil (Test 7.1.1 in AS 1289 – Methods of Testing Soils for Engineering Purposes).

AS 2870 is based on defining soil types into various hazard classes based on expected surface movement and depth of desiccation that could occur. It then applies various foundation designs and embedment depths based on the form of building construction (slab on ground, strip footing, stiffened raft, stiffened slab with deep edge beams, etc). AS2870 uses more reinforcing steel than NZ designs generally would to create stiffer foundations that are better able to tolerate ground movement.

The Australian approach also regards expansive soil to a considerable extent being a home owner maintenance issue and significant emphasis is put into ensuring that people understand the influence that trees and dry summers etc may have on foundation performance. See Appendix D.

Appendix D: CSIRO – BTF18 – Foundation Maintenance and Footing Performance: A Homeowners Guide

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

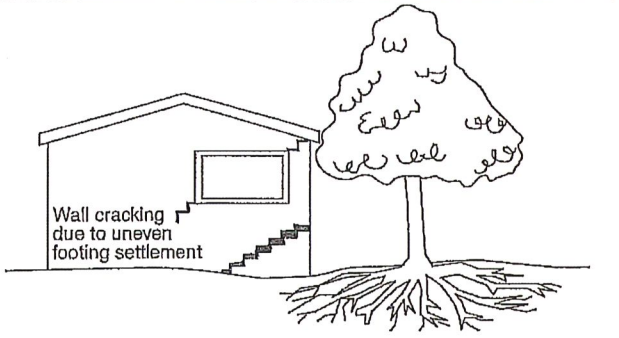
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

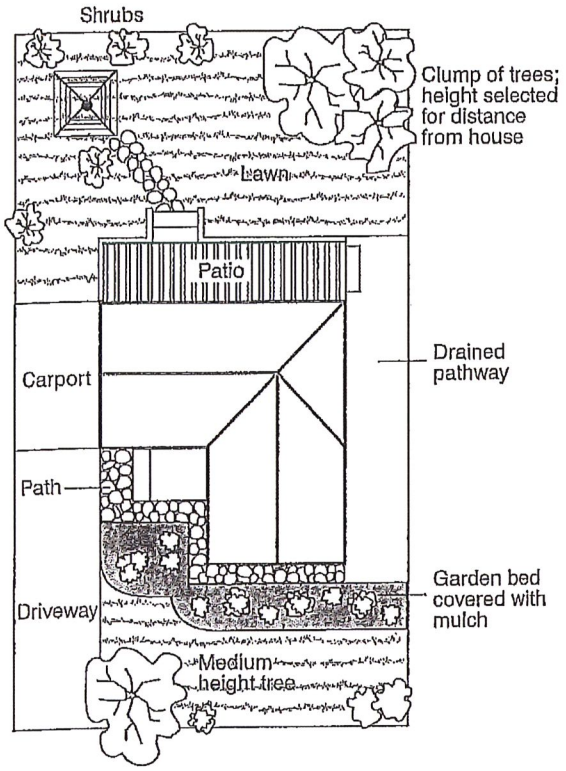
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Appendix E: Test Results

- 21854.0031–AHP5S1–132 Post Earthworks Investigation Plan
- 21854.0031–AHP5S1–133 Topsoil Depths Plan
- 21854.0031–AHP5S1–134 Earthworks Test Locations Plan
- Soil Expansion Test Results
- Post Earthworks Investigation Borehole Logs HA01 to HA14
- Earthworks Test Results

GEOTECHNICS

Our Ref: 1006879.0000.0.0
Customer Ref: 21854.0031
10 May 2018

Tonkin & Taylor
PO Box 5271, Wellesley Street,
Auckland 1141

Attention: Mr Andrew Linton

Dear Andrew

Millwater, Precinct 5, Stage 1

Laboratory Test Report

Samples from the above mentioned site have been tested as received according to your instructions. Test results are included in this report.

Samples were destroyed during testing.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report prepared by:

Sim Tirunahari
I am the author of this document
2018.05.10 12:38:48 +12'00'

.....

Sim Tirunahari
Soils Laboratory Manager
Approved Signatory

Authorised for Geotechnics by:

Steven Anderson
I am approving this document
2018.05.10 13:55:14 +12'00'

.....

Steven Anderson
Project Director

Report checked by:

Steven Anderson
I have reviewed this document
2018.05.10 13:55:31 +12'00'

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Steven Anderson
Operations & Technical Manager

This document consists of 5 pages.
10-May-18
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GEOTECHNICS
Ground Floor, 19 Morgan Street, Newmarket, Auckland 1023
PO Box 9360, Newmarket, Auckland 1149
p 64 9 356 3510
www.geotechnics.co.nz

Site: **Millwater, Precinct 5, Stage 1**

Your Job No: 21854.0031

Our Job No: 1006879.0000.0.0

Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**1**	**1**	**2**	**2**	**3**	**3**	**4**	**4**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	49.8	43.3	30.1	29.7	39.7	38.3	28.3	27.1
	Bulk Density	(t/m³)	1.68	1.71	1.81	1.79	1.79	1.80	1.83	1.86
	Dry Density	(t/m³)	1.12	1.19	1.39	1.38	1.28	1.30	1.43	1.46
	Final Water Content	(%)	50.9	42.5	32.3	32.4	41.3	40.3	31.0	29.2
	Swelling Strain	(%)	0.07	-0.15	0.03	0.03	0.15	-0.03	-0.17	-0.04
SHRINKAGE TEST	Final Water Content	(%)	12.5	32.4	18.3	21.4	21.2	24.8	14.1	12.1
	Shrinkage Strain	(%)	4.7	2.9	0.83	2.0	5.9	7.0	1.9	2.7
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Major	Major	Moderate	Major	Major	Major	Major	Major
SHRINK - SWELL INDEX		**(%)**	**2.6**	**1.6**	**0.5**	**1.1**	**3.3**	**3.9**	**1.0**	**1.5**

Remarks: The test results are IANZ accredited.

Entered by: JK Date: 10/05/2018 Checked by: ST Date: 10/05/2018

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SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**5**	**5**	**6**	**6**	**7**	**7**	**8**	**8**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	36.1	39.9	32.5	34.8	28.6	43.5	34.3	65.6
	Bulk Density	(t/m³)	1.72	1.75	1.79	1.81	1.88	1.67	1.82	1.77
	Dry Density	(t/m³)	1.26	1.25	1.35	1.34	1.46	1.16	1.36	1.07
	Final Water Content	(%)	38.6	41.5	34.0	36.5	30.8	44.2	36.1	66.5
	Swelling Strain	(%)	0.00	0.04	-0.02	0.07	0.08	-0.05	0.06	0.03
SHRINKAGE TEST	Final Water Content	(%)	19.9	20.0	16.5	19.8	19.6	28.0	22.3	37.3
	Shrinkage Strain	(%)	2.7	1.6	1.2	3.3	4.3	1.5	2.9	3.8
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Major
SHRINK - SWELL INDEX		**(%)**	**1.5**	**0.9**	**0.7**	**1.8**	**2.4**	**0.8**	**1.6**	**2.1**

Remarks: The test results are IANZ accredited.

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SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**9**	**9**	**10**	**10**	**11**	**11**	**12**	**12**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	27.4	28.9	42.3	52.5	36.4	34.7	33.0	30.1
	Bulk Density	(t/m³)	1.77	1.87	1.70	1.64	1.77	1.73	1.76	1.70
	Dry Density	(t/m³)	1.39	1.45	1.19	1.08	1.30	1.28	1.32	1.31
	Final Water Content	(%)	27.0	29.3	44.1	53.1	37.0	35.3	34.0	32.0
	Swelling Strain	(%)	0.02	1.02	-0.12	-0.05	0.04	-0.08	-0.03	-0.06
SHRINKAGE TEST	Finall Water Content	(%)	14.1	9.4	26.5	32.9	24.4	15.7	13.4	15.2
	Shrinkage Strain	(%)	1.8	2.0	3.3	5.2	3.1	2.2	0.83	1.1
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Minor	Major	Moderate	Major	Moderate	Major	Moderate	Major
SHRINK - SWELL INDEX		**(%)**	**1.0**	**1.4**	**1.8**	**2.9**	**1.7**	**1.2**	**0.5**	**0.6**

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Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**13**	**13**	**14**	**14**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	39.0	31.4	26.8	36.2
	Bulk Density	(t/m³)	1.78	1.80	1.85	1.82
	Dry Density	(t/m³)	1.28	1.37	1.46	1.34
	Final Water Content	(%)	39.6	33.5	27.7	37.6
	Swelling Strain	(%)	0.02	0.02	0.10	-0.07
SHRINKAGE TEST	Final Water Content	(%)	12.4	11.9	12.5	16.4
	Shrinkage Strain	(%)	2.8	3.2	2.6	1.2
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Major	Major	Major	Moderate
SHRINK - SWELL INDEX		**(%)**	**1.6**	**1.8**	**1.5**	**0.6**

Remarks: The test results are IANZ accredited.

Entered by: JK Date: 10/05/2018 Checked by: ST Date: 10/05/2018

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA01**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 831984.33 N (EDENTM2000) 391488.88 E
R.L.: 16.46m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 12/04/2018
HOLE FINISHED: 12/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL / ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Description and Additional Observations
Fill	SILT, non plastic, moist, dark brown with yellowish brown inclusions SILT, non plastic, moist, yellowish brown and brown with grey inclusions
Residual Soil	clayey SILT, low plasticity, moist, yellowish brown with red speckles 0.6m: orange brown and grey
Residual East Coast Bays Formation	SILT, non plastic, moist, grey 1.1m: wet 2.2m: solid refusal
	2.2m: Refusal

WATER: DRY; 12/04/2018 on completion

SCALA PENETROMETER (Blows/0mm): 1 2 3 4 5 6 7 8 9

TESTS:
- 104/43 kPa
- 102/21 kPa
- 83/6 kPa
- 98/25 kPa
- 104/15 kPa
- >215 kPa
- UTP

SAMPLES: TS

RL (m)	DEPTH (m)
16	0.5
15	1.0
14	1.5
13	2.0
	2.5
	3.0
	3.5

GRAPHIC LOG

WEATHERING: MOISTURE CONDITION: M; M-W

STRENGTH/DENSITY CLASSIFICATION: VSt; VSt-H

SHEAR STRENGTH (kPa): 10 25 100 200

COMMENTS:

Hole Depth 2.2m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA02**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1	LOCATION: Orewa West Precinct 5 stg1	JOB No.: 21854.0031-P5S1
CO-ORDINATES: 832053.50 N (EDENTM2000) 391465.43 E	DRILL TYPE: 50mm hand auger	HOLE STARTED: 01/04/2018
R.L.: 25.07m	DRILL METHOD: HA	HOLE FINISHED: 01/04/2018
DATUM: AUCKHT1946		DRILLED BY: GEOTECHNICS
		LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL									ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Fill					UTP UTP 156/49 kPa		25 24	0.5 1.0	TS	M	H VSt-H		SILT, non plastic, moist, dark brown SILT, non plastic, moist, reddish brown, grey and brown 0.6m: non plastic, yellowish brown with grey inclusions
Residual East Coast Bays Formation	◄				93/28 kPa 55/6 kPa 68/3 kPa 108/37 kPa 144/46 kPa 132/28 kPa 83/- kPa		23 22	1.5 2.0 2.5 3.0			St-VSt		SILT, non plastic, moist, dark grey 2.8m: trace water inflow
								3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA03**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832020.30 N, 391511.83 E (EDENTM2000)
R.L.: 21.45m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 12/04/2018
HOLE FINISHED: 12/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL								ENGINEERING DESCRIPTION					
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 15 25 50 100 200	Description and Additional Observations
Fill							21 / 0.0	TS	M			SILT, non plastic, moist, dark brown with yellowish brown inclusions
												fine GRAVEL, angular, dark grey
Residual Soil					● 166/70 kPa					VSt		SILT, some clay, low plasticity, moist, light whitish grey
					● 67/18 kPa		0.5			St		clayey SILT, low to medium plasticity, moist, light whitish grey 0.8m: low plasticity
					● 105/40 kPa		1.0			VSt		SILT, some clay, low plasticity, moist, light brownish white
Residual East Coast Bays Formation	DRY; 12/04/2018 on completion				● 77/28 kPa		20 / 1.5			St-VSt		SILT, some clay, low plasticity, moist, grey
					● 81/18 kPa							
					● 116/37 kPa		2.0					
					● 104/25 kPa					St		SILT, non plastic, moist, grey
					● 86/34 kPa		19 / 2.5					
					● 80/15 kPa							SILT, some clay, low plasticity, moist, grey
					● 89/18 kPa		3.0		M-W			SILT, some sand, non plastic, moist to wet, grey
							18 / 3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA04**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832083.02 N, 391516.88 E (EDENTM2000)
R.L.: 26.76m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 01/04/2018
HOLE FINISHED: 01/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL									ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 50 100 200	Description and Additional Observations
Fill					>215 kPa 135/43 kPa 144/52 kPa 162/52 kPa		26	0.5 1.0	TS	M	H VSt		SILT, non plastic, moist, dark brown with yellowish brown inclusions SILT, non plastic, moist, brown and yellowish brown and reddish brown 0.9m: grey inclusions
Residual East Coast Bays Formation	DRY; 11/04/2018 on completion				120/12 kPa 96/10 kPa 144/46 kPa 150/40 kPa 202/52 kPa >215 kPa		25 24	1.5 2.0 2.5 3.0			VSt-H		SILT, some clay, non plastic, moist, dark grey
							23	3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA05**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832064.47 N, 391567.19 E (EDENTM2000)
R.L.: 24.56m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 12/04/2018
HOLE FINISHED: 12/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 20 50 100 200	Description and Additional Observations
Fill					193/25 kPa		24	0.0	TS	M	VSt		SILT, non plastic, moist, dark brown
											VSt-H		SILT, non plastic, moist, reddish brown, minor grey inclusions
					>215 kPa			0.5					
					>215 kPa			1.0			H		SILT, non plastic, moist, grey
					>215 kPa								
Residual Soil					UTP		23	1.5					SILT, non plastic, moist, orange brown and yellowish brown, with bands of rusty oxides
					UTP					M-W			sandy SILT, non plastic, moist to wet, yellowish brown
					UTP			2.0					2.2m: light greyish brown mottled yellowish orange brown
					UTP		22	2.5					2.6m: light greyish brown
					UTP					M			SILT, non plastic, moist, light brown mottled yellowish orange brown
	DRY; 12/04/2018 on completion				UTP			3.0					
							21	3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA06**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: (EDENTM2000) 832120.83 N, 391555.52 E

R.L.: 28.40m

DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger

DRILL METHOD: HA

HOLE STARTED: 01/04/2018

HOLE FINISHED: 01/04/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 100 200	Description and Additional Observations
							28	0.0	TS	M	H		SILT, non plastic, moist, dark brown
					>215 kPa								SILT, non plastic, moist, brown and grey
Fill					114/18 kPa			0.5			VSt		SILT non plastic, moist, grey
					172/13 kPa			1.0					
					UTP						VSt-H		sandy SILT non plastic, moist, orange brown mottled light greyish white, with rusty oxides
					111/15 kPa		27	1.5					1.5m: light whitish brown
Residual Soil					141/21 kPa								
					202/32 kPa			2.0					2.1m: moist to wet, light brown speckled orange
					99/16 kPa		26	2.5			VSt		SILT, non plastic, moist, light whitish brown
					102/21 kPa								2.7m: grey
	DRY: 11/04/2018 on completion				141/31 kPa			3.0		W			sandy SILT, non plastic, wet, light brown
							25	3.1					3.1m: END OF BOREHOLE
								3.5					

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA07**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832060.55 N
(EDENTM2000) 391623.87 E

R.L.: 23.61m

DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger

DRILL METHOD: HA

HOLE STARTED: 12/04/2018
HOLE FINISHED: 12/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING / MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 100 200	Description and Additional Observations
Fill					215/86 kPa		23	0.0	TS	M	H		SILT, non plastic, moist, dark brown
													SILT, non plastic, moist, yellowish brown, minor grey inclusions
					86/46 kPa			0.5			VSt-H		SILT, minor clay, low plasticity, moist, yellowish brown with grey inclusions
													0.6m: non plastic, yellowish brown mottled reddish brown
					67/21 kPa			1.0			St		sandy SILT, non plastic, moist, yellowish orange brown
Residual Soil					59/3 kPa		22				F-St		SILT, non plastic, moist, yellowish orange brown
					43/6 kPa			1.5					
					49/6 kPa								
								2.0					2.0m: moist to wet, yellowish brown mottled light grey
					71/22 kPa						St		SILT, non plastic, moist, grey mottled yellowish orange brown
Residual East Coast Bays Formation	DRY: 12/04/2018 on completion				89/13 kPa		21	2.5					
					80/21 kPa								
					87/28 kPa			3.0					3.0m: grey
							20	3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA08**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832115.08 N, 391609.51 E (EDENTM2000)
R.L.: 26.45m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 01/04/2018
HOLE FINISHED: 01/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Fill									TS	M	VSt		SILT, some clay, non plastic, moist, dark brown, minor yellowish brown inclusions
											St		clayey SILT, low plasticity, moist, yellowish brown and reddish brown, stiff.
Residual Soil					120/31 kPa		26	0.5		M-W	St-VSt		SILT, non plastic, moist, reddish brown mottled yellowish brown and light greyish white
					104/26 kPa								0.8m: moist to wet, light whitish grey mottled pink
					62/7 kPa			1.0					1.1m: pink and orange
					77/15 kPa								1.3m: wet, orange with rusty bands
					116/25 kPa		25	1.5		M	St		clayey SILT, low plasticity, moist, yellowish orange brown
					55/13 kPa						St-VSt		SILT, non plastic, moist, yellowish orange brown
					>215 kPa			2.0					2.0m: orange brown
Residual East Coast Bays Formation	DRY: 11/04/2018 on completion				>215 kPa		24	2.5			H		SILT, non plastic, moist, dark grey
					UTP								2.6m: dry to moist 2.7m: solid refusal
							23	3.0					2.7m: Refusal
								3.5					

COMMENTS:

Hole Depth 2.7m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA09**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832119.63 N, 391682.26 E (EDENTM2000)
R.L.: 23.49m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 01/04/2018
HOLE FINISHED: 01/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Topsoil									TS	M	H		SILT non plastic, moist, dark brown
													clayey SILT, low plasticity, moist, yellowish brown and reddish brown
					>215 kPa								SILT non plastic, moist, yellowish brown with minor fine gravel and grey inclusions
					>215 kPa		23	0.5					
					UTP								
								1.0			VSt-H		SILT, some clay, low plasticity, light brown and yellowish brown with grey silt inclusions
Fill					150/99 kPa								
					UTP		22	1.5					
					178/86 kPa								
								2.0					
					116/78 kPa								
					104/26 kPa						VSt		SILT, non plastic, moist, light whitish grey mottled yellowish orange brown
Residual Soil	DRY; 11/04/2018 on completion						21	2.5					
					120/18 kPa								
					133/21 kPa			3.0					
													3.1m: END OF BOREHOLE
							20	3.5					

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA10**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832176.04 N (EDENTM2000) 391650.39 E

R.L.: 26.86m

DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger

DRILL METHOD: HA

HOLE STARTED: 01/04/2018

HOLE FINISHED: 01/04/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 50 100 200	Description and Additional Observations
Fill					UTP				TS	M	H		SILT, non plastic, moist, dark brown
													SILT, non plastic, moist, reddish brown
Residual Soil	DRY; 11/04/2018 on completion				43/12 kPa		26	0.5			F-St		SILT, some clay, low plasticity, moist, pink 0.5m: non plastic, some yellowish brown inclusioins
					58/7 kPa			1.0					
					87/28 kPa								
					58/15 kPa			1.5					
					49/16 kPa		25						
					44/15 kPa			2.0					
					50/18 kPa								
					55/18 kPa			2.5					
					64/22 kPa		24	3.0					
													3.1m: END OF BOREHOLE
							23	3.5					

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA11**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: 832185.70 N
(EDENTM2000) 391692.72 E

R.L.: 23.85m

DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger

DRILL METHOD: HA

HOLE STARTED: 01/04/2018

HOLE FINISHED: 01/04/2018

DRILLED BY: GEOTECHNICS

LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION:	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 0 50 100 200	Description and Additional Observations
Fill	DRY; 11/04/2018 on completion				>215 kPa 70/2 kPa 166/22 kPa UTP 80/40 kPa 74/37 kPa 80/18 kPa 89/37 kPa UTP UTP		23 22 21 20	0.5 1.0 1.5 2.0 2.5 3.0 3.5		M	VSt-H St H		(trace topsoil) SILT non plastic, moist, friable, yellowish brown mottled pink 1.0m: hard, friable 1.2m: grey inclusions clayey SILT, low plasticity, moist, yellowish brown, minor inclusions of topsoil SILT, non plastic, moist, yellowish brown with brown and grey inclusions SILT, non plastic, moist, yellowish brown with grey inclusions and minor fine gravel 3m: END OF BOREHOLE

COMMENTS:

Hole Depth 3m

Scale 1:20

Rev.: A

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HAND AUGER LOG

HOLE Id: **HA12**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1		LOCATION: Orewa West Precinct 5 stg1	JOB No.: 21854.0031-P5S1
CO-ORDINATES: (EDENTM2000)	832179.17 N 391584.29 E	DRILL TYPE: 50mm hand auger	HOLE STARTED: 01/04/2018
		DRILL METHOD: HA	HOLE FINISHED: 01/04/2018
R.L.:	30.14m		DRILLED BY: GEOTECHNICS
DATUM:	AUCKHT1946		LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL									ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Fill					UTP		30	0.5		M	H		SILT, non plastic, dry to moist, brown and grey
					UTP								
					UTP								0.9m: grey with red mottles
					UTP		29	1.0					
					77/25 kPa			1.5					1.4m: grey and yellowish brown, gravel at base
Residual Soil					58/12 kPa						St		SILT, some clay, low plasticity, moist, light brownish white
					55/15 kPa		28	2.0					2.0m: non plastic, light brown and light yellowish brown
					74/22 kPa								sandy SILT, non plastic, moist, yellowish brown
					41/15 kPa			2.5			F		SILT, non plastic, moist, yellowish brown
Residual East Coast Bays Formation	DRY; 11/04/2018 on completion				41/10 kPa			3.0					SILT, non plastic, moist to wet, dark grey
							27	3.5					3.1m: END OF BOREHOLE

COMMENTS:

Hole Depth 3.1m

Scale 1:20

Rev.: A

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Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA13**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1		LOCATION: Orewa West Precinct 5 stg1	JOB No.: 21854.0031-P5S1
CO-ORDINATES: (EDENTM2000)	832221.92 N 391639.05 E	DRILL TYPE: 50mm hand auger	HOLE STARTED: 01/04/2018
		DRILL METHOD: HA	HOLE FINISHED: 01/04/2018
R.L.:	24.36m		DRILLED BY: GEOTECHNICS
DATUM:	AUCKHT1946		LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL									ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 100 200	Description and Additional Observations
Fill					95/46 kPa 135/22 kPa 104/- kPa 93/15 kPa		24 23	0.0 0.5 1.0	TS	M	St-VSt		SILT, non plastic, moist, dark brown SILT, non plastic, moist, yellowish brown mottled reddish brown, some sandy layers
Residual Soil	DRY; 11/04/2018 on completion				121/83 kPa 116/52 kPa 108/52 kPa 138/56 kPa 141/59 kPa 129/41 kPa		22 21	1.5 2.0 2.5 3.0 3.5			VSt		clayey SILT, low to medium plasticity, moist, yellowish brown 1.9m: low plasticity SILT, some clay, non plastic, moist, yellowish and reddish brown SILT, some sand, non plastic, moist, yellowish orange brown 3m: END OF BOREHOLE

COMMENTS:

Hole Depth 3m

Scale 1:20

Rev.: A

HandAugerLog - 20/06/2018 2:17:13 p.m. - Produced with Core-GS by GeRoc

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA14**

Hole Location: Refer to site plan

SHEET: 1 OF 1

PROJECT: Orewa West P5S1 | LOCATION: Orewa West Precinct 5 stg1 | JOB No.: 21854.0031-P5S1

CO-ORDINATES: (EDENTM2000) 832234.53 N, 391578.11 E
R.L.: 26.65m
DATUM: AUCKHT1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA

HOLE STARTED: 01/04/2018
HOLE FINISHED: 01/04/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: RBE CHECKED: AJL

GEOLOGICAL								ENGINEERING DESCRIPTION				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/0mm) 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	Description and Additional Observations
Fill	DRY; 11/04/2018 on completion				● 150/28 kPa ● 120/9 kPa ● UTP ● >215 kPa ● >215 kPa ● UTP ● 132/77 kPa ● 156/92 kPa ● UTP ● UTP		26 / 0.0 25 / 0.5 24 / 1.0 23 / 1.5 2.0 2.5 3.0 3.5	TS	M D-M	VSt VSt-H H		SILT, non plastic, moist, dark brown SILT, some clay, some sand, low plasticity, moist, light brown mottled light yellowish brown and reddish brown 0.4m: friable, some sand 0.7m: minor clay 0.9m: minor fine gravel SILT non plastic, dry to moist, pink and yellowish brown 2.0m: abundant inclusions grey silt/sandy silt sandy SILT, friable, dry to moist, yellowish brown, with grey inclusions 3m: END OF BOREHOLE

COMMENTS:

Hole Depth 3m

Scale 1:20

Rev.: A

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S16 021/7				P5 Undercut	TAJ	29/01/2016	1.76	1.29	36.3	2.7	5.5	205	205	205	205	205		P
							1.75	1.28	36.3	2.7	5.8							
S16 021/8				P5 Undercut	TAJ	29/01/2016	1.74	1.24	40.5	2.7	3.9	205	205	205	205	205		P
							1.76	1.25	40.5	2.7	2.8							
s16 022/5	2659999.65	6511008.15	15.64	P5 Undercut	TAJ	30/01/2016	1.74	1.21	44.2	2.7	2.0	188	171	157	161	169		P
							1.74	1.21	44.2	2.7	1.9							
s16 022/6	2660007.13	6511007.08	15.63	P5 Undercut	TAJ	30/01/2016	1.78	1.25	42.5	2.7	0.9	171	157	171	186	171		P
							1.79	1.26	42.5	2.7	0.0							
s16 026/5	2660018.91	6511087.87	12.05	P5 Undercut	TAJ	4/02/2016	1.73	1.29	33.5	2.7	8.9	195	198	171	174	185		P
							1.73	1.30	33.5	2.7	8.6							
s16 026/6	2660019.66	6511065.39	12.19	P5 Undercut	TAJ	4/02/2016	1.86	1.44	29.3	2.7	4.6	144	137	188	147	154		P
							1.86	1.44	29.3	2.7	4.8							
s16 026/7	2660016.63	6511047.08	12.64	P5 Undercut	TAJ	4/02/2016	1.77	1.32	34.5	2.7	5.6	195	205	192	188	195		P
							1.77	1.31	34.5	2.7	6.0							
s16 027/1	2660015.03	6511047.28	14.41	P5 Undercut	TAJ	5/02/2016	1.70	1.21	40.4	2.7	6.4	161	154	157	171	161		P
							1.69	1.21	40.4	2.7	6.7							
s16 027/2	2660024.97	6511078.76	13.37	P5 Undercut	TAJ	5/02/2016	1.63	1.13	45.0	2.7	7.7	161	150	147	91	137		P
							1.65	1.13	45.0	2.7	6.9							
S16 036/4	2659946.74	6510911.22	11.06	P5 wall1	TAJ	23/02/2016	1.91	1.47	29.7	2.7	1.8	205	205	205	205	205		P
							1.93	1.48	29.7	2.7	0.9							
s16 042/1	2659949.70	6510919.13	12.07	P5 Behind wall1	TAJ	27/02/2016	1.87	1.48	26.8	2.7	5.8	205	205	205	205	205		P
							1.89	1.49	26.8	2.7	4.9							
S16 046/1		No GPS		Behind wall 1	TAJ	9/03/2016	1.79	1.33	34.9	2.7	4.7	126	112	104	106	112		F
							1.79	1.33	34.9	2.7	4.3							
S16 047/1				Behind Wall 1	TAJ	11/03/2016	1.84	1.42	29.5	2.7	0.0	205	205	205	205	205		P
							1.84	1.42	29.5	2.7	0.0							
S16 047/2				Behind wall 1	TAJ	11/03/2016	1.81	1.34	34.6	2.7	3.7	205	205	205	205	205		P
							1.80	1.34	34.6	2.7	4.3							
S16 047/10	2659956.92	6510931.72	13.73	Behind wall 1	TAJ	10/03/2016	1.91	1.49	28.8	2.7	2.2	205	205	205	205	205		P
							1.92	1.49	28.8	2.7	1.7							
S16 047/11	2659964.82	6510946.00	13.77	Behind Wall 1	TAJ	10/03/2016	1.91	1.33	43.9	2.7	0.0	205	205	205	205	205		P
							1.91	1.32	43.9	2.7	0.0							
S16 047/12	2659970.56	6510954.65	13.83	Behind wall 1	TAJ	10/03/2016	1.91	1.51	26.4	2.7	4.2	205	205	205	205	205		P
							1.91	1.51	26.4	2.7	4.0							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S16 048/2	2659954.40	6510933.41	14.02	P5 behind wall1	TAJ	11/03/2016	1.88	1.48	27.0	2.7	5.5	205	205	205	205	205		P
							1.87	1.47	27.0	2.7	5.7							
S16 048/3	2659965.14	6510946.32	14.17	P5 behind wall1	TAJ	11/03/2016	1.86	1.45	28.3	2.7	5.3	205	205	205	205	205		P
							1.84	1.44	28.3	2.7	6.2							
S16 050/1	2659973.92	6510960.46	15.17	P5 wall1	TAJ	15/03/2016	1.83	1.41	29.7	2.7	5.9	196	196	196	196	196		P
							1.84	1.42	29.7	2.7	5.3							
S16 050/2	2659966.40	6510947.66	14.99	P5 wall1	TAJ	15/03/2016	1.86	1.43	29.5	2.7	4.6	196	196	196	196	196		P
							1.86	1.44	29.5	2.7	4.5							
S16 051/1				P5 shear key	TAJ	16/03/2016	1.90	1.43	32.8	2.7	0.0	196	196	196	196	196		P
							1.90	1.43	32.8	2.7	0.2							
S16 051/2				P5 shear key	TAJ	16/03/2016	1.86	1.30	42.3	2.7	0.0	196	196	196	196	196		P
							1.85	1.30	42.3	2.7	0.0							
S16 052/1	2659918.60	6510836.67	4.39	P5 shear key	TAJ	17/03/2016	1.88	1.45	29.4	2.7	3.7	196	196	196	196	196		P
							1.87	1.45	29.4	2.7	3.9							
S16 052/2	2659902.51	6510840.93	4.59	P5 shear key	TAJ	17/03/2016	1.89	1.49	26.5	2.7	5.3	196	196	196	196	196		P
							1.88	1.48	26.5	2.7	5.8							
S16 052/3	2659900.45	6510831.43	5.21	P5 shear key	TAJ	17/03/2016	1.92	1.52	26.3	2.7	3.9	196	196	196	196	196		P
							1.91	1.52	26.3	2.7	4.0							
S16 052/12	2659912.10	6510829.17	5.72	P5 shear key	TAJ	17/03/2016	1.85	1.40	32.6	2.7	2.7	154	150	182	175	165		P
							1.84	1.39	32.6	2.7	3.3							
S16 052/13	2659896.54	6510832.48	6.16	P5 shear key	TAJ	17/03/2016	1.92	1.43	33.7	2.7	0.0	150	154	158	150	153		P
							1.91	1.43	33.7	2.7	0.0							
S16 052/14	2659901.89	6510838.63	5.84	P5 shear key	TAJ	17/03/2016	1.86	1.25	48.3	2.7	0.0	150	158	168	182	165		P
							1.87	1.26	48.3	2.7	0.0							
S16 053/4	2659913.55	6510830.37	6.18	p5 shear key	TAJ	18/03/2016	1.85	1.41	31.5	2.7	3.5	196	196	196	196	196		P
							1.85	1.41	31.5	2.7	3.4							
S16 053/5	2659911.99	6510832.97	6.17	p5 shear key	TAJ	18/03/2016	1.85	1.44	28.4	2.7	5.7	196	196	196	196	196		P
							1.84	1.44	28.4	2.7	6.0							
S16 054/3	2659904.25	6510837.27	7.39	Shear key	TAJ	19/03/2016	1.88	1.43	31.6	2.7	2.1	196	196	196	196	196		P
							1.87	1.42	31.6	2.7	2.4							
S16 054/4	2659915.65	6510834.62	5.75	Shear key	TAJ	19/03/2016	1.84	1.39	32.2	2.7	3.5	196	196	196	196	196		P
							1.86	1.40	32.2	2.7	2.7							
S16 056/1	2659907.64	6510827.81	7.13	P5 Shear Key	TAJ	22/03/2016	1.81	1.35	34.6	2.7	3.5	129	126	126	127	127		P
							1.82	1.35	34.6	2.7	3.0							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S16 056/2	2659919.41	6510835.09	7.70	P5 Shear Key	TAJ	22/03/2016	2.01	1.66	20.5	2.7	4.2	140	146	126	126	135		P
							2.01	1.67	20.5	2.7	4.0							
S16 056/3	2659910.82	6510843.71	7.50	P5 Shear Key	TAJ	22/03/2016	1.73	1.23	40.3	2.7	4.9	132	168	125	143	142		P
							1.74	1.24	40.3	2.7	4.3							
S16 058/1				P5 Behind wall 1	TA	30/03/2016	1.81	1.36	33.2	2.7	4.8	196	196	196	196	196		P
							1.80	1.35	33.2	2.7	5.2							
S16 059/2	2660024.42	6511082.34	13.39	P5 Wall 1	TA	31/03/2016	1.75	1.33	32.2	2.7	8.2	196	196	196	196	196		P
							1.74	1.32	32.2	2.7	8.7							
S16 062/14	2660015.64	6511045.46	14.49	P5 Behind Wall 1	TA	5/04/2016	1.96	1.57	24.4	2.7	3.3	196	196	196	196	196		P
							1.96	1.58	24.4	2.7	3.2							
S16 062/15	2660018.49	6511060.92	14.43	P5 Behind Wall 2	TA	5/04/2016	1.98	1.60	23.3	2.7	3.4	196	196	196	196	196		P
							1.98	1.61	23.3	2.7	3.1							
S16 062/16	2660022.42	6511073.28	14.35	P5 Behind Wall 3	TA	5/04/2016	1.99	1.58	25.3	2.7	1.2	196	196	196	196	196		P
							1.97	1.57	25.3	2.7	1.9							
S16 065/10	2660014.89	6511036.02	14.91	P5 Behind Wall 1	TA	8/04/2016	1.88	1.45	29.3	2.7	3.8	196	196	196	196	196		P
							1.88	1.46	29.3	2.7	3.3							
S16 065/11	2660017.28	6511062.95	14.63	P5 Behind Wall 1	TA	8/04/2016	1.94	1.53	27.1	2.7	2.0	196	196	196	196	196		P
							1.94	1.52	27.1	2.7	2.3							
S16 065/12	2660024.49	6511083.39	14.75	P5 Behind Wall 1	TA	8/04/2016	1.91	1.43	33.5	2.7	0.0	196	196	196	196	196		P
							1.90	1.43	33.5	2.7	0.0							
S16 069/7				P5 Behind Wall 1	TA	13/04/2016	1.95	1.54	26.6	2.7	2.0	192	192	192	192	192		P
							1.94	1.54	26.6	2.7	2.3							
S16 069/8				P5 Behind Wall 1	TA	13/04/2016	1.90	1.48	28.4	2.7	3.3	192	192	192	192	192		P
							1.91	1.48	28.4	2.7	2.9							
S16 071/3	2659936.53	6510909.73	11.00	P5 Wall 1	TA	15/04/2016	1.93	1.48	30.0	2.7	0.5	151	151	164	192	165		P
							1.94	1.49	30.0	2.7	0.0							
S16 074/7	2660020.62	6511051.71	15.60	P5 Wall 1	TA	20/04/2016	1.88	1.42	32.4	2.7	1.5	137	137	164	123	140		P
							1.88	1.42	32.4	2.7	1.7							
S16 074/8	2660024.26	6511062.29	15.76	P5 Wall 1	TA	20/04/2016	1.77	1.23	43.8	2.7	0.5	137	137	164	123	140		P
							1.78	1.24	43.8	2.7	0.1							
S16 074/20	2659985.87	6510978.64	15.99	P5 Wall 1	TA	21/04/2016	1.91	1.48	28.7	2.7	2.4	151	164	192	192	175		P
							1.91	1.48	28.7	2.7	2.4							
S16 074/21	2660001.43	6511002.07	15.59	P5 Wall 1	TA	21/04/2016	1.87	1.43	30.6	2.7	3.3	151	164	192	192	175		P
							1.86	1.43	30.6	2.7	3.6							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S16 074/22	2660016.34	6511047.65	15.54	P5 Wall 1	TA	21/04/2016	1.93	1.46	32.2	2.7	0.0	151	164	192	192	175		P
							1.94	1.47	32.2	2.7	0.0							
S16 076/7				P5 Shear Key	TA	26/04/2016	1.84	1.33	38.0	2.7	0.0	151	151	164	164	158		P
							1.85	1.34	38.0	2.7	0.0							
S16 077/7				P5 Shear Key	TA	27/04/2016	1.88	1.44	31.0	2.7	2.2	151	151	178	192	168		P
							1.88	1.44	31.0	2.7	2.3							
S16 077/8				P5 Shear Key	TA	27/04/2016	1.92	1.48	29.5	2.7	1.5	192	192	192	192	192		P
							1.90	1.47	29.5	2.7	2.3							
S16 077/9				P5 Wall 1	TA	27/04/2016	1.90	1.50	26.5	2.7	4.6	151	151	164	178	161		P
							1.89	1.49	26.5	2.7	5.2							
S16 077/10				P5 Wall 1	TA	27/04/2016	1.92	1.53	25.8	2.7	4.1	151	151	164	178	161		P
							1.93	1.53	25.8	2.7	3.8							
S16 077/11				P5 Wall 1	TA	27/04/2016	1.86	1.47	26.2	2.7	6.8	151	151	164	178	161		P
							1.86	1.47	26.2	2.7	7.0							
S16 077/17				P5 Shear Key	TA	27/04/2016	1.87	1.44	29.2	2.7	4.3	151	164	178	192	171		P
							1.86	1.44	29.2	2.7	4.8							
S16 077/18				P5 Shear Key	TA	27/04/2016	1.92	1.49	29.6	2.7	1.0	151	164	151	192	165		P
							1.92	1.48	29.6	2.7	1.3							
S16 078/4				P5 Shear Key	TA	28/04/2016	1.83	1.41	30.1	2.7	5.6	151	164	164	192	168		P
							1.84	1.42	30.1	2.7	4.9							
S16 078/5				P5 Shear Key	TA	28/04/2016	1.91	1.48	28.8	2.7	2.3	151	164	164	192	168		P
							1.91	1.49	28.8	2.7	2.2							
S16 078/13				P5 Shear Key	TA	28/04/2016	1.87	1.44	29.7	2.7	3.9	151	153	156	175	159		P
							1.85	1.43	29.7	2.7	4.9							
S16 078/14				P5 Shear Key	TA	28/04/2016	1.88	1.45	29.2	2.7	3.7	151	164	164	178	164		P
							1.89	1.47	29.2	2.7	2.9							
S16 079/1				P5 Shear Key	TA	29/04/2016	1.86	1.42	30.6	2.7	3.9	151	164	192	192	175		P
							1.84	1.41	30.6	2.7	4.5							
S16 079/2				P5 Shear Key	TA	29/04/2016	1.88	1.46	28.8	2.7	4.1	151	164	192	192	175		P
							1.88	1.46	28.8	2.7	3.8							
S16 080/7	2660014.38	6511043.01	16.50	P5 Re Wall 1	TA	2/05/2016	1.87	1.47	27.3	2.7	5.4	192	192	192	192	192		P
							1.88	1.48	27.3	2.7	5.0							
S16 080/8	2660002.16	6511007.58	16.42	P5 Re Wall 1	TA	2/05/2016	1.88	1.47	28.0	2.7	4.2	192	192	192	192	192		P
							1.89	1.47	28.0	2.7	4.2							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S16 080/9	2659987.35	6510977.42	16.53	P5 Re Wall 1	TA	2/05/2016	1.84	1.44	27.6	2.7	6.7	192	192	192	192	192		P
							1.85	1.45	27.6	2.7	6.2							
S16 080/13	2659946.40	6510906.97	12.35	P5 Re Wall 1	TA	2/05/2016	1.87	1.48	26.4	2.7	5.9	192	192	192	192	192		P
							1.87	1.48	26.4	2.7	6.0							
S16 081/3	2659908.84	6510827.16	8.29	P5 Shear key	TA	3/05/2016	1.92	1.49	28.5	2.7	2.3	192	192	192	192	192		P
							1.93	1.50	28.5	2.7	1.6							
S16 081/4	2659893.12	6510830.13	8.31	P5 Shear key	TA	3/05/2016	1.88	1.45	29.8	2.7	3.1	192	192	192	192	192		P
							1.88	1.45	29.8	2.7	3.2							
S16 081/5	2659871.35	6510828.77	8.12	P5 Shear key	TA	3/05/2016	1.92	1.47	30.8	2.7	0.5	151	164	192	192	175		P
							1.93	1.48	30.8	2.7	0.0							
S16 181-5	2659902.26	6511102.79	19.91	North gully	TA	7/12/2016	1.74	1.22	42.5	2.7	3.1	214	214	214	214	214		P
							1.74	1.22	42.5	2.7	3.0							
S16 182-2	2659878.43	6511095.71	24.31	North Gully	TA	9/12/2016	1.92	1.45	32.8	2.7	0.0	214	214	214	214	214		P
							1.90	1.43	32.8	2.7	0.3							
S16 182-3	2659904.24	6511099.31	21.57	North Gully	TA	9/12/2016	1.91	1.52	25.7	2.7	4.9	145	168	168	191	168		P
							1.89	1.50	25.7	2.7	5.7							
S16 182-4	2659896.84	6511102.70	21.47	North Gully	TA	9/12/2016	1.91	1.46	30.9	2.7	1.1	168	141	199	214	181		P
							1.90	1.45	30.9	2.7	1.5							
S16 184-2	2659902.91	6511093.54	22.30	North Gully	TA	12/12/2016	1.78	1.33	34.1	2.7	5.6	214	183	153	214	191		P
							1.77	1.32	34.1	2.7	6.0							
S16 184-3	2659892.41	6511091.57	22.50	North Gully	TA	12/12/2016	1.82	1.34	35.3	2.7	2.8	214	183	199	199	199		P
							1.82	1.34	35.3	2.7	2.9							
S16 184-7	2659883.63	6511103.88	23.57	North Gully	TA	12/12/2016	1.94	1.50	29.4	2.7	0.4	174	171	191	199	184		P
							1.93	1.49	29.4	2.7	1.2							
S16 184-8	2659898.35	6511094.01	23.41	North Gully	TA	12/12/2016	1.82	1.36	34.3	2.7	3.2	165	168	186	174	173		P
							1.83	1.36	34.3	2.7	2.9							
S16 185-5	2659910.97	6511117.50	13.27	Behind Wall 5	TA	13/12/2016	1.82	1.33	36.3	2.7	2.3	214	214	214	214	214		P
							1.86	1.36	36.3	2.7	0.2							
S16 186-3	2659885.58	6511098.87	24.26	North Gully	TA	14/12/2016	1.80	1.30	38.3	2.7	1.9	214	214	214	214	214		P
							1.81	1.31	38.3	2.7	1.2							
S16 186-4	2659898.38	6511093.33	23.90	North Gully	TA	14/12/2016	1.79	1.32	35.2	2.7	4.4	153	168	214	214	187		P
							1.78	1.32	35.2	2.7	4.9							
S16 188-10	2659912.68	6511119.81	14.28	Behind Wall 5	TA	16/12/2016	1.88	1.46	29.1	2.7	3.6	214	214	214	214	214		P
							1.88	1.45	29.1	2.7	3.9							
S17 021-11	2659831.14	6510879.28	14.87	Fill W of Office	CB	2/02/2017	1.95	1.61	21.30	2.7	6.2	214	214	214	214	214		P
							1.95	1.61	21.30	2.7	6.2							
S17 021-12	2659869.21	6510897.91	13.89	Fill W of Office	CB	2/02/2017	1.88	1.44	31.0	2.7	2.2	130	186	191	199	177		P
							1.87	1.43	31.0	2.7	2.7							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S17 021-13	2659890.46	6510899.24	13.00	Fill W of Office	CB	2/02/2017	1.88	1.43	31.1	2.7	2.4	191	199	214	214	205		P
							1.87	1.43	31.1	2.7	2.9							
S17 031-4	2659873.97	6510910.23	14.02	Fill Behind S End of Wall 1	CBEN	22/02/2017	2.02	1.67	20.9	2.7	3.1	125	183	214	180	176		P
							2.01	1.66	20.9	2.7	3.8							
S17 031-7	2659800.85	6510821.82	11.18	Fill NE of Wall 2	CBEN	22/02/2017	1.85	1.43	29.2	2.7	5.4	214	214	214	214	214		P
							1.84	1.43	29.2	2.7	5.5							
S17 031-8	2659804.15	6510830.60	11.25	Fill NE of Wall 2	CBEN	22/02/2017	1.86	1.39	33.5	2.7	2.0	183	183	214	214	199		P
							1.85	1.39	33.5	2.7	2.1							
S17 032-1	2659785.44	6510845.51	14.15	Fill NE of Wall 2	CBEN	23/02/2017	1.84	1.36	35.6	2.7	1.3	130	145	153	168	149		P
							1.86	1.37	35.6	2.7	0.5							
S17 032-2	2659809.55	6510843.85	13.99	Fill NE of Wall 2	CBEN	23/02/2017	1.86	1.42	30.7	2.7	3.7	141	145	154	168	152		P
							1.86	1.42	30.7	2.7	3.5							
S17 036-5	2659940.50	6511110.99	17.44	N RE Wall	CBEN	28/02/2017	1.85	1.39	33.1	2.7	2.6	211	214	214	214	213		P
							1.85	1.39	33.1	2.7	2.3							
S17 036-10	2659886.57	6510856.10	7.65	Pond Below Office	CBEN	28/02/2017	1.91	1.54	24.6	2.7	5.3	214	214	214	214	214		P
							1.92	1.54	24.6	2.7	4.9							
S17 037-4	2659898.34	6510846.87	8.21	Pond Below Office	CMO	1/03/2017	1.90	1.45	31.4	2.7	1.0	183	214	214	214	206		P
							1.90	1.45	31.4	2.7	1.0							
S17 037-5	2659891.00	6510872.52	8.74	Pond Below Office	CMO	1/03/2017	1.90	1.45	31.2	2.7	1.2	176	186	214	214	198		P
							1.90	1.45	31.2	2.7	1.2							
S17 037-6	2659832.79	6510894.13	14.69	Fill Behind S End of Wall 1	CMO	1/03/2017	1.95	1.57	24.1	2.7	3.9	214	214	214	214	214		P
							1.97	1.59	24.1	2.7	2.9							
S17 037-7	2659843.39	6510900.79	14.56	Fill Behind S End of Wall 1	CMO	1/03/2017	1.88	1.50	25.5	2.7	6.3	214	214	214	214	214		P
							1.88	1.50	25.5	2.7	6.3							
S17 037-11	2659859.97	6510908.31	14.67	Fill Behind S End of Wall 1	CMO	1/03/2017	1.85	1.48	24.7	2.7	8.4	214	214	214	214	214		P
							1.87	1.50	24.7	2.7	7.4							
S17 038-1	2659906.22	6510851.22	9.17	Pond Below Office	CMO	2/03/2017	1.84	1.40	31.3	2.7	4.2	176	183	191	214	191		P
							1.86	1.42	31.3	2.7	3.2							
S17 038-2	2659949.19	6511112.19	17.96	N RE Wall	CMO	2/03/2017	1.80	1.35	33.3	2.7	5.0	168	196	153	202	180		P
							1.80	1.35	33.3	2.7	5.0							
S17 038-3	2659932.38	6511116.96	17.77	N RE Wall	CMO	2/03/2017	1.80	1.34	33.9	2.7	4.6	186	214	134	122	164		P
							1.81	1.35	33.9	2.7	4.1							
S17 038-4	2659906.75	6511119.89	17.67	N RE Wall	CMO	2/03/2017	1.81	1.35	34.2	2.7	3.9	199	214	214	214	210		P
							1.83	1.36	34.2	2.7	2.9							
S17 038-8	2659881.99	6510859.35	8.42	Pond Below Office	CMO	2/03/2017	1.91	1.50	27.1	2.7	3.6	183	176	153	206	180		P
							1.94	1.53	27.1	2.7	2.1							
S17 038-9	2659888.94	6510872.63	8.66	Pond Below Office	CMO	2/03/2017	1.96	1.65	18.5	2.7	8.1	214	214	214	214	214		P
							1.96	1.65	18.5	2.7	8.1							
S17 039-1	2659916.50	6511117.24	17.88	N RE Wall	CMO	3/03/2017	1.82	1.35	34.8	2.7	3.0	168	183	191	199	185		P
							1.81	1.34	34.8	2.7	3.5							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S17 041-11	2659939.65	6511114.18	18.28	N RE Wall	CBEN	6/03/2017	1.85	1.40	31.6	2.7	3.7	214	214	214	214	214		P
							1.85	1.40	31.6	2.7	3.6							
S17 041-12	2659924.55	6511115.59	17.41	N RE Wall	CBEN	6/03/2017	1.82	1.34	35.2	2.7	2.9	214	214	214	214	214		P
							1.81	1.34	35.2	2.7	3.2							
S17 041-13	2659910.00	6511119.50	18.39	N RE Wall	CBEN	6/03/2017	1.86	1.37	35.9	2.7	0.1	214	214	214	214	214		P
							1.86	1.37	35.9	2.7	0.1							
S17 048-5	2659951.49	6511110.83	19.23	N RE Wall	CBEN	17/03/2017	1.85	1.42	30.7	2.7	4.0	214	214	214	214	214		P
							1.86	1.43	30.7	2.7	3.4							
S17 048-6	2659929.16	6511110.61	19.41	N RE Wall	CBEN	17/03/2017	1.82	1.32	38.3	2.7	0.7	214	214	214	214	214		P
							1.85	1.34	38.3	2.7	0.0							
S17 048-11	2659897.48	6511124.85	19.37	N RE Wall	CBEN	17/03/2017	1.88	1.34	39.7	2.7	0.0	153	141	153	183	158		P
							1.88	1.34	39.7	2.7	0.0							
S17 048-12	2659917.30	6511114.03	19.67	N RE Wall	CBEN	17/03/2017	1.83	1.32	38.7	2.7	0.3	214	214	214	214	214		P
							1.82	1.32	38.7	2.7	0.4							
S17 050-2	2659876.61	6510913.03	15.86	Behind Wall 1 South End	CBEN	20/03/2017	1.93	1.53	26.7	2.7	2.7	214	214	214	214	214		P
							1.94	1.53	26.7	2.7	2.4							
S17 050-3	2659839.85	6510900.20	14.19	Behind Wall 1 South End	CBEN	20/03/2017	1.89	1.40	35.1	2.7	0.0	214	214	214	214	214		P
							1.89	1.40	35.1	2.7	0.0							
S17 050-4	2659932.72	6511109.70	19.88	N RE Wall	CBEN	20/03/2017	1.74	1.25	38.7	2.7	5.0	214	183	214	214	206		P
							1.73	1.25	38.7	2.7	5.4							
S17 050-5	2659944.42	6511105.55	19.85	N RE Wall	CBEN	20/03/2017	1.87	1.38	35.8	2.7	0.0	176	214	214	214	205		P
							1.87	1.38	35.8	2.7	0.0							
S17 051-1	2659910.59	6511119.03	20.18	N RE Wall	CBEN	21/03/2017	1.83	1.37	33.3	2.7	3.4	183	214	199	214	203		P
							1.83	1.37	33.3	2.7	3.4							
S17 051-2	2659931.84	6511114.49	20.33	N RE Wall	CBEN	21/03/2017	1.83	1.36	34.1	2.7	3.1	214	214	214	214	214		P
							1.83	1.36	34.1	2.7	2.9							
S17 051-3	2659966.94	6511103.62	20.37	SE Shear Key	CBEN	21/03/2017	1.92	1.48	29.3	2.7	1.6	214	214	214	214	214		P
							1.91	1.48	29.3	2.7	1.8							
S17 051-4	2659803.86	6510805.84	3.70	SE Shear Key	CBEN	21/03/2017	1.82	1.38	31.7	2.7	5.1	153	214	168	183	180		P
							1.83	1.39	31.7	2.7	4.7							
S17 051-5	2659828.88	6510813.96	3.29	SE Shear Key	CBEN	21/03/2017	1.82	1.38	32.2	2.7	4.6	214	199	183	214	203		P
							1.83	1.39	32.2	2.7	4.0							
S17 052-4	2659906.49	6511112.39	20.57	N RE Wall	CBEN	22/03/2017	1.89	1.44	31.2	2.7	1.6	214	214	214	214	214		P
							1.89	1.44	31.2	2.7	2.0							
S17 052-5	2659924.06	6511109.59	20.70	N RE Wall	CBEN	22/03/2017	1.84	1.41	30.9	2.7	4.3	214	214	214	214	214		P
							1.85	1.41	30.9	2.7	4.2							
S17 052-6	2659950.95	6511102.75	20.75	N RE Wall	CBEN	22/03/2017	1.87	1.43	30.4	2.7	3.4	214	214	214	214	214		P
							1.88	1.44	30.4	2.7	2.7							
S17 052-7	2659824.71	6510890.30	16.22	S end Wall 1	CBEN	22/03/2017	1.85	1.42	30.1	2.7	4.4	185	194	214	214	202		P
							1.84	1.42	30.1	2.7	4.8							

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Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S17 052-8	2659858.47	6510909.43	16.32	S end Wall 1	CBEN	22/03/2017	1.73	1.25	38.8	2.7	5.5	176	183	141	141	160		P
							1.73	1.25	38.8	2.7	5.5							
S17 053-1	2659804.25	6510804.10	5.70	S Shear Key	CBEN	23/03/2017	1.82	1.34	35.6	2.7	2.6	153	214	168	183	180		P
							1.83	1.35	35.6	2.7	2.0							
S17 053-2	2659836.81	6510816.18	5.37	S Shear Key	CBEN	23/03/2017	1.83	1.39	31.5	2.7	4.6	168	183	214	153	180		P
							1.81	1.38	31.5	2.7	5.5							
S17 053-3	2659960.48	6511099.51	21.50	N RE Wall	CBEN	23/03/2017	1.84	1.37	33.7	2.7	2.9	24	214	214	214	167		P
							1.84	1.38	33.7	2.7	2.6							
S17 053-4	2659982.30	6511096.16	21.43	N RE Wall	CBEN	23/03/2017	1.80	1.33	35.2	2.7	3.6	214	214	214	214	214		P
							1.81	1.34	35.2	2.7	3.4							
S17 053-5	2659931.23	6511110.22	20.99	N RE Wall	CBEN	23/03/2017	1.81	1.35	34.0	2.7	4.3	168	176	214	214	193		P
							1.83	1.36	34.0	2.7	3.1							
S17 053-6	2659947.09	6511106.15	21.38	N RE Wall	CBEN	23/03/2017	1.81	1.36	33.3	2.7	4.6	214	214	214	214	214		P
							1.81	1.36	33.3	2.7	4.5							
S17 054-1	2659820.52	6510815.83	6.25	S Shear Key	CBEN	24/03/2017	1.83	1.36	34.5	2.7	2.5	165	162	156	165	162		P
							1.84	1.37	34.5	2.7	1.9							
S17 054-2	2659846.21	6510821.74	6.36	S Shear Key	CBEN	24/03/2017	1.87	1.44	29.5	2.7	3.9	214	214	186	168	196		P
							1.86	1.43	29.5	2.7	4.6							
S17 054-3	2659916.32	6511116.96	21.36	N RE Wall	CBEN	24/03/2017	1.82	1.36	33.7	2.7	3.6	171	186	159	165	170		P
							1.83	1.37	33.7	2.7	3.3							
S17 054-4	2659943.41	6511109.89	21.89	N RE Wall	CBEN	24/03/2017	1.89	1.44	30.8	2.7	2.0	214	214	214	214	214		P
							1.89	1.45	30.8	2.7	1.9							
S17 054-5	2659958.12	6511104.78	21.69	N RE Wall	CBEN	24/03/2017	1.85	1.39	33.3	2.7	2.4	159	183	162	168	168		P
							1.85	1.39	33.3	2.7	2.2							
S17 060 -1	2659794.33	6510803.37	7.29	S Shear Key	CMO	3/04/2017	1.82	1.38	32.1	2.7	4.7	199	176	191	168	184		P
							1.83	1.40	30.7	2.7	5.2							
S17 060 -2	2659819.53	6510805.64	7.34	S Shear Key	CMO	3/04/2017	1.91	1.45	32.0	2.7	0.1	176	176	206	214	193		P
							1.91	1.44	32.8	2.7	0.0							
S17 060 -3	2659844.87	6510827.96	7.65	S Shear Key	CMO	3/04/2017	1.88	1.42	32.5	2.7	1.3	199	214	214	214	210		P
							1.87	1.38	35.7	2.7	0.0							
S17 060 -7	2659801.46	6510798.97	7.56	S Shear Key	CMO	3/04/2017	1.81	1.40	29.4	2.7	7.1	214	153	191	199	189		P
							1.82	1.37	32.5	2.7	4.5							
S17 060 -8	2659817.63	6510814.11	7.86	S Shear Key	CMO	3/04/2017	1.92	1.53	25.4	2.7	4.4	199	176	168	183	182		P
							1.92	1.51	27.0	2.7	3.2							
S17 064-3	2659907.12	6511117.34	21.68	N RE Wall	CBEN	10/04/2017	1.90	1.46	30.0	2.7	2.1	214	214	214	214	214		P
							1.89	1.46	30.0	2.7	2.3							
S17 064-4	2659918.11	6511105.26	21.82	N RE Wall	CBEN	10/04/2017	1.89	1.47	28.8	2.7	3.2	214	214	214	214	214		P
							1.89	1.47	28.8	2.7	3.3							
S17 065-1	2659898.39	6511121.90	22.47	N RE Wall	CBEN	11/04/2017	1.82	1.36	33.3	2.7	4.1	214	206	183	214	204		P
							1.82	1.37	33.3	2.7	3.8							

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Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m³)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S17 065-2	2659995.74	6511092.52	22.56	N RE Wall	CBEN	11/04/2017	1.84	1.40	32.1	2.7	3.5	214	199	194	214	205		P
							1.85	1.40	32.1	2.7	3.0							
S17 070-2	2659876.65	6510914.02	16.29	Pond W of Shear Key 1	CMO	24/04/2017	1.95	1.47	32.5	2.7	0.0	168	183	214	214	195		P
							1.97	1.48	33.3	2.7	0.0							
S17 070-3	2659829.82	6510894.35	17.37	Pond W of Shear Key 1	CMO	24/04/2017	1.83	1.40	30.6	2.7	5.2	214	199	214	206	208		P
							1.83	1.41	30.1	2.7	5.6							
S17 070-6	2659758.94	6510827.25	9.25	Pond W of Shear Key 1	CMO	24/04/2017	1.86	1.40	32.7	2.7	2.3	214	214	199	183	203		P
							1.86	1.42	31.2	2.7	3.3							
S17 071-1	2659761.43	6510822.29	9.81	Pond W of Shear Key 1	CMO	26/04/2017	1.85	1.43	29.6	2.7	4.9	171	202	194	176	186		P
							1.85	1.41	31.5	2.7	3.6							
S17 071-5	2659815.02	6510810.50	10.22	S Shear Key	CMO	26/04/2017	1.82	1.41	28.9	2.7	6.9	174	188	211	183	189		P
							1.83	1.41	29.6	2.7	5.9							
S17 071-6	2659830.63	6510816.18	9.56	S Shear Key	CMO	26/04/2017	1.87	1.43	30.6	2.7	3.2	176	199	214	170	190		P
							1.87	1.44	29.9	2.7	3.6							
S17 072-2	2659768.57	6510829.59	10.41	Pond W of Shear Key 1	CMO	27/04/2017	1.85	1.41	31.4	2.7	3.6	214	214	214	214	214		P
							1.83	1.37	33.7	2.7	3.2							
S17 075-4	2659948.39	6511105.49	23.16	N RE Wall	CMO	3/05/2017	1.89	1.45	30.3	2.7	2.3	183	168	214	199	191		P
							1.90	1.49	27.6	2.7	3.8							
S17 075-5	2659920.39	6511112.13	25.30	N RE Wall	CMO	3/05/2017	1.92	1.45	32.0	2.7	0.0	160	214	199	183	189		P
							1.91	1.46	31.0	2.7	0.8							
S17 077-1	2659928.92	6511103.08	24.68	N RE Wall	CMO	8/05/2017	1.84	1.43	29.1	2.7	5.7	214	183	206	160	191		P
							1.85	1.42	29.9	2.7	4.7							
S17 077-2	2659896.75	6511111.59	24.45	N RE Wall	CMO	8/05/2017	1.84	1.40	31.5	2.7	4.1	183	183	214	214	199		P
							1.83	1.40	31.0	2.7	5.0							
S17 079-2	2659908.41	6511106.13	25.50	N RE Wall	TA	10/05/2017	1.86	1.42	30.9	2.7	3.5	214	214	214	214	214		P
							1.84	1.40	31.3	2.7	4.2							
S17 079-3	2659923.35	6511102.65	25.22	N RE Wall	TA	10/05/2017	1.79	1.33	35.0	2.7	4.5	214	214	214	214	214		P
							1.79	1.32	35.5	2.7	4.2							
S17 086-3	2659883.22	6511110.33	27.34	N RE Wall	CBEN	26/05/2017	1.78	1.30	36.9	2.7	4.0	157	160	168	189	169		P
							1.77	1.29	36.9	2.7	4.4							
S17 086-4	2659880.94	6511109.61	24.32	N RE Wall	CBEN	26/05/2017	1.82	1.31	38.9	2.7	0.6	214	183	175	214	197		P
							1.81	1.30	38.9	2.7	1.1							
S17 096-4	2659902.46	6510919.57	17.33	Behind Wall 1 South End	CBEN	15/06/2017	1.93	1.57	23.3	2.7	5.4	214	214	214	214	214		P
							1.91	1.55	23.3	2.7	6.5							
S17 099-4	2659882.43	6510917.61	18.71	Behind Wall 1 South End	CBEN	20/06/2017	1.86	1.41	31.8	2.7	3.0	199	214	191	214	205		P
							1.86	1.41	31.8	2.7	2.7							
S17 099-5	2659910.00	6510915.03	18.84	Behind Wall 1 South End	CBEN	20/06/2017	1.92	1.48	29.7	2.7	1.4	153	214	168	199	184		P
							1.97	1.52	29.7	2.7	0.0							
S17 100-1	2659882.35	6510920.37	18.56	Behind Wall 1 South End	CBEN	21/06/2017	1.89	1.46	29.5	2.7	3.0	168	176	214	199	189		P
							1.90	1.47	29.5	2.7	2.2							
S17 101-1	2659825.39	6510894.19	19.35	Behind Wall 1 South End	CBEN	28/06/2017	1.87	1.44	30.0	2.7	3.3	145	145	168	183	160		P
							1.87	1.44	30.0	2.7	3.5							
S17 101-2	2659862.31	6510913.27	23.09	Behind Wall 1 South End	CBEN	28/06/2017	1.85	1.45	27.9	2.7	5.9	183	183	161	153	170		P
							1.87	1.46	27.9	2.7	4.9							

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23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S17 101-3	2659888.55	6510918.64	19.45	Behind Wall 1 South End	CBEN	28/06/2017	1.89	1.48	27.8	2.7	4.3	153	168	168	183	168		P
							1.88	1.47	27.8	2.7	4.7							
S17 102-1	2659976.80	6511087.45	24.70	N RE Wall Silt Pond	CBEN	29/06/2017	1.73	1.28	34.7	2.7	7.9	183	199	214	214	203		P
							1.73	1.29	34.7	2.7	7.8							
S17 116-2	2659785.59	6510805.66	8.90	Shear Key 1	CBEN	14/09/2017	1.86	1.39	33.8	2.7	1.6	214	214	214	214	214		P
							1.88	1.40	33.8	2.7	0.7							
S17 117-2	2659763.33	6510803.60	9.93	Shear Key 1	CBEN	15/09/2017	1.77	1.24	42.2	2.7	1.4	214	214	214	214	214		P
							1.75	1.23	42.2	2.7	2.6							
S17 118-2	2659782.26	6510808.62	10.99	Shear Key 1	TA	20/09/2017	1.84	1.37	34.2	2.7	2.3	146	204	160	160	168		P
							1.83	1.37	34.2	2.7	2.6							
S17 118-3	2659765.37	6510810.21	10.80	Shear Key 1	TA	20/09/2017	1.81	1.33	35.8	2.7	3.0	204	204	175	204	197		P
							1.82	1.34	35.8	2.7	2.6							
S17 120-1	2659786.92	6510809.74	11.31	Shear Key 1	TA	29/09/2017	1.84	1.36	35.5	2.7	1.7	146	160	175	146	157		P
							1.83	1.35	35.5	2.7	2.2							
S17 128-5	2659792.56	6510821.27	9.45	Shear Key 1	TA	13/10/2017	1.99	1.53	30.2	2.7	0.0	175	175	160	146	164		P
							1.98	1.52	30.2	2.7	0.0							
S17 129-4	2659783.37	6510832.73	14.14	W End Wall 2	TA	16/10/2017	1.87	1.45	28.4	2.7	4.9	168	190	175	204	184		P
							1.87	1.46	28.4	2.7	4.5							
S17 129-5	2659767.81	6510825.58	13.66	W End Wall 2	TA	16/10/2017	1.88	1.45	29.0	2.7	4.0	204	204	204	204	204		P
							1.88	1.46	29.0	2.7	3.8							
S17 141-1	2659745.84	6510906.34	20.90	Shear key 2	CBEN	2/11/2017	1.91	1.38	37.8	2.7	0.0	204	204	204	204	204		P
							1.89	1.37	37.8	2.7	0.0							
S17 143-4	2659745.05	6510911.02	21.79	Shear key 2	CBEN	6/11/2017	1.88	1.43	31.4	2.7	2.3	204	204	204	146	190		P
							1.89	1.44	31.4	2.7	1.7							
S17 153-5	2659860.02	6510828.16	8.69	Shear key 1	CBEN	21/11/2017	1.90	1.52	25.1	2.7	5.8	190	160	168	190	177		P
							1.91	1.53	25.1	2.7	5.1							
S17 168-12	2659945.10	6510970.24	21.64	Subgrade above Wall 1	CBEN	11/12/2017	1.85	1.35	37.3	2.7	0.0	204	204	204	204	204		P
							1.86	1.35	37.3	2.7	0.0							
S17 169-5	2659991.52	6511020.11	24.64	Subgrade above Wall 1	CBEN	12/12/2017	1.83	1.42	28.6	2.7	6.6	204	204	204	204	204		P
							1.82	1.42	28.6	2.7	7.1							
S17 173-5	2659888.65	6511108.58	27.22	Fill on top of North RE Wall	CBEN	18/12/2017	1.78	1.36	31.3	2.7	7.2	204	204	204	204	204		P
							1.77	1.35	31.3	2.7	8.0							
S18 006-4	2659835.66	6510942.80	23.36	Gully 7	ELHO	15/01/2018	1.85	1.47	25.8	2.7	7.8	204	204	204	204	204		P
							1.84	1.46	25.8	2.7	8.2							
S18 006-5	2659812.08	6510918.41	22.38	Gully 7	ELHO	15/01/2018	1.86	1.44	28.6	2.7	5.2	204	204	204	204	204		P
							1.87	1.45	28.6	2.7	4.8							
S18 015-5	2659776.71	6510909.85	21.29	Lots 143-148	ELHO	26/01/2018	1.90	1.42	34.0	2.7	0.0	204	204	204	204	204		P
							1.92	1.43	34.0	2.7	0.0							
S18 015-6	2659794.33	6510911.04	22.46	Lots 143-148	ELHO	26/01/2018	1.83	1.32	37.9	2.7	0.8	204	204	204	204	204		P
							1.80	1.31	37.9	2.7	2.0							
S18 017-5	2659894.08	6510986.30	25.75	Lots 143-148	ELHO	30/01/2018	1.84	1.44	28.1	2.7	6.2	204	204	204	204	204		P
							1.89	1.47	28.1	2.7	4.1							
S18 018-1	2659838.03	6510943.80	23.44	Lots 143-148	ELHO	31/01/2018	1.92	1.52	26.0	2.7	4.1	204	204	204	204	204		P
							1.91	1.52	26.0	2.7	4.3							
S18 018-3	2659791.04	6510927.75	22.14	Lots 143-148	ELHO	31/01/2018	1.88	1.48	27.4	2.7	4.7	204	204	204	204	204		P
							1.88	1.48	27.4	2.7	4.7							

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Auckland 1023, New Zealand
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w. www.geotechnics.co.nz

Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S18 020-2	2659788.19	6510945.53	24.54	Lots 143-148	ELHO	7/02/2018	1.78	1.36	30.7	2.7	7.9	204	204	204	204	204		P
							1.77	1.36	30.7	2.7	8.1							
S18 020-3	2659815.12	6510956.58	25.72	Lots 143-148	ELHO	7/02/2018	1.88	1.47	28.0	2.7	4.6	204	204	204	204	204		P
							1.86	1.45	28.0	2.7	5.5							
S18 021-6	2659814.76	6510920.88	21.85	Lots 134-138	ELHO	8/02/2018	1.94	1.54	26.5	2.7	2.4	204	204	204	204	204		P
							1.96	1.55	26.5	2.7	1.5							
S18 027-3	2659927.45	6511032.02	27.03	Lots 24-27	ELHO	19/02/2018	1.82	1.39	31.3	2.7	5.3	204	204	204	204	204		P
							1.81	1.42	27.2	2.7	8.6							
S18 028-4	2659772.52	6510947.68	24.82	Undercut 3	ELHO	20/02/2018	1.81	1.39	30.0	2.7	6.5	204	204	204	204	204		P
							1.82	1.40	30.0	2.7	6.0							
S18 028-5	2659799.64	6510957.85	25.46	Undercut 3	ELHO	20/02/2018	1.82	1.39	30.8	2.7	5.4	204	204	204	204	204		P
							1.83	1.40	30.8	2.7	5.1							
S18 029-3	2659802.55	6510959.36	26.17	Undercut 3	ELHO	21/02/2018	1.83	1.42	29.3	2.7	5.9	204	204	204	204	204		P
							1.84	1.42	29.3	2.7	5.8							
S18 029-7	2659830.16	6510975.47	26.23	Undercut 3	ELHO	21/02/2018	1.93	1.48	30.1	2.7	0.6	204	204	204	204	204		P
							1.94	1.49	30.1	2.7	0.0							
S18 029-8	2659865.88	6511013.56	27.74	Undercut 3	ELHO	21/02/2018	1.85	1.42	30.7	2.7	4.1	204	204	204	204	204		P
							1.85	1.42	30.7	2.7	4.0							
S18 030-2	2659842.49	6510985.68	26.97	Undercut 3	ELHO	22/02/2018	1.81	1.36	32.8	2.7	4.8	204	204	204	204	204		P
							1.82	1.37	32.8	2.7	4.4							
S18 030-3	2659861.13	6511005.46	27.56	Undercut 3	ELHO	22/02/2018	1.82	1.38	32.5	2.7	4.4	204	204	204	204	204		P
							1.81	1.37	32.5	2.7	4.9							
S18 031-3	2659900.87	6511038.51	28.73	Gully 2	ELHO	23/02/2018	1.77	1.34	32.4	2.7	7.2	204	204	204	204	204		P
							1.75	1.32	32.4	2.7	8.2							
S18 034-3	2659806.20	6510964.86	27.78	RE Wall 6	ELHO	28/02/2018	1.78	1.34	33.2	2.7	6.1	204	204	204	204	204		P
							1.80	1.35	33.2	2.7	4.9							
S18 034-4	2659823.43	6510972.38	27.90	RE Wall 6	ELHO	28/02/2018	1.79	1.34	32.9	2.7	5.9	204	204	204	204	204		P
							1.78	1.34	32.9	2.7	6.3							
S18 035-3	2659975.06	6511084.29	30.55	NE Silt Pond	ELHO	1/03/2018	1.84	1.40	31.9	2.7	3.8	204	204	204	204	204		P
							1.83	1.39	31.9	2.7	4.2							
S18 035-7	2659974.66	6511078.86	24.17	NE Silt Pond	ELHO	1/03/2018	1.82	1.34	35.8	2.7	2.5	204	204	204	204	204		P
							1.80	1.33	35.8	2.7	3.3							
S18 035-8	2659969.08	6511073.92	25.27	NE Silt Pond	ELHO	1/03/2018	1.80	1.33	35.2	2.7	3.8	204	204	204	204	204		P
							1.80	1.33	35.2	2.7	3.6							
S18 035-10	2659829.67	6510978.17	28.66	RE Wall 6	ELHO	1/03/2018	1.81	1.34	34.6	2.7	3.7	204	204	204	204	204		P
							1.81	1.35	34.6	2.7	3.6							
S18 037-4	2659835.11	6510984.34	26.43	RE Wall 6	ELHO	5/03/2018	1.75	1.30	34.6	2.7	7.1	204	204	204	204	204		P
							1.75	1.30	34.6	2.7	6.8							
S18 037-5	2659993.15	6511072.15	22.45	NE Silt Pond	ELHO	5/03/2018	1.81	1.37	32.8	2.7	4.6	204	204	204	204	204		P
							1.81	1.36	32.8	2.7	5.0							
S18 037-12	2659981.39	6511067.31	24.67	NE Silt Pond	ELHO	5/03/2018	1.80	1.34	33.8	2.7	4.8	204	204	204	204	204		P
							1.80	1.35	33.8	2.7	4.6							
S18 038-5	2659872.20	6511025.89	30.44	RE Wall 6	ELHO	6/03/2018	1.84	1.43	29.2	2.7	5.6	204	204	204	204	204		P
							1.84	1.42	29.2	2.7	5.8							
S18 039-4	2659841.29	6510993.36	29.12	RE Wall 6	ELHO	7/03/2018	1.80	1.38	30.0	2.7	7.4	204	204	204	204	204		P
							1.81	1.39	30.0	2.7	6.8							

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: P5 Silverdale Arran's Hill Earth Works **Client: Tonkin & Taylor** **T&T Job #: 21854.0037** **Job # 614089.040/1**

Entered By: TA/CBEN/ELHO

Checked By:

NZS 4407:1991 Field water content and field dry density using a nuclear densometer

Test 4.2.1 Direct Transmission Mode

NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail (Specification > 140 kPa and < 10 % Air Voids)
												Test 1	Test 2	Test 3	Test 4			
S18 041-4	2659915.18	6510860.32	6.89	RE Wall 6	ELHO	9/03/2018	2.06	1.80	14.5	2.7	7.3	204	204	204	204	204		P
							2.05	1.79	14.5	2.7	7.9							
S18 041-5	2659902.47	6510864.48	7.19	RE Wall 6	ELHO	9/03/2018	2.07	1.77	16.6	2.7	4.9	204	204	204	204	204		P
							2.06	1.77	16.6	2.7	5.2							
S18 041-11	2659864.71	6511016.88	31.97	RE Wall 6	ELHO	9/03/2018	1.85	1.42	30.3	2.7	4.5	204	204	204	204	204		P
							1.85	1.42	30.3	2.7	4.4							
S18 048-1	2659750.80	6510953.91	26.80	Undercut 3	ELHO	20/03/2018	1.92	1.51	26.6	2.7	3.7	204	204	204	204	204		P
							1.92	1.52	26.6	2.7	3.5							
S18 055-5	2659901.64	6510858.55	8.04	Wetland (Below Rd 1)	CBEN	3/04/2018	1.85	1.44	28.8	2.7	5.4	204	204	204	204	204		P
							1.86	1.44	28.8	2.7	4.9							
S18 055-6	2659875.71	6510868.73	12.09	Wetland (Below Rd 1)	CBEN	3/04/2018	1.87	1.45	29.1	2.7	4.2	204	204	204	204	204		P
							1.85	1.43	29.1	2.7	5.2							
S18 056-1	2659899.08	6510861.78	8.62	Wetland (Below Rd 1)	CBEN	4/04/2018	1.83	1.44	27.0	2.7	7.9	204	204	204	204	204		P
							1.83	1.44	27.0	2.7	7.7							
S18 056-2	2659845.90	6510834.87	9.43	Wetland (Below Rd 1)	CBEN	4/04/2018	1.83	1.43	28.6	2.7	6.4	204	204	204	204	204		P
							1.83	1.42	28.6	2.7	6.7							
S18 056-4	2659876.03	6511094.10	27.39	N Pond Stage 1	CBEN	4/04/2018	1.79	1.39	29.3	2.7	7.9	204	204	204	204	204		P
							1.79	1.38	29.3	2.7	8.3							
S18 056-5	2659891.94	6511081.13	25.63	N Pond Stage 1	CBEN	4/04/2018	1.79	1.39	28.8	2.7	8.5	204	204	204	204	204		P
							1.80	1.40	28.8	2.7	7.9							
S18 056-6	2659897.28	6511079.29	26.35	N Pond Stage 1	CBEN	4/04/2018	1.90	1.51	25.9	2.7	4.8	204	204	204	204	204		P
							1.90	1.51	25.9	2.7	5.0							
S18 057-2	2659882.14	6511080.14	27.74	N Pond Stage 1	CBEN	5/04/2018	1.84	1.41	30.6	2.7	4.6	204	204	204	204	204		P
							1.84	1.41	30.6	2.7	4.5							
S18 057-6	2659892.18	6511086.13	28.98	N Pond Stage 1	CBEN	5/04/2018	1.83	1.38	32.4	2.7	4.3	204	204	204	204	204		P
							1.84	1.39	32.4	2.7	3.5							
S18 058-3	2659879.64	6511086.54	28.78	N Pond Stage 1	CBEN	6/04/2018	1.83	1.41	29.5	2.7	5.9	204	204	204	204	204		P
							1.84	1.42	29.5	2.7	5.6							
S18 058-6	2659885.19	6511089.46	28.61	N Pond Stage 1	CBEN	6/04/2018	1.92	1.54	24.3	2.7	5.3	204	204	204	204	204		P
							1.92	1.55	24.3	2.7	5.1							
S18 058-7	2659896.58	6511092.25	28.51	N Pond Stage 1	CBEN	6/04/2018	1.93	1.55	24.1	2.7	5.1	204	204	204	204	204		P
							1.92	1.55	24.1	2.7	5.3							
S18 059-6	2659887.04	6511076.25	29.74	N Pond Stage 1	CBEN	9/04/2018	1.80	1.37	31.4	2.7	6.2	204	204	204	204	204		P
							1.80	1.37	31.4	2.7	6.3							
S18 059-7	2659873.08	6511084.43	30.45	N Pond Stage 1	CBEN	9/04/2018	1.80	1.38	31.1	2.7	6.3	204	204	204	204	204		P
							1.81	1.38	31.1	2.7	5.9							