REPORT

Tonkin+Taylor

MILLWATER SUBDIVISION - ARRAN POINT PRECINCT 7 STAGE 5

Geotechnical Completion Report

Prepared for
WFH Properties Ltd
Prepared by
Tonkin & Taylor Ltd
Date
April 2019
Job Number
21854.0037/APP7S5.v1

Exceptional thinking together
www.tonkintaylor.co.nz

Distribution:

WFH Properties Ltd	2 copies
Woods Ltd	2 copies
Tonkin & Taylor Ltd (FILE)	1 copy

Table of contents

Executive summary

Tonkin + Taylor Ltd (T+T) was engaged by WFH Properties Ltd to monitor and provide earthworks certification for the 45 No. Residential Lots contained within Stage 5 of Arran Point Precinct 7 at the Millwater Subdivision in Silverdale. Stage 5 comprises residential Lots 14 to 43 and 69 to 83, Joint Owned Access Lane (JOAL) Lot 802, and Road 01 (Arran Point Parade) and Road 03 (Cassidy Drive) inclusive as shown on the Woods Final Contours Plan (Woods Ref 37005–05–100–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 November 2011 Geotechnical Investigation Report for the North Bridge, Southern Abutment (Ref. [4]).

d November 2013 Geotechnical Investigation Report for Arran Point Precinct 7 (Ref. [5]).

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

Bulk earthworks associated with development of Stage 5 of Arran Point (Precinct 7) were undertaken by Hick Bros Civil Contractors Ltd and commenced in March 2014 with completion by April 2018. Earthworks comprised the following, and are shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2:

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

b Installation of subsoil drains.

c Cut to fill earthworks across the entire Stage 5 area as shown on the Woods Cut & Fill As–Built Lowest to Final Surface (Woods Ref 37005–05–110–AB) in Appendix A1.

d Construction of 1 No. Shear Key (SK1) as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

e Construction of 2 No. Palisade Walls (Palisade Walls 1E and 1F) as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

f Construction of 2 No. 9m high, 1 in 1.5 (V:H) engineered fill batter slopes (parts of RE 3 and RE 4) as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

g Construction of 2 No. geogrid reinforced segmental block walls (Screen Block Wall 05 and part of Allan Block Wall 01) as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

We note that landslide ground movement occurred on 15 December 2016 during bulk earthworks across the Stage 5 area. The landslip has been remediated in accordance with the methodology agreed with all parties.

Civil earthworks commenced on site in July 2018 and were completed by March 2019, and comprised the following:

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

b Installation of roading and services.

Overall subdivisional soil types are moderately to highly expansive (Class M to H1), 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 6.11 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 45 No. Residential Lots contained within Stage 5 of Arran Point Precinct 7 at the Millwater Subdivision in Silverdale. Stage 5 comprises residential Lots 14 to 43 and 69 to 83, Joint Owned Access Lane (JOAL) Lot 802, and Road 01 (Arran Point Parade) and Road 03 (Cassidy Drive) inclusive as shown on the Woods Final Contours Plan (Woods Ref 37005–05–100–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 November 2011 Geotechnical Investigation Report for the North Bridge, Southern Abutment (Ref. [4]).

d November 2013 Geotechnical Investigation Report for Arran Point Precinct 7 (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 Arran Point Precinct 7. 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 5.

Bulk earthworks associated with development of Stage 5 of Arran Point (Precinct 7) were undertaken by Hick Bros Civil Contractors Ltd and commenced in March 2014 with completion by April 2018. The geotechnical works associated with the development are shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

We note that landslide ground movement occurred on 15 December 2016 during bulk earthworks across the Stage 5 area. The landslip has been remediated in accordance with the methodology agreed with all parties.

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 2 No. reinforced earth slopes (parts of RE 3 and RE 4);

c Monitoring and certification of construction of 2 No. Palisade Walls (Palisade Walls 1E and 1F);

d Monitoring and certification of construction of 2 No. geogrid reinforced segmental block walls (Screen Block Wall 05 and part of Allan Block Wall 01);

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 Arran Point Precinct 7, Stage 5 area of the Millwater subdivision is located within what is known as Precinct 7 in the Orewa West Structure Plan.

The Arran Point Precinct 7 area is bound by Arran Drive to the west, and the Orewa estuary to the north, south and east. The overall Arran Point Precinct 7 and Stage 5 areas are shown on T+T Drawing 21854.0037–APP7S5–100 in Appendix A2.

Pre-development gradients within the Stage 5 area were gentle to moderately steep (1 in 3 to 1 in 15 (V:H)) with an overall fall to the south.

Post-development gradients within the Stage 5 area remain gentle to moderately steep (1 in 3 to 1 in 15 (V:H)) and generally fall to the south as before. In order to form more level building platforms, steep reinforced earth slopes of up to 1 in 1.5 (V:H) and geogrid reinforced segmental block (Allan Block and Screen Block) walls have been constructed as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

Stage 5 is presently accessed from the existing Arran Point Parade.

1.3 Geological Setting

Published geological mapping and information indicates the Arran Point Precinct 7 area is underlain by East Coast Bays Formation (ECBF) materials. In addition to the ECBF materials, our investigations identified the presence of alluvial materials in isolated locations on site.

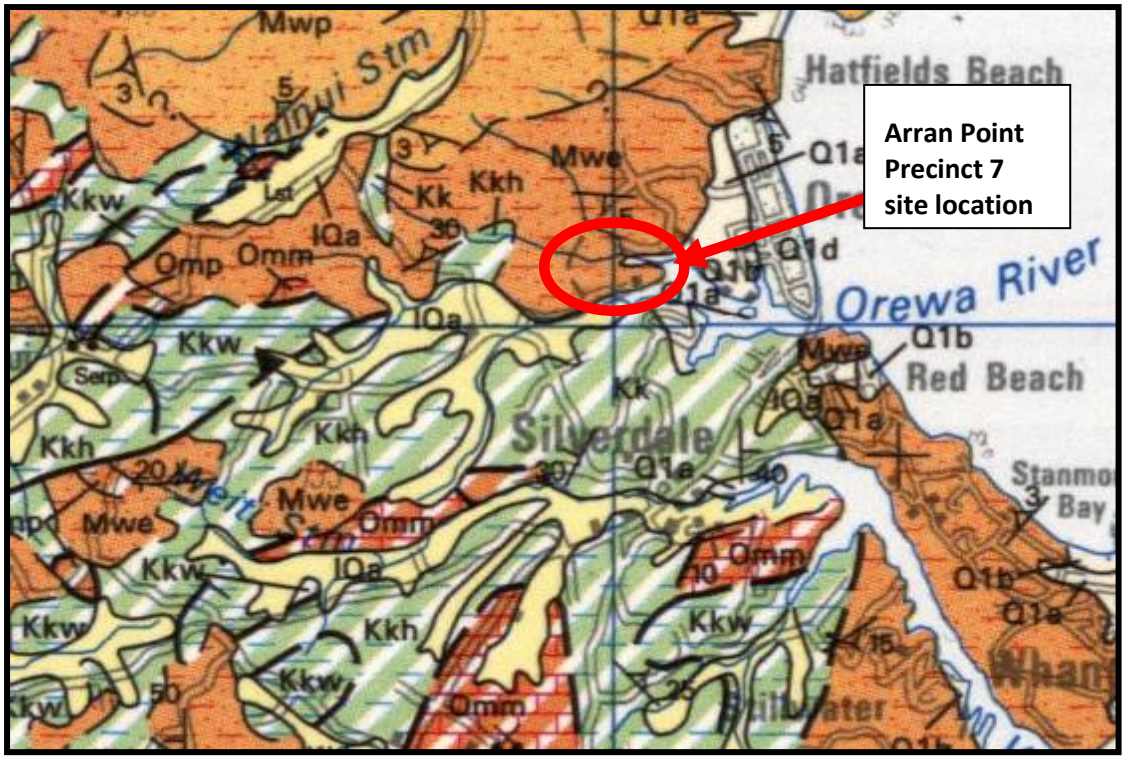


Figure 1 - Local Geology (from Edbrooke)

Summary descriptions of geological units in the Arran 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

Up to 20 m thick and from 3 to 10 m above present base level: forms higher coastal and valley terraces throughout the map area; in places locally discontinuous or absent. These 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.

Geological cross–sections through the Arran Point Precinct 7, Stage 5 area, based on site investigations and observations during construction, are enclosed as Drawing Numbers 21854.0037–APP7S4–103 to –104 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 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 palisade walls and retaining walls was undertaken by ICB Retaining and Construction Ltd (ICB), also under Hicks' control.

Civil works construction has been completed by JG Civil Ltd (JGCL).

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 March 2014 through to April 2018 under Hicks' control. Civil earthworks and construction for the residential Lots were under JGCL's control and were undertaken progressively from July 2018 through to completion in March 2019.

Key Stage 5 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 site as shown on the Woods Cut & Fill As–Built Lowest to Final Surface (Woods Ref 37005–05–110–AB) in Appendix A1.

d Construction of 1 No. Shear Key (SK1), 2 No. Palisade Walls (Palisade Walls 1E and 1F), 2 No. reinforced earth slopes (parts of RE 3 and RE 4), and 2 No. geogrid reinforced segmental block walls (Screen Block Wall 05 and part of Allan Block Wall 01) as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

e Remediation, as part of bulk earthworks, of a landslide that occurred within the Stage 5 area, as shown on T+T Drawing 21854.0037–APP7S5–101 in Appendix A2.

Key Stage 5 civil works components included:

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

b Installation of roading and services.

The earthworks, shear keys, undercuts, retaining walls, and subsoil drainage as–built plans are included in Appendix A1 (Woods Drawings 37005–05–100–AB, –110–AB to –112–AB, –120–AB to –122–AB, and –130–AB to –132–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 (Undercuts, Shear Keys & 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 (Undercuts, Shear Keys & 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 01 and 05):

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, Clegg Impact value, 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 Arran Point Precinct 7 during bulk earthworks as part of the undercut, shear key, reinforced earth slopes and geogrid reinforced segmental block walls construction.

The subsoil drains installed within the undercut, 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 reinforced earth slope construction comprised the following:

a 160mm diameter, Hiway grade, perforated Nexus pipes along the 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 2.0 metres 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 reinforced earth slope drains were connected to the reticulated stormwater system or discharge into the Orewa Estuary below, as shown on the Woods Shear Key, Undercut and Subsoil Drain AsBuilt Plans (Woods Ref 37005–05–120–AB to –122–AB) in Appendix A1, and on T+T Drawing 21854.0037–APP7S5–102 in Appendix A2.

3.2 Shear Keys

Based on stability analyses undertaken as part of the investigation reporting, shear keys were identified as being required across Arran Point Precinct 7 to provide satisfactory factors of safety against instability for the finished development of Stage 5.

1 No. Shear Key (i.e. SK1) was excavated within Stage 5 during the bulk earthworks in the location shown on the T+T Drawing 21854.0037–APP7S5–101, included in Appendix A2. Excavations for the Shear Key were 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).

Due to the depth of competent rock expected along part of the shear key alignment, 2 No. palisade pile walls were extended through the base of the shear key to be founded within the underlying competent rock. This is discussed further in Section 3.3 below.

The shear key long–section for SK1 was developed based on the mapping undertaken and is included in Appendix A2 (T+T Drawing 21854.0037–APP7S5–107). This 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 37005–05–120–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 layer of minimum 300mm thickness 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. This in essence became the rear face drainage for the reinforced earth slope.

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 Palisade Walls

The ECBF bedding plane shears identified during excavations and mapping within SK1 were assessed as dipping down southwards below the adjacent estuary. In view of that assessment, and the results of stability analyses undertaken as part of the investigation reporting, 2 No. Palisade Walls (Palisade Walls 1E and 1F) were identified as being required along SK1 to provide satisfactory factors of safety against instability for the finished Stage 5 development.

2 No. Palisade Walls (Palisade Walls 1E and 1F) were constructed within Stage 5 during the bulk earthworks in the location shown on the T+T Drawing 21854.0037–APP7S5–101, included in Appendix A2. Palisade Wall 1E comprises 9m to 12m long 310UC97 steel piles installed at 1.0m or 1.8m centres encased in 600mm diameter concreted holes. Palisade Wall 1F comprises 6m to 10m long 300mm diameter timber SED piles installed at 1.8m centres encased in 550mm diameter concreted holes. Drilling for the palisade wall pile bores were inspected and logged by an Engineering Geologist to check that the base of the piles had been extended sufficiently into the competent underlying ECBF rock materials.

Ground conditions exposed during palisade walls' 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.

3.4 Reinforced Earth Slopes

2 No. reinforced earth slopes (i.e. parts of RE 3 and RE 4) were constructed during the bulk earthworks and comprise horizontally laid uniaxial High Density Polyethylene (HDPE) geogrids placed at maximum 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.

A typical cross–section of the reinforced earth slopes is shown on T+T Drawing 21854.0037–APP7S5–105 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 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 shear key drainage) 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 outlets extend to connect into the reticulated stormwater system or discharge out to the adjacent stream system.

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

The slope faces will be subject to a planting covenant 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 limitation zone has been applied across the slope (See Sections 5.3 and 6.7).

3.5 Geogrid Reinforced Segmental Block Retaining Walls

Two geogrid reinforced segmental block walls (Screen Block Wall 05 and part of Allan Block Wall 01) were constructed during bulk earthworks within Stage 5.

Allan Block Wall 01 comprises uniaxial High Density Polyethylene (HDPE) geogrids placed at a maximum of 0.4m (vertical) intervals within the well compacted engineered hardfill, placed in accordance with the bulk earthworks specification (Section 2.3 above). The grids 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).

Construction of the Allan Block retaining wall 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 and 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.

Screen Block Wall 05 comprises 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 extend up to within 1m of the ground surface.

Construction of the Screen Block retaining wall 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.

Typical cross–sections of the geogrid reinforced segmental block walls are shown on T+T Drawings 21854.0037–S1–04 and 21854.0037–MBW5–04 to –MBW5–10 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 of 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 (Wall 01) or discharge into the adjacent stream below (Wall 05), as shown on the Woods As–Built plans 37005–05–120–AB to –122–AB in Appendix A1.

These walls have been designed to accommodate a maximum 10kPa surcharge or associated traffic surcharge, although development immediately behind/above the walls is likely to be precluded by Council planning rules.

Certification of these walls, in accordance with the relevant Engineering Approval, has been supplied in:

a Tonkin & Taylor Ltd., 19 September 2016. *Millwater – Arrans Point Precinct 7 Stage 1, Producer statement – Construction Review (PS4), Engineering Approval No. RMA 6200 / RDC 21438,* T+T Ref. 21854.0037/APP7S1-W1W2.

b Tonkin & Taylor Ltd., 7 December 2018. *Millwater – Arrans Point Precinct 7, Producer statement – Construction Review (PS4), Retaining Wall 05, Engineering Approval Consent No. RDC 21520, Resource Consent No. RMA 62000,* T+T Ref. 21854.0037/APP7S5.

3.6 Undercuts

An undercut (minimum 2m deep and 5m wide) was excavated below the toe of RE 4 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, an undercut extending sufficiently into the competent underlying ECBF rock materials was excavated below the toe of RE 3. Excavations for this undercut were inspected and mapped by an Engineering Geologist to check that the undercut 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).

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 5 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 AsBuilt Plans (Woods Ref 37005–05–120–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 and palisade walls to be constructed across Arran Point Precinct 7, so as to provide acceptable factors of safety against slope instability for the finished development of Stage 5.

During excavation of Shear Key 1, 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.

Inspections were also undertaken by a T+T Engineering Geologist during drilling of the Palisade Walls 1E and 1F pile bores, to confirm the materials encountered and to ensure the piles extended into the competent underlying ECBF rock materials.

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 Arran Point Precinct 7, Stage 5 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 to H1 (moderately to highly expansive) with characteristic surface movements anticipated to be in the range of 20mm to 60mm. 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 5 area have been constructed as reinforced earth fill structures with face gradients of 1 in 1.5 (V:H). They are located in Lots 30 to 43, 69 to 72 and 77 to 83. Construction within the flatter parts of these Lots is intended, and a Building Limitation 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 slope is shown on T+T Drawing 21854.0037–APP7S5–110 (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, and the results of compaction quality control testing, we consider that differential settlement induced by self-weight of engineered fill will now be largely complete. Further settlements should generally be within normally accepted design tolerances of 25mm, as outlined in NZS 3604:2011 (Ref. [8]), with respect to conventional building development.

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 5 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:

γ = 18 kN/m^3,

c' = 0 kPa,

Ø' = 30°,

K_a = 0.30,

K_p = 3.33,

Undrained shear strength, "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 5 area are shown on the Woods Retaining Wall As–Built Plans (Woods Ref 37005–05–130–AB to –132–AB). These walls have been designed to accommodate a maximum 10kPa surcharge or associated traffic surcharge, 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 5 that will need to consider the presence of the existing retaining wall during site development are:

a Allan Block Wall 01 – Lots 14 to 18 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 AsBuilt Plans (Woods Ref 37005–05–120–AB to –122–AB) in Appendix A1, and on T+T Drawing 21854.0037–APP7S5–102 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 21854.0037–APP7S5–111) are attached in Appendix E.

5.8 Stormwater

Public stormwater services have been installed within Arran Point Precinct 7, Stage 5. 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 37005–05–300–AB to –303–AB and –400–AB to –403–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 Arran Point Precinct 7 Stage 5 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 each of the Lots and these are shown on T+T Drawing 21854.0037–APP7S5–112 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 to H1 (moderately to highly expansive) with characteristic surface movements anticipated to be in the range of 20mm to 60mm.

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 Arran Point Precinct 7 Stage 5 (comprising residential Lots 14 to 43 and 69 to 83, JOAL Lots 802, Road 01 (Arran Point Parade) and Road 03 (Cassidy Drive) 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 Arran Point Precinct 7 Ref No. 21854.0037 dated November 2013. 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 37005, Millwater, Arran Point Precinct 7, Stage 5, Drawing Numbers 37005–05–100–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 14 to 43 and 69 to 80 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 81 and 83 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

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]).

6.6.3 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 H1 (highly expansive) as defined in AS 2870:2011 (Ref. [7]) with anticipated characteristic surface ground movements of 40mm to 60mm. 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:

i) Minimum foundation embedment of 750 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.

6.6.4 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 30 to 43, 69 to 72 and 77 to 83 inclusive:**

6.7.1 These Lots contain a "Building Limitation Zone" relating to the reinforced earth slope which forms the 1 in 1.5 (V:H) slope along the Lot boundaries. The restriction zone is shown on T+T Drawing 21854.0037–APP7S5–110 in Appendix A2. Excavation, filling and/or construction within this zone is not to be undertaken, to ensure stability of the slope 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 slope has assumed a maximum distributed load of 10kPa (dead plus live loads) up to the edge of the Building Limitation Zone.

6.7.3 Any cut or fill walls greater than 1.5m retained height, or of any height within 2m of the building limitation zones shown on T+T Drawing 21854.0037–APP7S5–110 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 Limitation Zone may proceed in accordance with the recommendations outlined in Sections 6.5 and 6.6.

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 AsBuilt Plans (Woods Ref 37005–05–120–AB to –122–AB) in Appendix A1, and on T+T Drawing 21854.0037–APP7S5–102 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 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 Arran Point Precinct 7, Stage 5 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 Arran Point Precinct 7 Stage 5 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:

.....

James Lee

Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:

.....

Andrew Stiles

Project Director

JXXL
p:\21854\21854.0037 - arrans hill p7\gcr\stage 5\jxxl.190404.app7s5-gcr.docx

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., November 2011. *Millwater – North Bridge, Southern Abutment, Geotechnical Investigation Report,* T+T Ref. 21854.012.

[5] Tonkin & Taylor Ltd., November 2013. *Millwater Subdivision, Arrans Hill – Precinct 7 – Geotechnical Investigation Report,* T+T Ref. 21854.0037.

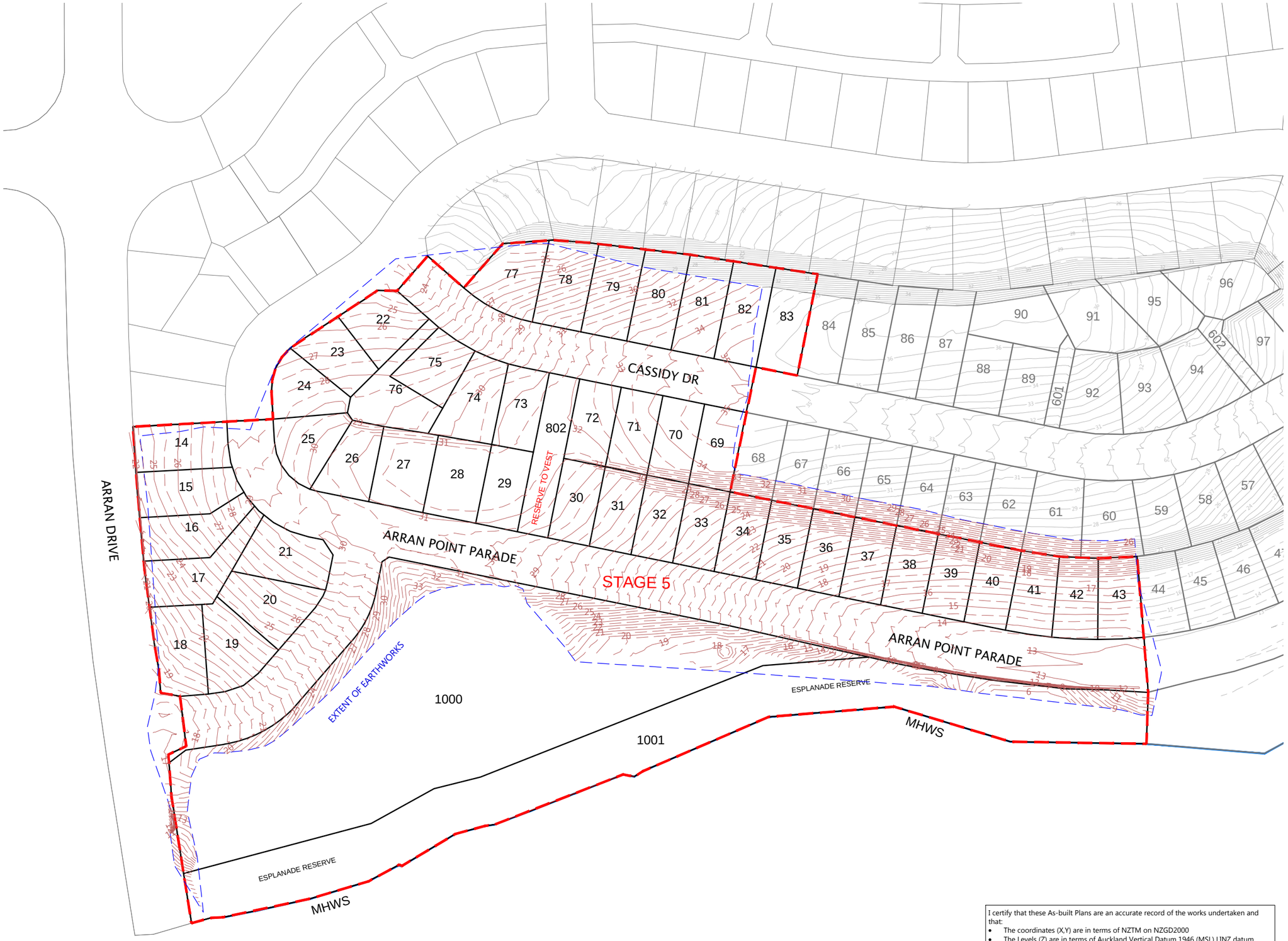
[6] New Zealand Standards, 1989. *NZS 4431:1989 Code of Practice for Earth Fill for Residential Development.*

[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

- **37005–05–100–AB** **Final Contours Plan**
- **37005–05–110–AB** **Cut & Fill As–Built – Lowest to Final Surface**
- **37005–05–111–AB** **Cut & Fill As–Built – Original to Lowest Surface**
- **37005–05–112–AB** **Cut & Fill As–Built – Original to Final Surface**
- **37005–05–120–AB to –122–AB** **Shear Key, Undercut and Subsoil Drain AsBuilt Plans**
- **37005–05–130–AB to –132–AB** **Retaining Wall As–Built Plans**
- **37005–05–300–AB to –303–AB** **Stormwater As–Built Plans**
- **37005–05–400–AB to –403–AB** **Wastewater As–Built Plans**



SCALEBAR (m)

0 15 30 75

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- CONTOURS MAJOR
- CONTOURS MINOR
- CONTOURS EXISTING
- STAGE BOUNDARIES
- LOT BOUNDARIES
- EXTENT OF EARTHWORKS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	06/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

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: 08/03/2019

Name: ROWAN HALAM

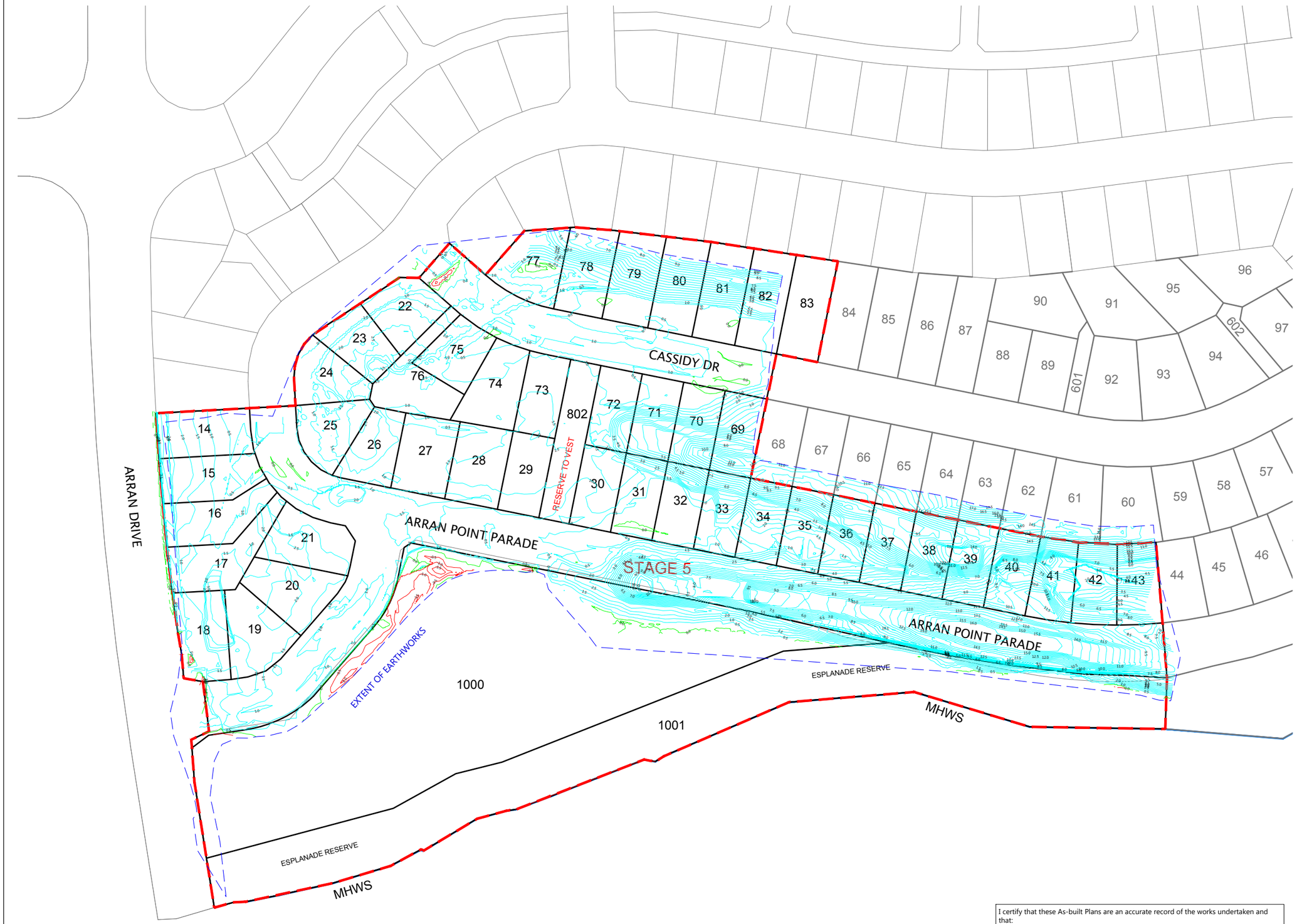
MILLWATER ARRAN POINT STAGE 5

FINAL CONTOURS PLAN

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-100-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-100-AB-FINAL CONTOURS.DWG

K:\37005 - Arran Hill Precinct 7 Stage 5\Drawings\Surv\Asbuilt\37005-05-100-AB-FINAL CONTOURS.dwg, 11/03/2019 1:35:56 p.m., DWG To PDF - High-Res.pc3



SCALEBAR (m)

SCALE 1:1500 @A3 1:750 @A1

0 15 30 75

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- FILL CONTOUR
- CUT CONTOUR
- ZERO CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES
- EXTENT OF EARTHWORKS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	06/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	SK	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

CUT & FILL AS-BUILT
LOWEST TO FINAL SURFACE
SHEET 1 OF 3

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

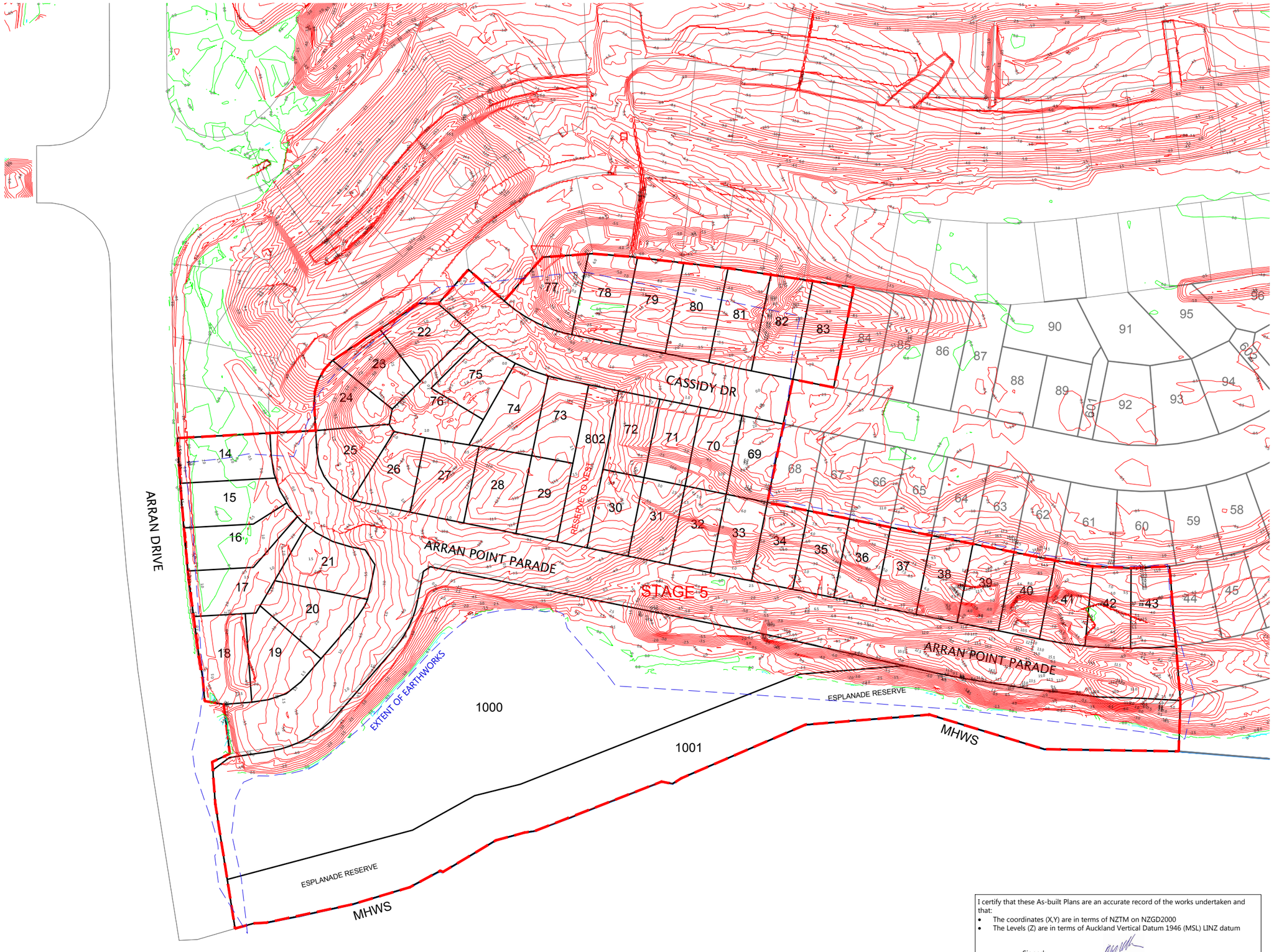
Signed: _____
Registered Professional Surveyor

Date: 08/03/2019

Name: ROWAN HALAM

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-110-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-110-AB-CUT FILL CONTOURS.DWG



SCALEBAR (m)

0 15 30 75

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- FILL CONTOUR
- CUT CONTOUR
- ZERO CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES
- EXTENT OF EARTHWORKS

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: 08/03/2019

Name: ROWAN HALAM

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	06/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	SK	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

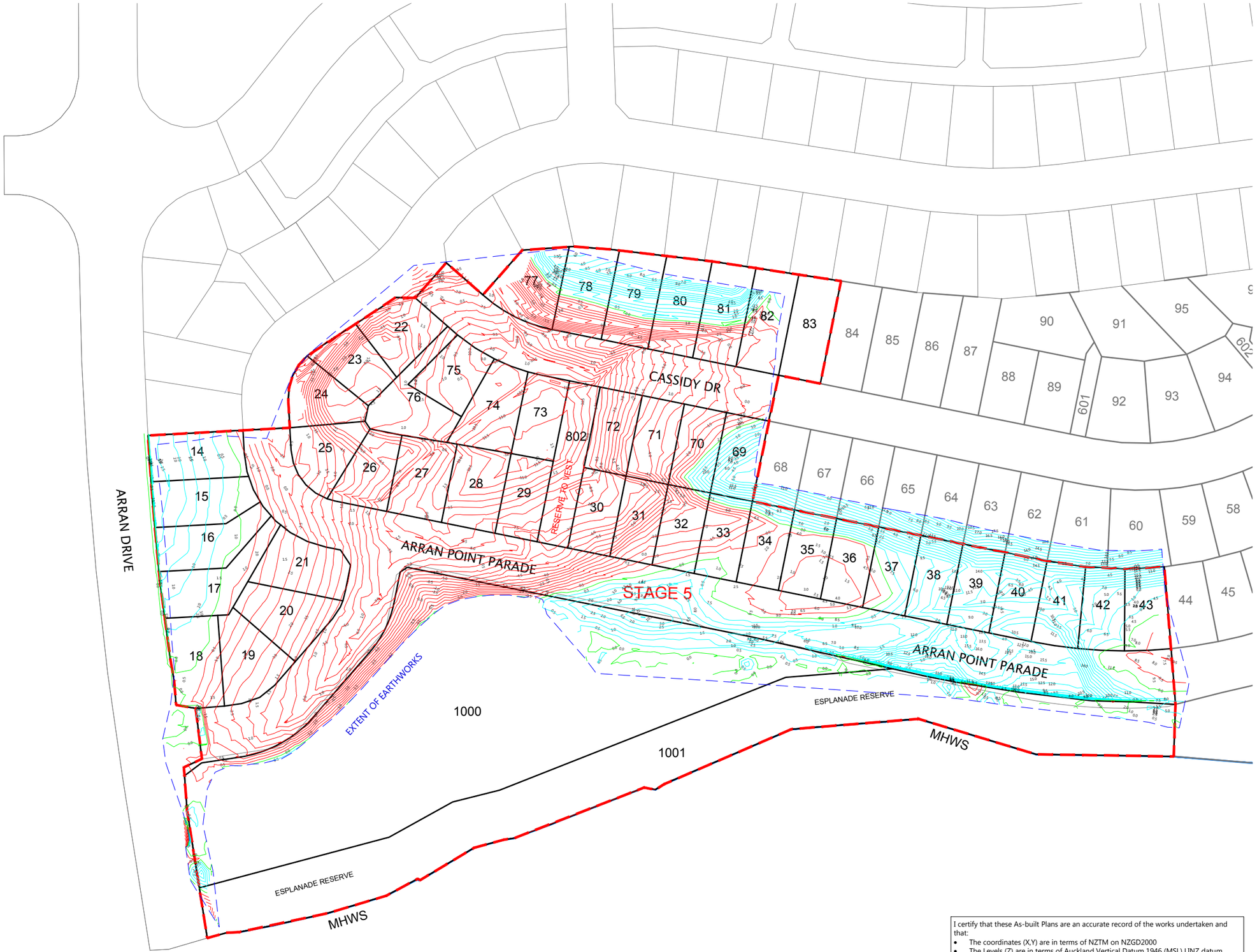
N

MILLWATER
ARRAN POINT
STAGE 5

CUT & FILL AS-BUILT
ORIGINAL TO LOWEST SURFACE
SHEET 2 OF 3

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-111-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURVYASBUILT\37005-05-110-AB-CUT FILL CONTOURS.DWG



SCALEBAR (m)

0 15 30 75

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

- FILL CONTOUR
- CUT CONTOUR
- ZERO CONTOUR
- STAGE BOUNDARIES
- LOT BOUNDARIES
- EXTENT OF EARTHWORKS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	06/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	SK	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

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: 08/03/2019

Name: ROWAN HALAM

MILLWATER
ARRAN POINT
STAGE 5

CUT & FILL AS-BUILT
ORIGINAL TO FINAL SURFACE
SHEET 3 OF 3

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-112-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-110-AB-CUT FILL CONTOURS.DWG

WOODS
Est.1970

SEE SHEET 121

SEE SHEET 122

UNDERCUT 2

UNDERCUT 2

UNDERCUT 3

UNDERCUT 4

UNDERCUT 5

UNDERCUT 5

CASSIDY DR

ARRAN DRIVE

ARRAN POINT PARADE

ARRAN POINT PARADE

RESERVE TO VEST

STAGE 5

SHEARKEY 1

ESPLANADE RESERVE

ESPLANADE RESERVE

MHWS

MHWS

1000

1001

802

601

602

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98

SCALEBAR (m)

0 15 30 75

NOTES

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

LEGEND

- 150 PVC RETAINING WALL DRAINAGE
- NOVACOIL SUBSOIL DRAINS
- REINFORCED EARTH & RETAINING WALL SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE
- SUBGRADE UNDERCUT AREAS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	MRB	
CHECKED	KR	
APPROVED	MRH	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

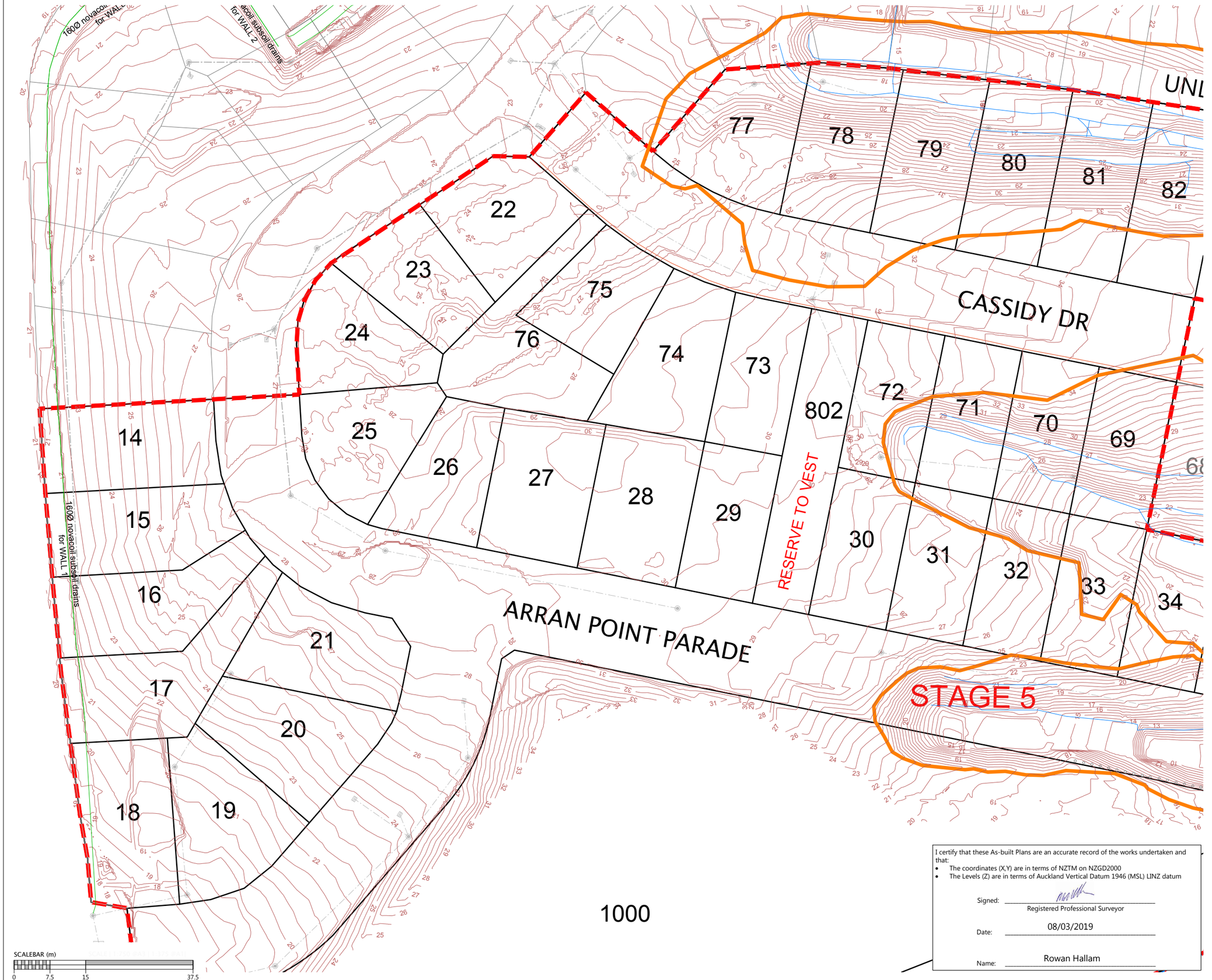
Date: 08/03/2019

Name: Rowan Hallam

MILLWATER
ARRAN POINT
STAGE 5
SHEAR KEY, UNDERCUT AND SUBSOIL DRAIN ASBUILT OVERALL LAYOUT
SHEET 1 OF 3

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-120-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-120-AB-SK UC & SUBSOILDWG



WOODS
Est.1970

NOTES

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

LEGEND

- 150 PVC RETAINING WALL DRAINAGE
- NOVACOIL SUBSOIL DRAINS
- REINFORCED EARTH & RETAINING WALL SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE
- SUBGRADE UNDERCUT AREAS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	MRB	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

SHEAR KEY, UNDERCUT AND SUBSOIL DRAIN ASBUILT
SHEET 2 OF 3

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: 08/03/2019

Name: Rowan Hallam

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-121-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-120-AB-SK UC & SUBSOIL.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: 08/03/2019

Name: Rowan Hallam

WOODS
EST.1970

UNDERCUT 3

CASSIDY DR

UNDERCUT 5

STAGE 5

SHEARKEY 1

ARRAN POINT PARADE

ESPLANADE RESERVE

79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 601 602

72 71 70 69 68 67 66 65 64 63 62 61 60 59 58

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

SCALEBAR (m)
0 7.5 15 37.5

NOTES

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

LEGEND

- 150 PVC RETAINING WALL DRAINAGE
- NOVACOIL SUBSOIL DRAINS
- REINFORCED EARTH & RETAINING WALL SUBSOIL DRAINS
- EXISTING STORMWATER DRAINAGE
- NEW STORMWATER DRAINAGE
- STAGE BOUNDARIES
- LOT BOUNDARIES
- CONTOURS
- SHEAR KEY & UNDERCUT AREAS
- PALISADE WALL PILE
- SUBGRADE UNDERCUT AREAS

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	MRB	
CHECKED	KR	
APPROVED	MRH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

SHEAR KEY, UNDERCUT
AND SUBSOIL DRAIN ASBUILT
SHEET 3 OF 3

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-122-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-120-AB-SK UC & SUBSOIL.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: 08/03/2019

Name: ROWAN HALAM

SEE SHEET 131

SEE SHEET 132

STAGE 5

CASSIDY DR

ARRAN POINT PARADE

ARRAN DRIVE

ESPLANADE RESERVE

MHWS

EX SWMH 5/1

RESERVE EST

1000

1001

802

607

1692

LEGEND:

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

SCALEBAR (m)

0 15 30 75

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	KR	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

MILLWATER
ARRAN POINT
STAGE 5

RETAINING WALL AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 3

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-130-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURVYASBUILT\37005-05-130-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: 08/03/2019

Name: ROWAN HALAM

WOODS
EST.1970

LEGEND:

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

CASSIDY DR

ARRAN POINT PARADE

RESERVE TO VEST

STAGE 5

VEGETATED EARTH BATTER

160ø Novaflo from retaining walls

Change point for type of wall

BOTTOM OF NEW ALLAN BLOCK RETAINING WALL EAST OF BOUNDARY

POOL TYPE FENCE ON TOP OF RETAINING WALL

SCALEBAR (m)
0 7.5 15 37.5

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	KR	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

RETAINING WALL AS-BUILT
SHEET 2 OF 3

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-131-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-130-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: 08/03/2019

Name: ROWAN HALAM

WOODS
EST.1970

LEGEND:

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

CASSIDY DR

VEGETATED EARTH BATTER

78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93

601

'3 802 72 71 70 69 68 67 66 65 64 63 62 61 60

RESERVE TO VEST

30 31 32 33 34 35 36 37 38 39 40 41 42 43

VEGETATED EARTH BATTER

STAGE 5

HIGH BOSS BALUSTRADE FENCE ON TOP OF RETAINING WALL

0.60

BOTTOM OF NEW ALLAN BLOCK RETAINING WALL

0.45

ARRAN POINT PARADE

HIGH BOSS BALUSTRADE FENCE ON TOP OF RETAINING WALL

0.35

BOTTOM OF NEW ALLAN BLOCK RETAINING WALL

1.15

ESPLANADE RESERVE

MHWS

1001

SCALEBAR (m)
0 7.5 15 37.5

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	T&T	
DRAWN	KR	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

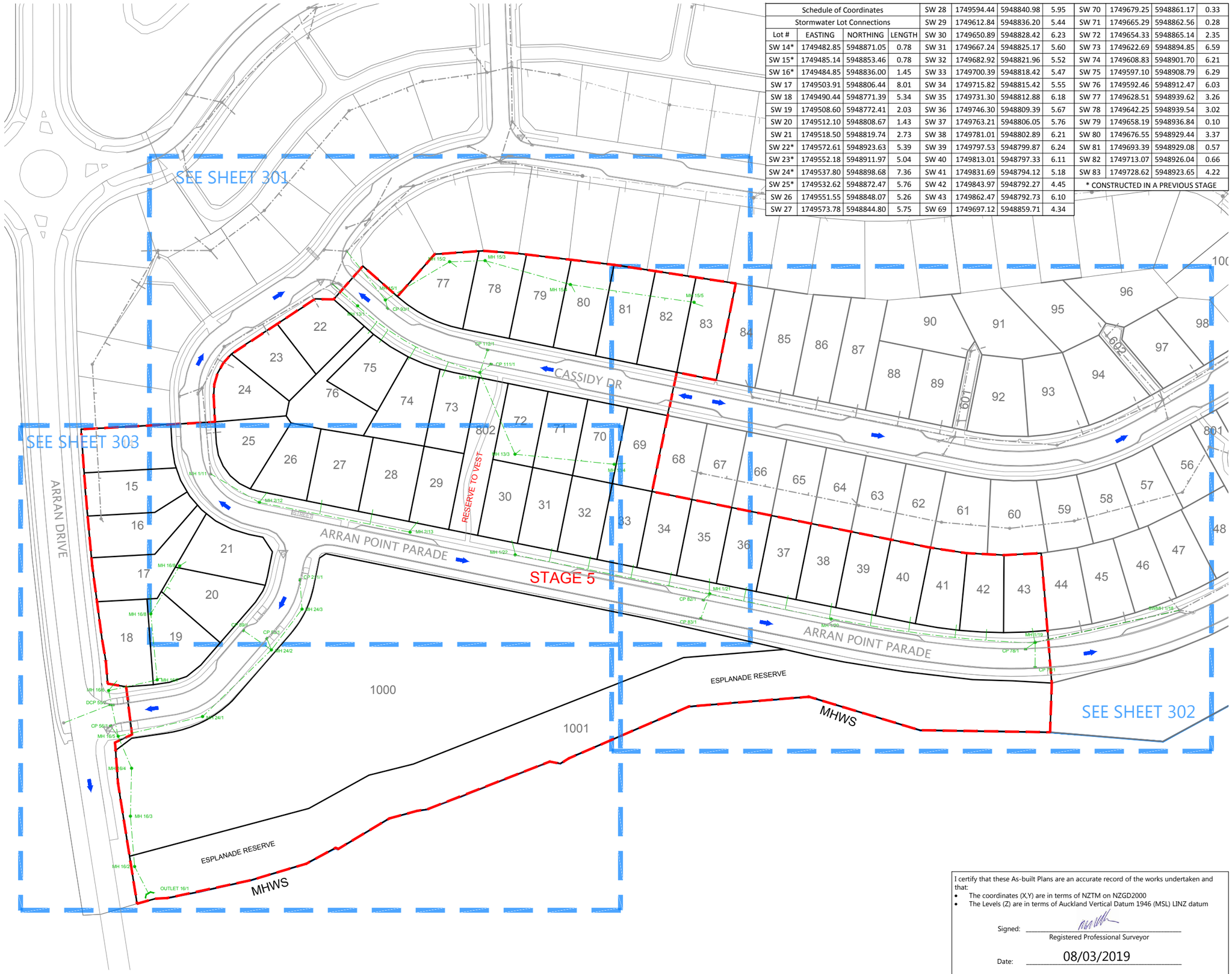
WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

RETAINING WALL AS-BUILT
SHEET 3 OF 3
(SLC-62000)

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-132-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-130-AB-WALLS.DWG



Schedule of Coordinates				SW 28	1749594.44	5948840.98	5.95	SW 70	1749679.25	5948861.17	0.33
Stormwater Lot Connections				SW 29	1749612.84	5948836.20	5.44	SW 71	1749665.29	5948862.56	0.28
Lot #	EASTING	NORTHING	LENGTH	SW 30	1749650.89	5948828.42	6.23	SW 72	1749654.33	5948865.14	2.35
SW 14*	1749482.85	5948871.05	0.78	SW 31	1749667.24	5948825.17	5.60	SW 73	1749622.69	5948894.85	6.59
SW 15*	1749485.14	5948853.46	0.78	SW 32	1749682.92	5948821.96	5.52	SW 74	1749608.83	5948901.70	6.21
SW 16*	1749484.85	5948836.00	1.45	SW 33	1749700.39	5948818.42	5.47	SW 75	1749597.10	5948908.79	6.29
SW 17	1749503.91	5948806.44	8.01	SW 34	1749715.82	5948815.42	5.55	SW 76	1749592.46	5948912.47	6.03
SW 18	1749490.44	5948771.39	5.34	SW 35	1749731.30	5948812.88	6.18	SW 77	1749628.51	5948939.62	3.26
SW 19	1749508.60	5948772.41	2.03	SW 36	1749746.30	5948809.39	5.67	SW 78	1749642.25	5948939.54	3.02
SW 20	1749512.10	5948808.67	1.43	SW 37	1749763.21	5948806.05	5.76	SW 79	1749658.19	5948936.84	0.10
SW 21	1749518.50	5948819.74	2.73	SW 38	1749781.01	5948802.89	6.21	SW 80	1749676.55	5948929.44	3.37
SW 22*	1749572.61	5948923.63	5.39	SW 39	1749797.53	5948799.87	6.24	SW 81	1749693.39	5948929.08	0.57
SW 23*	1749552.18	5948911.97	5.04	SW 40	1749813.01	5948797.33	6.11	SW 82	1749713.07	5948926.04	0.66
SW 24*	1749537.80	5948898.68	7.36	SW 41	1749831.69	5948794.12	5.18	SW 83	1749728.62	5948923.65	4.22
SW 25*	1749532.62	5948872.47	5.76	SW 42	1749843.97	5948792.27	4.45	* CONSTRUCTED IN A PREVIOUS STAGE			
SW 26	1749551.55	5948848.07	5.26	SW 43	1749862.47	5948792.73	6.10				
SW 27	1749573.78	5948844.80	5.75	SW 69	1749697.12	5948859.71	4.34				

SCALEBAR (m)

0 15 30 75

SCALE 1:1500 @ A3 1:750 @ A1

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: 08/03/2019

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER OUTLET
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY
- REVISED EXISTING INFORMATION 19.17

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.

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

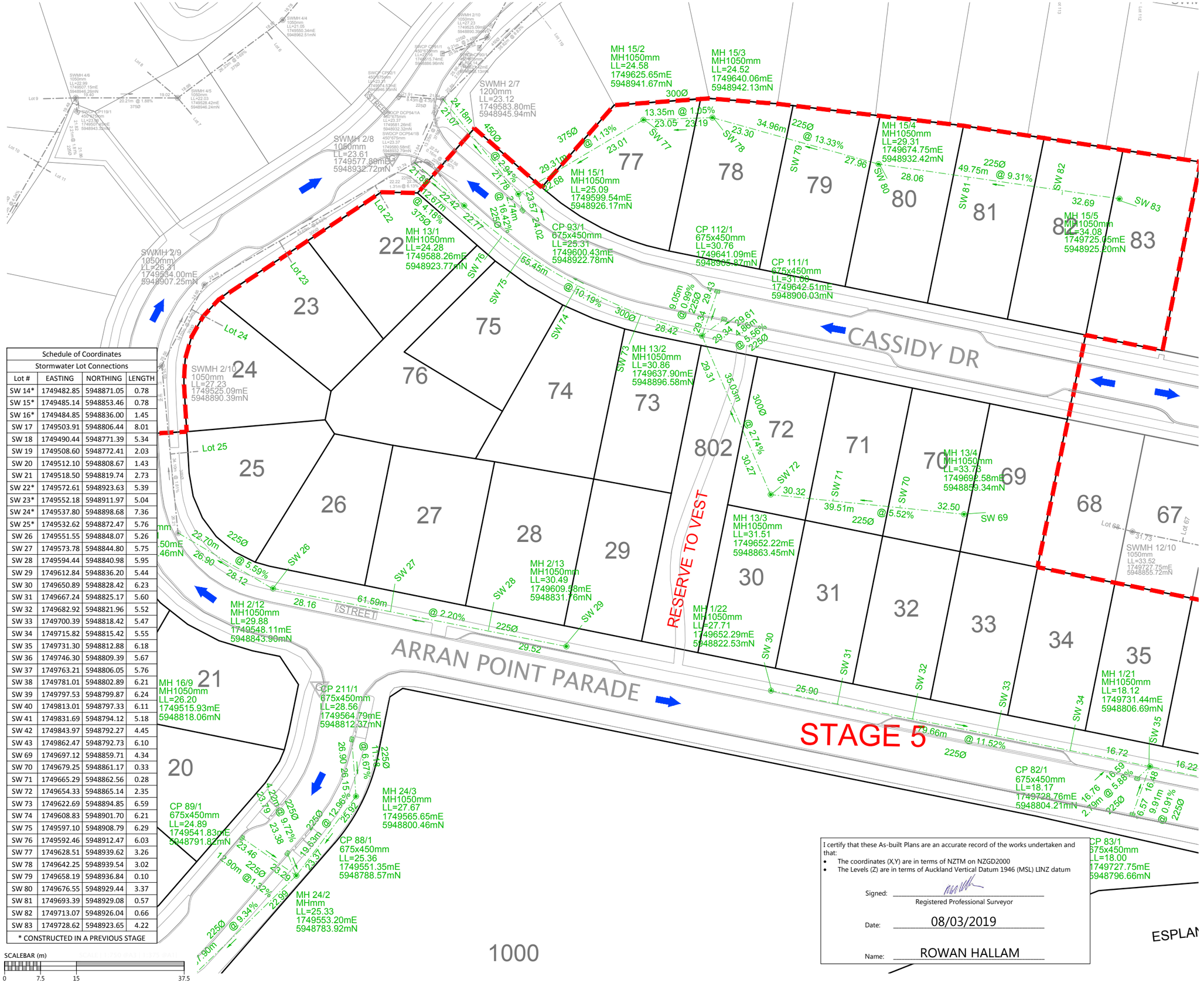
N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5
STORMWATER AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 4

STATUS	AS-BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-300-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-300-AB-STORMWATER.DWG



Schedule of Coordinates			
Stormwater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SW 14*	1749482.85	5948871.05	0.78
SW 15*	1749485.14	5948853.46	0.78
SW 16*	1749484.85	5948836.00	1.45
SW 17	1749503.91	5948806.44	8.01
SW 18	1749490.44	5948771.39	5.34
SW 19	1749508.60	5948772.41	2.03
SW 20	1749512.10	5948808.67	1.43
SW 21	1749518.50	5948819.74	2.73
SW 22*	1749572.61	5948923.63	5.39
SW 23*	1749552.18	5948911.97	5.04
SW 24*	1749537.80	5948898.68	7.36
SW 25*	1749532.62	5948872.47	5.76
SW 26	1749551.55	5948848.07	5.26
SW 27	1749573.78	5948844.80	5.75
SW 28	1749594.44	5948840.98	5.95
SW 29	1749612.84	5948836.20	5.44
SW 30	1749650.89	5948828.42	6.23
SW 31	1749667.24	5948825.17	5.60
SW 32	1749682.92	5948821.96	5.52
SW 33	1749700.39	5948818.42	5.47
SW 34	1749715.82	5948815.42	5.55
SW 35	1749731.30	5948812.88	6.18
SW 36	1749746.30	5948809.39	5.67
SW 37	1749763.21	5948806.05	5.76
SW 38	1749781.01	5948802.89	6.21
SW 39	1749797.53	5948799.87	6.24
SW 40	1749813.01	5948797.33	6.11
SW 41	1749831.69	5948794.12	5.18
SW 42	1749843.97	5948792.27	4.45
SW 43	1749862.47	5948792.73	6.10
SW 69	1749697.12	5948859.71	4.34
SW 70	1749679.25	5948861.17	0.33
SW 71	1749665.29	5948862.56	0.28
SW 72	1749654.33	5948865.14	2.35
SW 73	1749622.69	5948894.85	6.59
SW 74	1749608.83	5948901.70	6.21
SW 75	1749597.10	5948908.79	6.29
SW 76	1749592.46	5948912.47	6.03
SW 77	1749628.51	5948939.62	3.26
SW 78	1749642.25	5948939.54	3.02
SW 79	1749658.19	5948936.84	0.10
SW 80	1749676.55	5948929.44	3.37
SW 81	1749693.39	5948929.08	0.57
SW 82	1749713.07	5948926.04	0.66
SW 83	1749728.62	5948923.65	4.22
* CONSTRUCTED IN A PREVIOUS STAGE			

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: 08/03/2019

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER OUTLET
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY
- REVISED EXISTING INFORMATION 19.17

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.

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

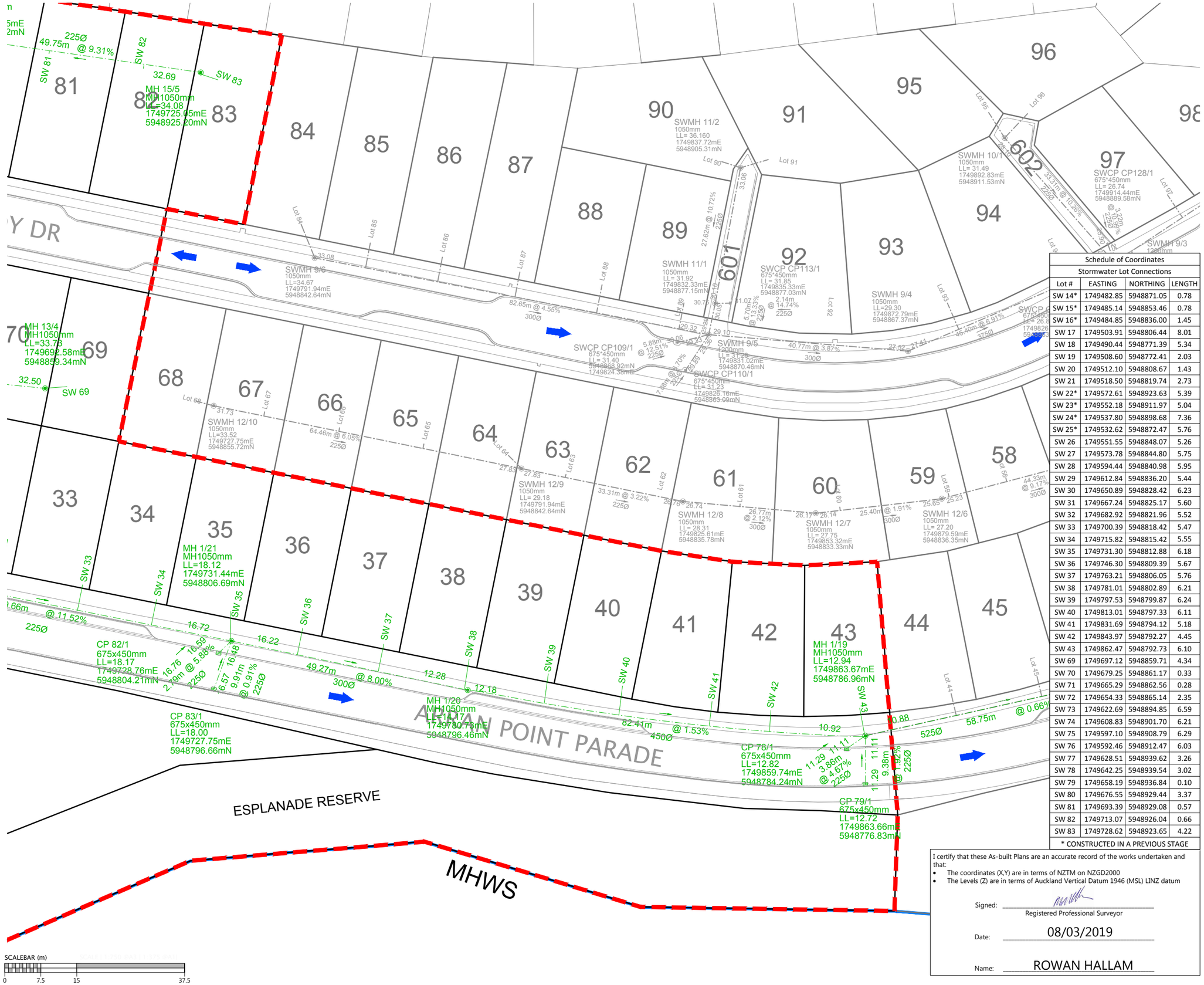
WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

STORMWATER AS-BUILT
SHEET 2 OF 4

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-301-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURVEY\ASBUILT\37005-05-300-AB STORMWATER.DWG



Schedule of Coordinates			
Stormwater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SW 14*	1749482.85	5948871.05	0.78
SW 15*	1749485.14	5948853.46	0.78
SW 16*	1749484.85	5948836.00	1.45
SW 17	1749503.91	5948806.44	8.01
SW 18	1749490.44	5948771.39	5.34
SW 19	1749508.60	5948772.41	2.03
SW 20	1749512.10	5948808.67	1.43
SW 21	1749518.50	5948819.74	2.73
SW 22*	1749572.61	5948923.63	5.39
SW 23*	1749552.18	5948911.97	5.04
SW 24*	1749537.80	5948898.68	7.36
SW 25*	1749532.62	5948872.47	5.76
SW 26	1749551.55	5948848.07	5.26
SW 27	1749573.78	5948844.80	5.75
SW 28	1749594.44	5948840.98	5.95
SW 29	1749612.84	5948836.20	5.44
SW 30	1749650.89	5948828.42	6.23
SW 31	1749667.24	5948825.17	5.60
SW 32	1749682.92	5948821.96	5.52
SW 33	1749700.39	5948818.42	5.47
SW 34	1749715.82	5948815.42	5.55
SW 35	1749731.30	5948812.88	6.18
SW 36	1749746.30	5948809.39	5.67
SW 37	1749763.21	5948806.05	5.76
SW 38	1749781.01	5948802.89	6.21
SW 39	1749797.53	5948799.87	6.24
SW 40	1749813.01	5948797.33	6.11
SW 41	1749831.69	5948794.12	5.18
SW 42	1749843.97	5948792.27	4.45
SW 43	1749862.47	5948792.73	6.10
SW 69	1749697.12	5948859.71	4.34
SW 70	1749679.25	5948861.17	0.33
SW 71	1749665.29	5948862.56	0.28
SW 72	1749654.33	5948865.14	2.35
SW 73	1749622.69	5948894.85	6.59
SW 74	1749608.83	5948901.70	6.21
SW 75	1749597.10	5948908.79	6.29
SW 76	1749592.46	5948912.47	6.03
SW 77	1749628.51	5948939.62	3.26
SW 78	1749642.25	5948939.54	3.02
SW 79	1749658.19	5948936.84	0.10
SW 80	1749676.55	5948929.44	3.37
SW 81	1749693.39	5948929.08	0.57
SW 82	1749713.07	5948926.04	0.66
SW 83	1749728.62	5948923.65	4.22

* CONSTRUCTED IN A PREVIOUS STAGE

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: 08/03/2019

Name: ROWAN HALLAM

WOODS
EST.1970

LEGEND

- STORMWATER MANHOLE
- STORMWATER OUTLET
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY
- REVISED EXISTING INFORMATION 19.17

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.

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

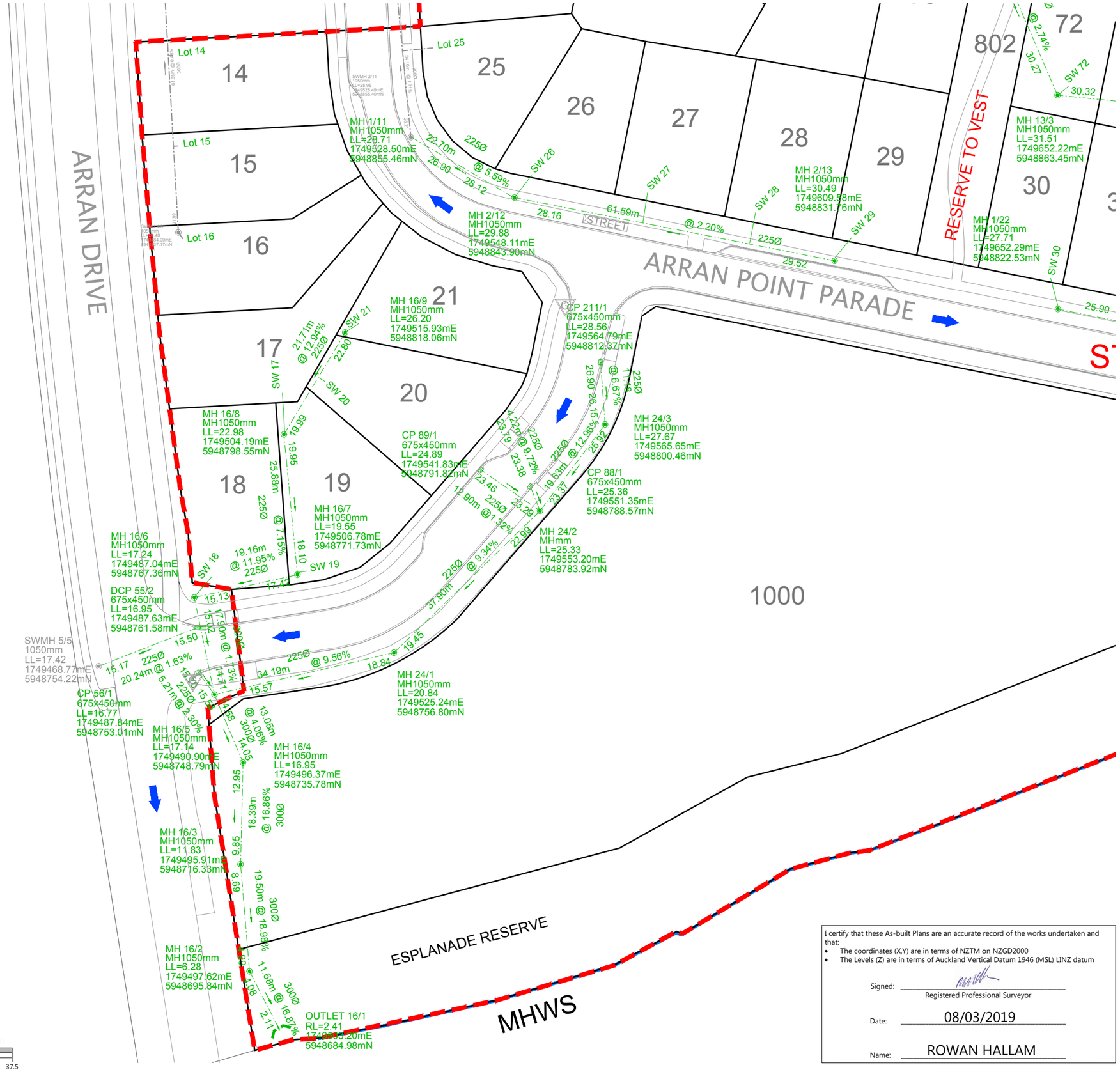
N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5
STORMWATER AS-BUILT
SHEET 3 OF 4

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-302-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-300-AB-STORMWATER.DWG



Schedule of Coordinates			
Stormwater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SW 14*	1749482.85	5948871.05	0.78
SW 15*	1749485.14	5948853.46	0.78
SW 16*	1749484.85	5948836.00	1.45
SW 17	1749503.91	5948806.44	8.01
SW 18	1749490.44	5948771.39	5.34
SW 19	1749508.60	5948772.41	2.03
SW 20	1749512.10	5948808.67	1.43
SW 21	1749518.50	5948819.74	2.73
SW 22*	1749572.61	5948923.63	5.39
SW 23*	1749552.18	5948911.97	5.04
SW 24*	1749537.80	5948898.68	7.36
SW 25*	1749532.62	5948872.47	5.76
SW 26	1749551.55	5948848.07	5.26
SW 27	1749573.78	5948844.80	5.75
SW 28	1749594.44	5948840.98	5.95
SW 29	1749612.84	5948836.20	5.44
SW 30	1749650.89	5948828.42	6.23
SW 31	1749667.24	5948825.17	5.60
SW 32	1749682.92	5948821.96	5.52
SW 33	1749700.39	5948818.42	5.47
SW 34	1749715.82	5948815.42	5.55
SW 35	1749731.30	5948812.88	6.18
SW 36	1749746.30	5948809.39	5.67
SW 37	1749763.21	5948806.05	5.76
SW 38	1749781.01	5948802.89	6.21
SW 39	1749797.53	5948799.87	6.24
SW 40	1749813.01	5948797.33	6.11
SW 41	1749831.69	5948794.12	5.18
SW 42	1749843.97	5948792.27	4.45
SW 43	1749862.47	5948792.73	6.10
SW 69	1749697.12	5948859.71	4.34
SW 70	1749679.25	5948861.17	0.33
SW 71	1749665.29	5948862.56	0.28
SW 72	1749654.33	5948865.14	2.35
SW 73	1749622.69	5948894.85	6.59
SW 74	1749608.83	5948901.70	6.21
SW 75	1749597.10	5948908.79	6.29
SW 76	1749592.46	5948912.47	6.03
SW 77	1749628.51	5948939.62	3.26
SW 78	1749642.25	5948939.54	3.02
SW 79	1749658.19	5948936.84	0.10
SW 80	1749676.55	5948929.44	3.37
SW 81	1749693.39	5948929.08	0.57
SW 82	1749713.07	5948926.04	0.66
SW 83	1749728.62	5948923.65	4.22
* CONSTRUCTED IN A PREVIOUS STAGE			

SCALEBAR (m)

0 7.5 15 37.5

LEGEND

- STORMWATER MANHOLE
- STORMWATER OUTLET
- STORMWATER CESSPIT
- STORMWATER DOUBLE CESSPIT
- OVERLAND FLOW
- NEW STORMWATER
- EXISTING STORMWATER
- SUBSOIL DRAINAGE
- STAGE BOUNDARY
- REVISED EXISTING INFORMATION 19.17

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.

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

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: 08/03/2019

Name: ROWAN HALLAM

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

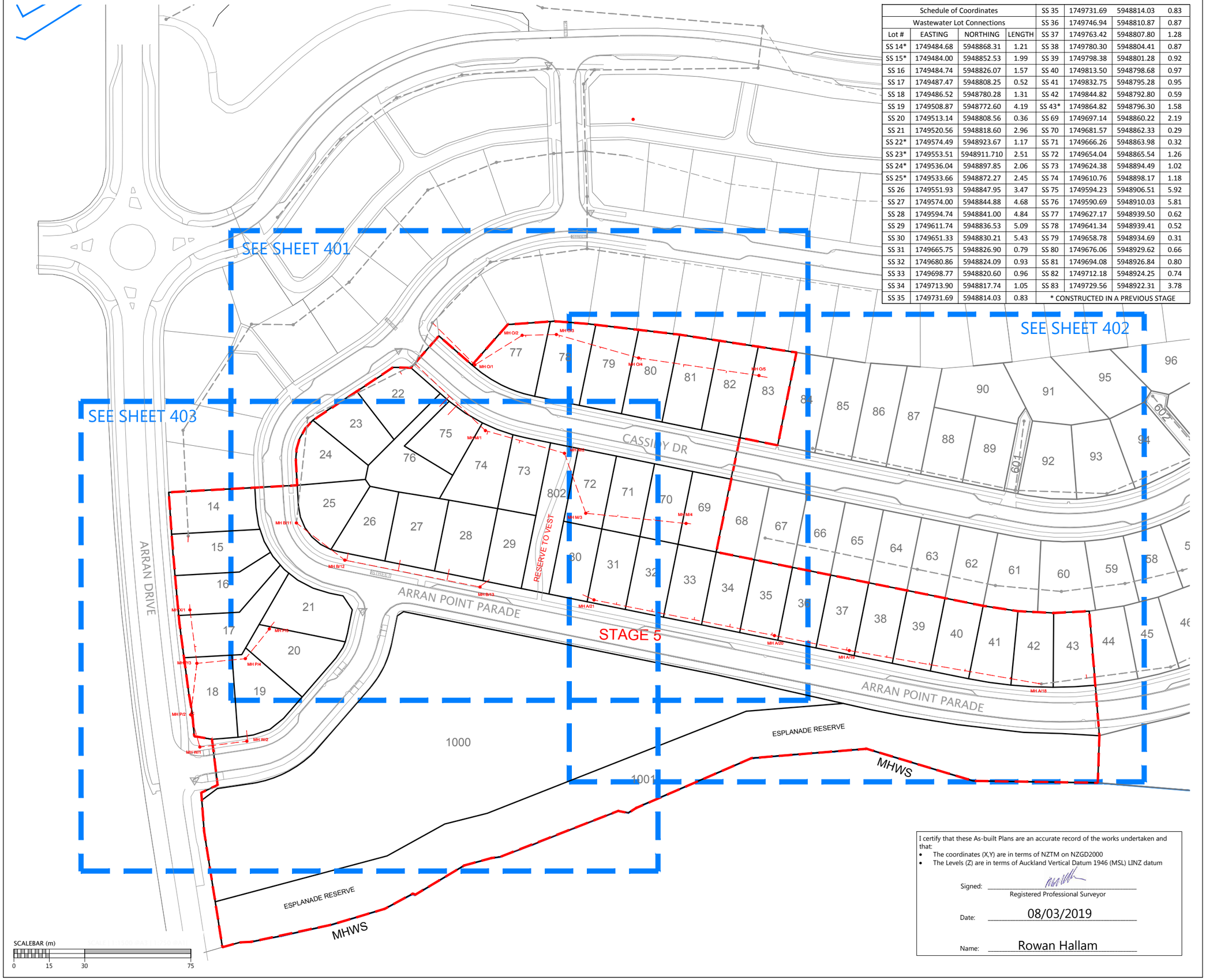
WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

STORMWATER AS-BUILT
SHEET 4 OF 4

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-303-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-300-AB-STORMWATER.DWG



Schedule of Coordinates				SS 35	1749731.69	5948814.03	0.83
Wastewater Lot Connections				SS 36	1749746.94	5948810.87	0.87
Lot #	EASTING	NORTHING	LENGTH	SS 37	1749763.42	5948807.80	1.28
SS 14*	1749484.68	5948868.31	1.21	SS 38	1749780.30	5948804.41	0.87
SS 15*	1749484.00	5948852.53	1.99	SS 39	1749798.38	5948801.28	0.92
SS 16	1749484.74	5948826.07	1.57	SS 40	1749813.50	5948798.68	0.97
SS 17	1749487.47	5948808.25	0.52	SS 41	1749832.75	5948795.28	0.95
SS 18	1749486.52	5948780.28	1.31	SS 42	1749844.82	5948792.80	0.59
SS 19	1749508.87	5948772.60	4.19	SS 43*	1749864.82	5948796.30	1.58
SS 20	1749513.14	5948808.56	0.36	SS 69	1749697.14	5948860.22	2.19
SS 21	1749520.56	5948818.60	2.96	SS 70	1749681.57	5948862.33	0.29
SS 22*	1749574.49	5948923.67	1.17	SS 71	1749666.26	5948863.98	0.32
SS 23*	1749553.51	5948911.710	2.51	SS 72	1749654.04	5948865.54	1.26
SS 24*	1749536.04	5948897.85	2.06	SS 73	1749624.38	5948894.49	1.02
SS 25*	1749533.66	5948872.27	2.45	SS 74	1749610.76	5948898.17	1.18
SS 26	1749551.93	5948847.95	3.47	SS 75	1749594.23	5948906.51	5.92
SS 27	1749574.00	5948844.88	4.68	SS 76	1749590.69	5948910.03	5.81
SS 28	1749594.74	5948841.00	4.84	SS 77	1749627.17	5948939.50	0.62
SS 29	1749611.74	5948836.53	5.09	SS 78	1749641.34	5948939.41	0.52
SS 30	1749651.33	5948830.21	5.43	SS 79	1749658.78	5948934.69	0.31
SS 31	1749665.75	5948826.90	0.79	SS 80	1749676.06	5948929.62	0.66
SS 32	1749680.86	5948824.09	0.93	SS 81	1749694.08	5948926.84	0.80
SS 33	1749698.77	5948820.60	0.96	SS 82	1749712.18	5948924.25	0.74
SS 34	1749713.90	5948817.74	1.05	SS 83	1749729.56	5948922.31	3.78
SS 35	1749731.69	5948814.03	0.83	* CONSTRUCTED IN A PREVIOUS STAGE			

LEGEND

NEW SANITARY SEWER MANHOLE	◉
NEW SANITARY SEWER	– – – –
EXISTING SANITARY SEWER	———
REVISED INVERT LEVEL	19.17

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	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

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: 08/03/2019

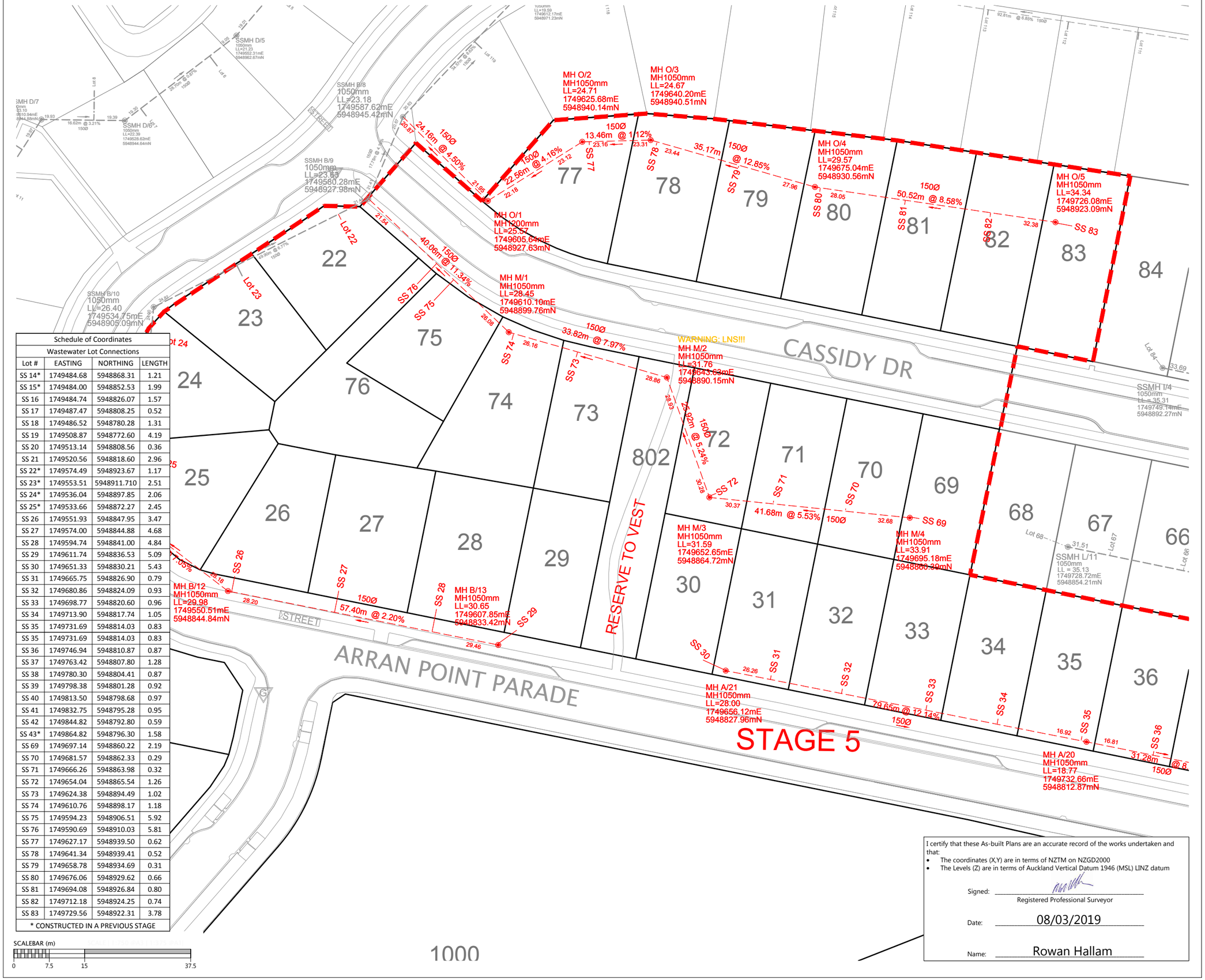
Name: Rowan Hallam

MILLWATER
ARRAN POINT
STAGE 5

WASTEWATER AS-BUILT
OVERALL LAYOUT
SHEET 1 OF 4

STATUS	AS BUILT	REV
SCALE	1:1500 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-400-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-400-AB-SEWER.DWG



Schedule of Coordinates			
Wastewater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SS 14*	1749484.68	5948868.31	1.21
SS 15*	1749484.00	5948852.53	1.99
SS 16	1749484.74	5948826.07	1.57
SS 17	1749487.47	5948808.25	0.52
SS 18	1749486.52	5948780.28	1.31
SS 19	1749508.87	5948772.60	4.19
SS 20	1749513.14	5948808.56	0.36
SS 21	1749520.56	5948818.60	2.96
SS 22*	1749574.49	5948923.67	1.17
SS 23*	1749553.51	5948911.710	2.51
SS 24*	1749536.04	5948897.85	2.06
SS 25*	1749533.66	5948872.27	2.45
SS 26	1749551.93	5948847.95	3.47
SS 27	1749574.00	5948844.88	4.68
SS 28	1749594.74	5948841.00	4.84
SS 29	1749611.74	5948836.53	5.09
SS 30	1749651.33	5948830.21	5.43
SS 31	1749665.75	5948826.90	0.79
SS 32	1749680.86	5948824.09	0.93
SS 33	1749698.77	5948820.60	0.96
SS 34	1749713.90	5948817.74	1.05
SS 35	1749731.69	5948814.03	0.83
SS 35	1749731.69	5948814.03	0.83
SS 36	1749746.94	5948810.87	0.87
SS 37	1749763.42	5948807.80	1.28
SS 38	1749780.30	5948804.41	0.87
SS 39	1749798.38	5948801.28	0.92
SS 40	1749813.50	5948798.68	0.97
SS 41	1749832.75	5948795.28	0.95
SS 42	1749844.82	5948792.80	0.59
SS 43*	1749864.82	5948796.30	1.58
SS 69	1749697.14	5948860.22	2.19
SS 70	1749681.57	5948862.33	0.29
SS 71	1749666.26	5948863.98	0.32
SS 72	1749654.04	5948865.54	1.26
SS 73	1749624.38	5948894.49	1.02
SS 74	1749610.76	5948898.17	1.18
SS 75	1749594.23	5948906.51	5.92
SS 76	1749590.69	5948910.03	5.81
SS 77	1749627.17	5948939.50	0.62
SS 78	1749641.34	5948939.41	0.52
SS 79	1749658.78	5948934.69	0.31
SS 80	1749676.06	5948929.62	0.66
SS 81	1749694.08	5948926.84	0.80
SS 82	1749712.18	5948924.25	0.74
SS 83	1749729.56	5948922.31	3.78
* CONSTRUCTED IN A PREVIOUS STAGE			

SCALEBAR (m)
0 7.5 15 37.5
1000

LEGEND

NEW SANITARY SEWER MANHOLE	◉
NEW SANITARY SEWER	— — —
EXISTING SANITARY SEWER	———
REVISED INVERT LEVEL	19.17

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.

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: 08/03/2019

Name: Rowan Hallam

REVISION DETAILS		BY	DATE
1	ISSUED FOR INFORMATION	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	MRH	WOODS.CO.NZ

N

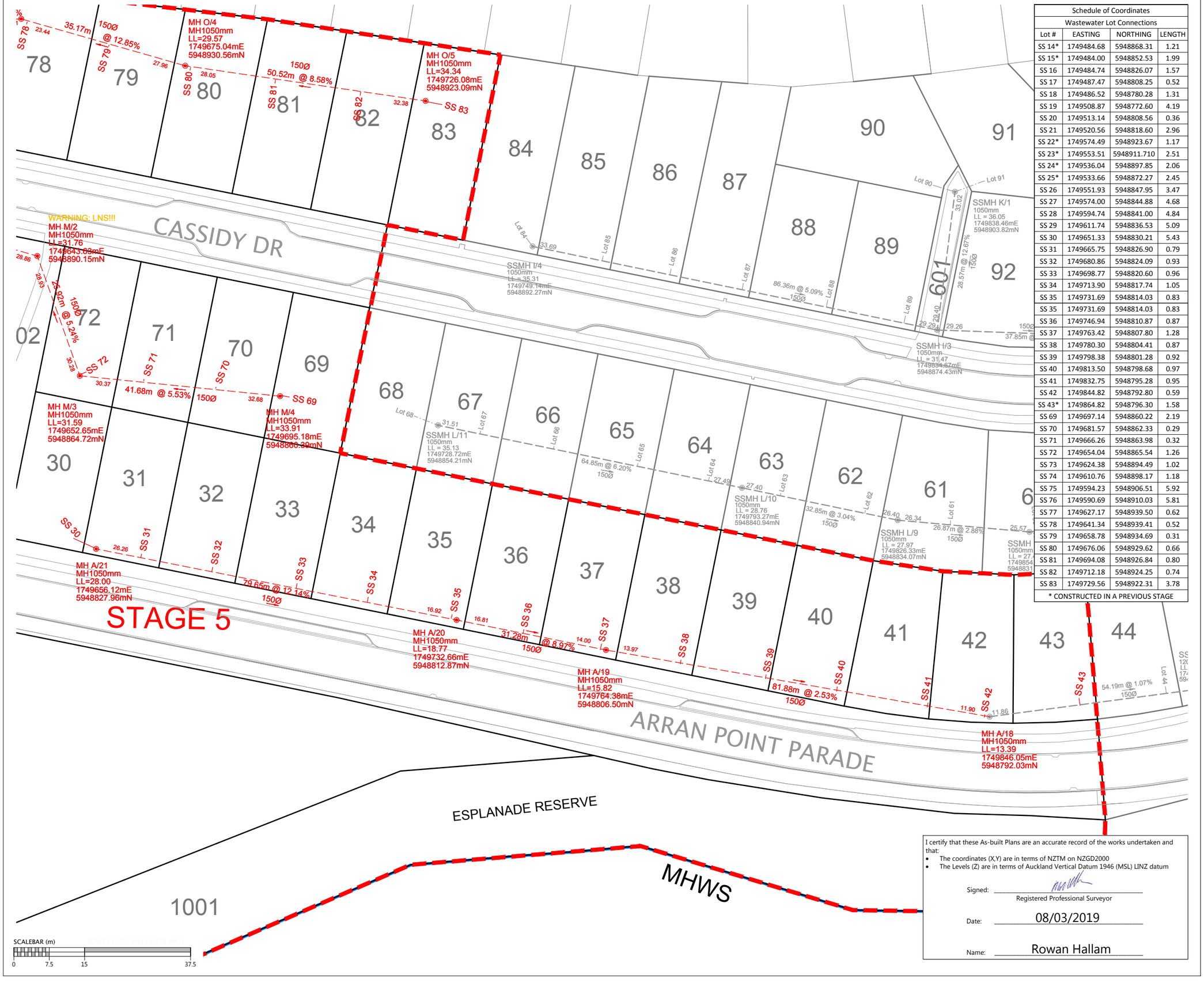
WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

WASTEWATER AS-BUILT
SHEET 2 OF 4

STATUS	AS BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-401-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-400-AB-SEWER.DWG



Schedule of Coordinates			
Wastewater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SS 14*	1749484.68	5948868.31	1.21
SS 15*	1749484.00	5948852.53	1.99
SS 16	1749484.74	5948826.07	1.57
SS 17	1749487.47	5948808.25	0.52
SS 18	1749486.52	5948780.28	1.31
SS 19	1749508.87	5948772.60	4.19
SS 20	1749513.14	5948808.56	0.36
SS 21	1749520.56	5948818.60	2.96
SS 22*	1749574.49	5948923.67	1.17
SS 23*	1749553.51	5948911.710	2.51
SS 24*	1749536.04	5948897.85	2.06
SS 25*	1749533.66	5948872.27	2.45
SS 26	1749551.93	5948847.95	3.47
SS 27	1749574.00	5948844.88	4.68
SS 28	1749594.74	5948841.00	4.84
SS 29	1749611.74	5948836.53	5.09
SS 30	1749651.33	5948830.21	5.43
SS 31	1749665.75	5948826.90	0.79
SS 32	1749680.86	5948824.09	0.93
SS 33	1749698.77	5948820.60	0.96
SS 34	1749713.90	5948817.74	1.05
SS 35	1749731.69	5948814.03	0.83
SS 35	1749731.69	5948814.03	0.83
SS 36	1749746.94	5948810.87	0.87
SS 37	1749763.42	5948807.80	1.28
SS 38	1749780.30	5948804.41	0.87
SS 39	1749798.38	5948801.28	0.92
SS 40	1749813.50	5948798.68	0.97
SS 41	1749832.75	5948795.28	0.95
SS 42	1749844.82	5948792.80	0.59
SS 43*	1749864.82	5948796.30	1.58
SS 69	1749697.14	5948860.22	2.19
SS 70	1749681.57	5948862.33	0.29
SS 71	1749666.26	5948863.98	0.32
SS 72	1749654.04	5948865.54	1.26
SS 73	1749624.38	5948894.49	1.02
SS 74	1749610.76	5948898.17	1.18
SS 75	1749594.23	5948906.51	5.92
SS 76	1749590.69	5948910.03	5.81
SS 77	1749627.17	5948939.50	0.62
SS 78	1749641.34	5948939.41	0.52
SS 79	1749658.78	5948934.69	0.31
SS 80	1749676.06	5948929.62	0.66
SS 81	1749694.08	5948926.84	0.80
SS 82	1749712.18	5948924.25	0.74
SS 83	1749729.56	5948922.31	3.78
* CONSTRUCTED IN A PREVIOUS STAGE			

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: 08/03/2019

Name: Rowan Hallam

WOODS
Est.1970

LEGEND

- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER
- EXISTING SANITARY SEWER
- REVISED INVERT LEVEL 19.17

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	KR	08/03/19

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

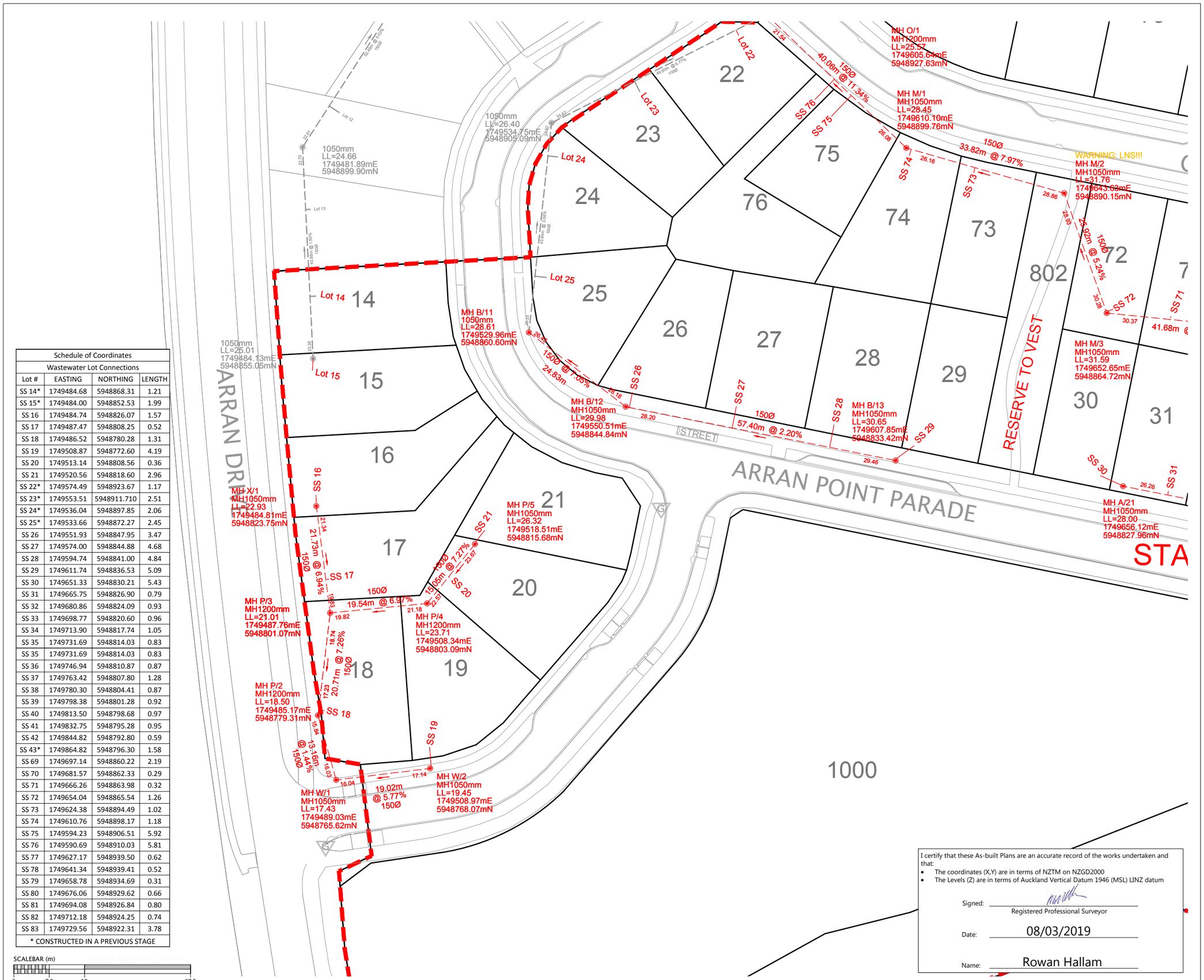
WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

WASTEWATER AS-BUILT
SHEET 3 OF 4

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-402-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-400-AB-SEWER.DWG



Schedule of Coordinates			
Wastewater Lot Connections			
Lot #	EASTING	NORTHING	LENGTH
SS 14*	1749484.68	5948868.31	1.21
SS 15*	1749484.00	5948852.53	1.99
SS 16	1749484.74	5948826.07	1.57
SS 17	1749487.47	5948808.25	0.52
SS 18	1749486.52	5948780.28	1.31
SS 19	1749508.87	5948772.60	4.19
SS 20	1749513.14	5948808.56	0.36
SS 21	1749520.56	5948818.60	2.96
SS 22*	1749574.49	5948923.67	1.17
SS 23*	1749553.51	5948911.710	2.51
SS 24*	1749536.04	5948897.85	2.06
SS 25*	1749533.66	5948872.27	2.45
SS 26	1749551.93	5948847.95	3.47
SS 27	1749574.00	5948844.88	4.68
SS 28	1749594.74	5948841.00	4.84
SS 29	1749611.74	5948836.53	5.09
SS 30	1749651.33	5948830.21	5.43
SS 31	1749665.75	5948826.90	0.79
SS 32	1749680.86	5948824.09	0.93
SS 33	1749698.77	5948820.60	0.96
SS 34	1749713.90	5948817.74	1.05
SS 35	1749731.69	5948814.03	0.83
SS 35	1749731.69	5948814.03	0.83
SS 36	1749746.94	5948810.87	0.87
SS 37	1749763.42	5948807.80	1.28
SS 38	1749780.30	5948804.41	0.87
SS 39	1749798.38	5948801.28	0.92
SS 40	1749813.50	5948798.68	0.97
SS 41	1749832.75	5948795.28	0.95
SS 42	1749844.82	5948792.80	0.59
SS 43*	1749864.82	5948796.30	1.58
SS 69	1749697.14	5948860.22	2.19
SS 70	1749681.57	5948862.33	0.29
SS 71	1749666.26	5948863.98	0.32
SS 72	1749654.04	5948865.54	1.26
SS 73	1749624.38	5948894.49	1.02
SS 74	1749610.76	5948898.17	1.18
SS 75	1749594.23	5948906.51	5.92
SS 76	1749590.69	5948910.03	5.81
SS 77	1749627.17	5948939.50	0.62
SS 78	1749641.34	5948939.41	0.52
SS 79	1749658.78	5948934.69	0.31
SS 80	1749676.06	5948929.62	0.66
SS 81	1749694.08	5948926.84	0.80
SS 82	1749712.18	5948924.25	0.74
SS 83	1749729.56	5948922.31	3.78
* CONSTRUCTED IN A PREVIOUS STAGE			

SCALEBAR (m)

SCALE | 1:750 @A3 | 1:375 @A1

0 7.5 15 37.5

WOODS
EST.1970

LEGEND

NEW SANITARY SEWER MANHOLE	◉
NEW SANITARY SEWER	– – –
EXISTING SANITARY SEWER	———
REVISED INVERT LEVEL	19.17

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	KR	08/03/19

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: 08/03/2019

Name: Rowan Hallam

SURVEYED	WOODS	8 Nugent St Grafton Auckland
DESIGNED	MB	
DRAWN	SK	
CHECKED	NC	
APPROVED	RH	WOODS.CO.NZ

N

WFH PROPERTIES

MILLWATER
ARRAN POINT
STAGE 5

WASTEWATER AS-BUILT
SHEET 4 OF 4

STATUS	AS-BUILT	REV
SCALE	1:750 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	37005-05-403-AB	

Document No. K:\37005 - ARRAN HILL PRECINCT 7 STAGE 5\DRAWINGS\SURV\ASBUILT\37005-05-400-AB-SEWER.DWG

Appendix A2: T+T Drawings

- **21854.0037–APP7S5–100** **Drawing List and Site Location Plan**
- **21854.0037–APP7S5–101** **Geotechnical Works Plan**
- **21854.0037–APP7S5–102** **Geotechnical Works Subsoil Drain Plan**
- **21854.0037–APP7S5–103** **Geological Cross Sections 1 & 2**
- **21854.0037–APP7S5–104** **Geological Cross Sections 3, 5 & 6**
- **21854.0037–APP7S5–105** **RE Slopes 3 and 4 Typical Details**
- **21854.0037–APP7S5–106** **Shear Key 1 Plan**
- **21854.0037–APP7S5–107** **Shear Key 1 Longsection**
- **21854.0037–APP7S5–108** **Geology Legend and Definition of Terms**
- **21854.0037–APP7S5–110** **Building Limitation Plan**

Allan Block Wall 01 Drawing:

- **21854.0037–S1–04** **Retaining Wall 01 Typical Cross Section Details**

Screen Block Wall 05 Drawings:

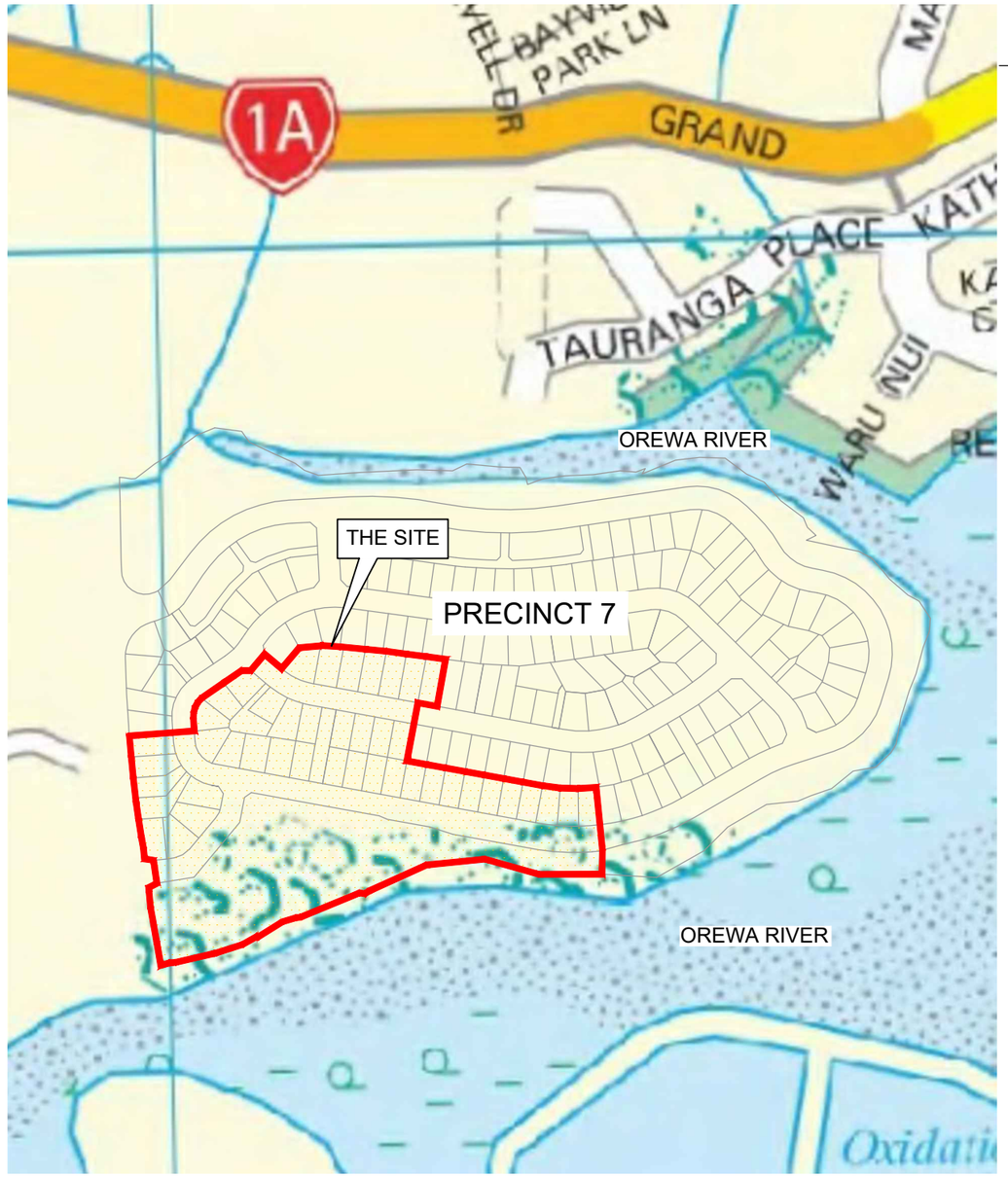
- **21854.0037–MBW5–04** **Retaining Wall 05 – Typical Cross Section (Sheet 1 of 3)**
- **21854.0037–MBW5–05** **Retaining Wall 05 – Typical Cross Section (Sheet 2 of 3)**
- **21854.0037–MBW5–06** **Retaining Wall 05 – Typical Cross Section (Sheet 3 of 3)**
- **21854.0037–MBW5–07** **Retaining Wall 05 – Typical Cross Section (6m<H<=7.3m)**
- **21854.0037–MBW5–08** **Retaining Wall 05 – Typical Cross Section (5m<H<=6m)**
- **21854.0037–MBW5–09** **Retaining Wall 05 – Typical Cross Section (3m<H<=5m)**
- **21854.0037–MBW5–10** **Retaining Wall 05 – Typical Cross Section (H<=3m)**

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-100.dwg 2019-Apr-08 9:27:43 AM Plotted By: JONALD CASTRO

WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION
MILLWATER-ARRANS POINT PRECINCT 7 (STAGE 5)
COMPLETION REPORT ISSUE

DRAWING	Rev	Title
GENERAL		
● 21854.0037-APP7S5-100	1	DRAWING LIST AND LOCATION PLAN
● 21854.0037-APP7S5-101	1	GEOTECHNICAL WORKS PLAN
● 21854.0037-APP7S5-102	1	GEOTECHNICAL WORKS SUBSOIL DRAIN PLAN
● 21854.0037-APP7S5-103	1	GEOLOGICAL CROSS SECTIONS 1 & 2
● 21854.0037-APP7S5-104	1	GEOLOGICAL CROSS SECTIONS 3, 5 & 6
● 21854.0037-APP7S5-105	1	RE SLOPES 3 AND 4 TYPICAL DETAILS
● 21854.0037-APP7S5-106	1	SHEAR KEY 1 PLAN
● 21854.0037-APP7S5-107	1	SHEAR KEY 1 LONGSECTION
● 21854.0037-APP7S5-108	1	GEOLOGY LEGEND AND DEFINITION OF TERMS
● 21854.0037-APP7S5-110	1	BUILDING LIMITATION PLAN
APPENDIX E		
● 21854.0037-APP7S5-111	1	POST EARTHWORKS INVESTIGATION PLAN
● 21854.0037-APP7S5-112	1	TOPSOIL DEPTHS PLAN
● 21854.0037-APP7S5-113	1	EARTHWORKS TESTING LOCATION PLAN

● Denotes drawing this issue: 08/04/2019



STREET MAP SOURCED FROM LAND INFORMATION NEW ZEALAND DATA (CROWN COPYRIGHT RESERVED).

LOCATION PLAN
SCALE 1:5000

A3 SCALE 1:5000
0 50 100 150 200 250 (m)

ORIGINAL IN COLOUR

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

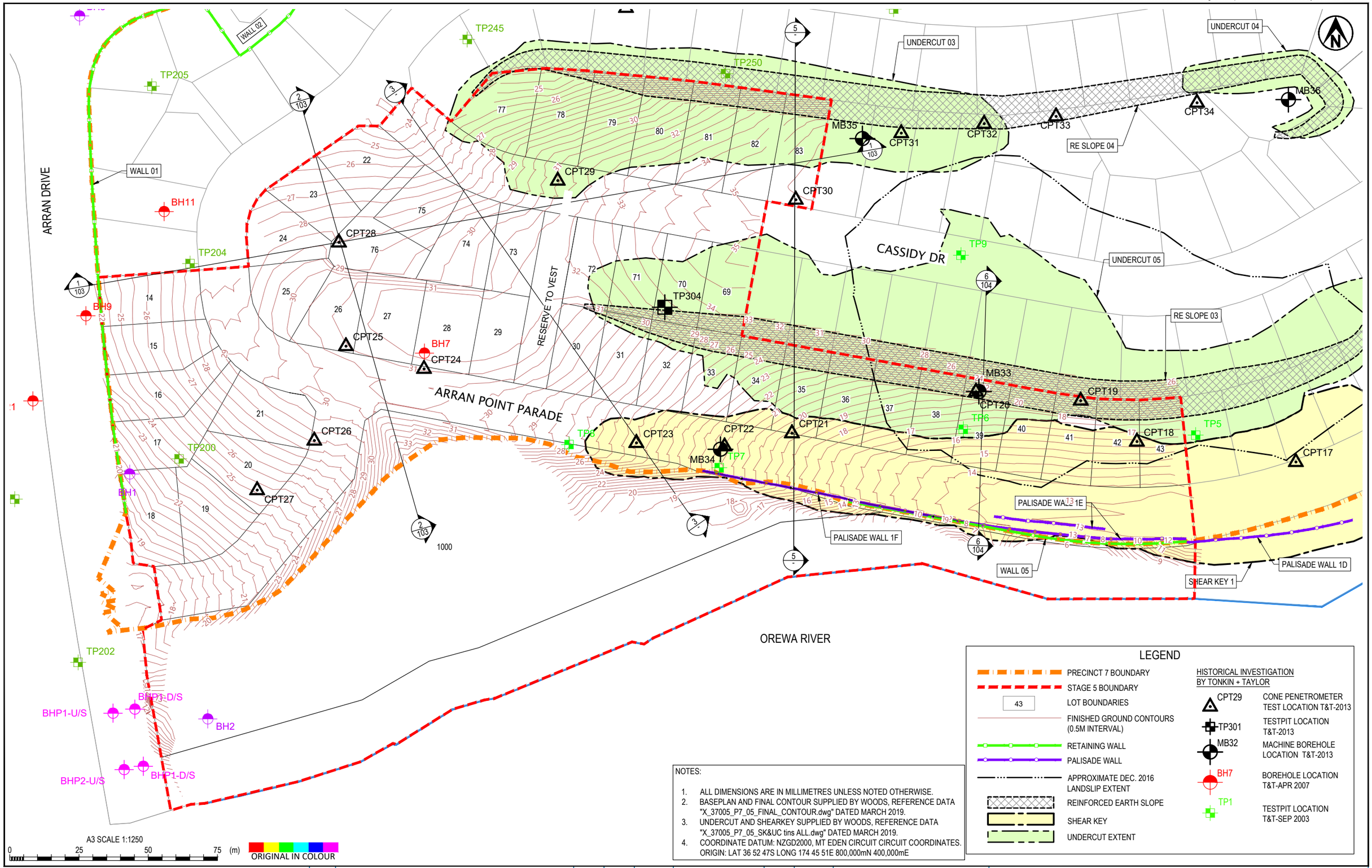
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS
DRAWN	JC	Mar.19	COMPLETION REPORT
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**
PROJECT **RESIDENTIAL SUBDIVISION**
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) DRAWING LIST AND LOCATION PLAN
SCALE (A3) 1:5000 DWG No. 21854.0037-APP7S5-100 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-101.dwg 2019-Apr-08 9:36:41 AM Plotted By: JONALD CASTRO



LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- APPROXIMATE DEC. 2016 LANDSLIP EXTENT
- REINFORCED EARTH SLOPE
- SHEAR KEY
- UNDERCUT EXTENT

HISTORICAL INVESTIGATION BY TONKIN + TAYLOR

- CPT29 CONE PENETROMETER TEST LOCATION T&T-2013
- TP301 TESTPIT LOCATION T&T-2013
- MB32 MACHINE BOREHOLE LOCATION T&T-2013
- BH7 BOREHOLE LOCATION T&T-APR 2007
- TP1 TESTPIT LOCATION T&T-SEP 2003

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) GEOTECHNICAL WORKS PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-101 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-102.dwg 2019-Apr-08 9:28:11 AM Plotted By: JONALD CASTRO

ARRAN DRIVE

WALL 01

WALL 02

UNDERCUT 03

UNDERCUT 04

UNDERCUT 05

RE SLOPE 04

RE SLOPE 03

CASSIDY DR

RESERVE TO VEST

ARRAN POINT PARADE

PALISADE WALL 1F

WALL 05

PALISADE WALL 1E

PALISADE WALL 1D

SHEAR KEY 1

1000

OREWA RIVER

ORIGINAL IN COLOUR

LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- REINFORCED EARTH SLOPE
- SHEAR KEY
- UNDERCUT EXTENT
- SUBSOIL DRAIN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

APPROVED DATE

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

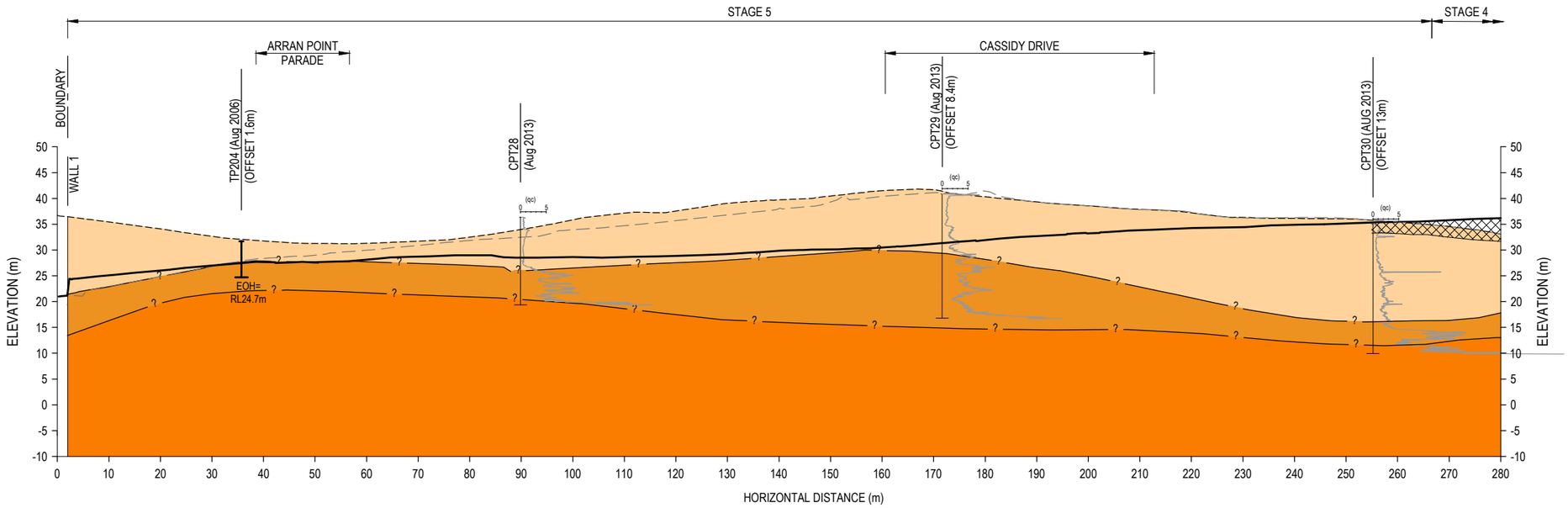
CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

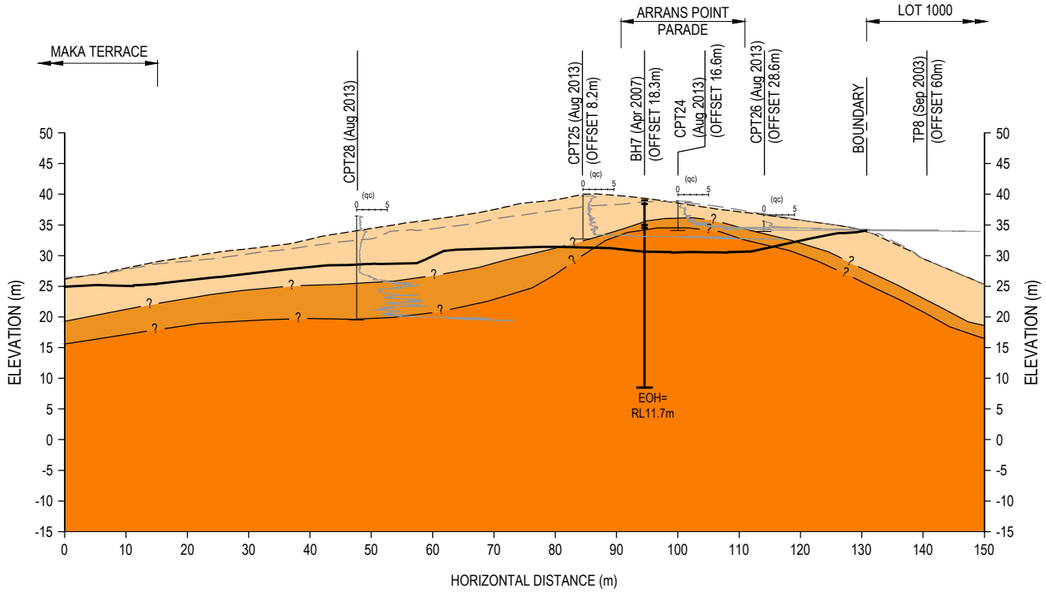
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) GEOTECHNICAL WORKS SUBSOIL DRAIN PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-102 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-103.dwg 2019-Apr-11 3:51:11 PM Plotted By: JONALD CASTRO



SECTION 1 / 101
SCALE 1: 1000



SECTION 2 / 101
SCALE 1: 1000

LEGEND

- ORIGINAL 2009 GROUND PROFILE
- 2015 GROUND PROFILE
- STAGE 5 FINISHED GROUND LEVEL
- INFERRED GEOLOGICAL BOUNDARY
- SHEARKEY/UNDERCUTS
- ENGINEERED FILL
- COLLUVIUM
- RESIDUAL SOILS/ COMPLETELY WEATHERED ECBF
- HIGHLY TO SLIGHTLY WEATHERED ECBF
- SLIGHTLY WEATHERED TO UNWEATHERED ECBF

GEOLOGICAL SECTIONS ARE AN INTERPRETATION OF THE INVESTIGATION DATA WHICH IS AVAILABLE ONLY AT DISCRETE LOCATIONS. ADDITIONAL PALEO-VALLEYS AND VARIABILITY IN SOIL LAYERS AND ECBF ROCK INTERFACE MAY BE PRESENT IN AREAS BETWEEN TEST LOCATIONS.

A3 SCALE 1:1000
0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

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

REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

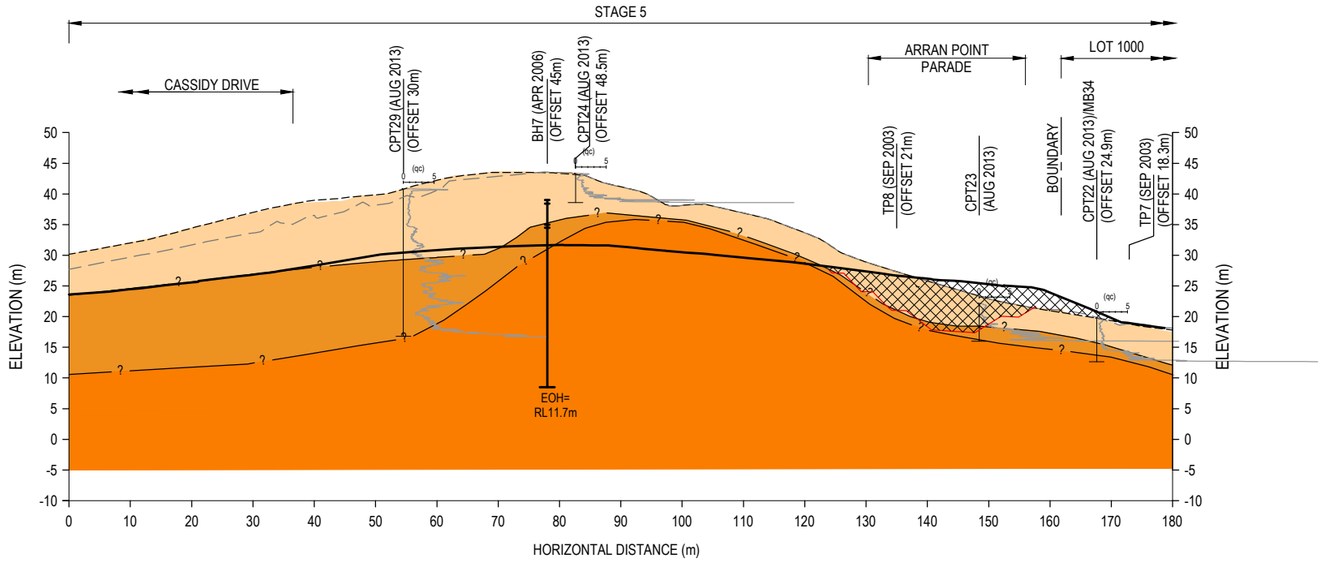
DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

APPROVED _____ DATE _____

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

CLIENT **WFH PROPERTIES LTD**
PROJECT **RESIDENTIAL SUBDIVISION**
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) GEOLOGICAL CROSS SECTIONS 1 & 2
SCALE (A3) 1:1000 DWG No. 21854.0037-APP7S5-103 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-103.dwg 2019-Apr-11 3:51:11 PM Plotted By: JONALD CASTRO

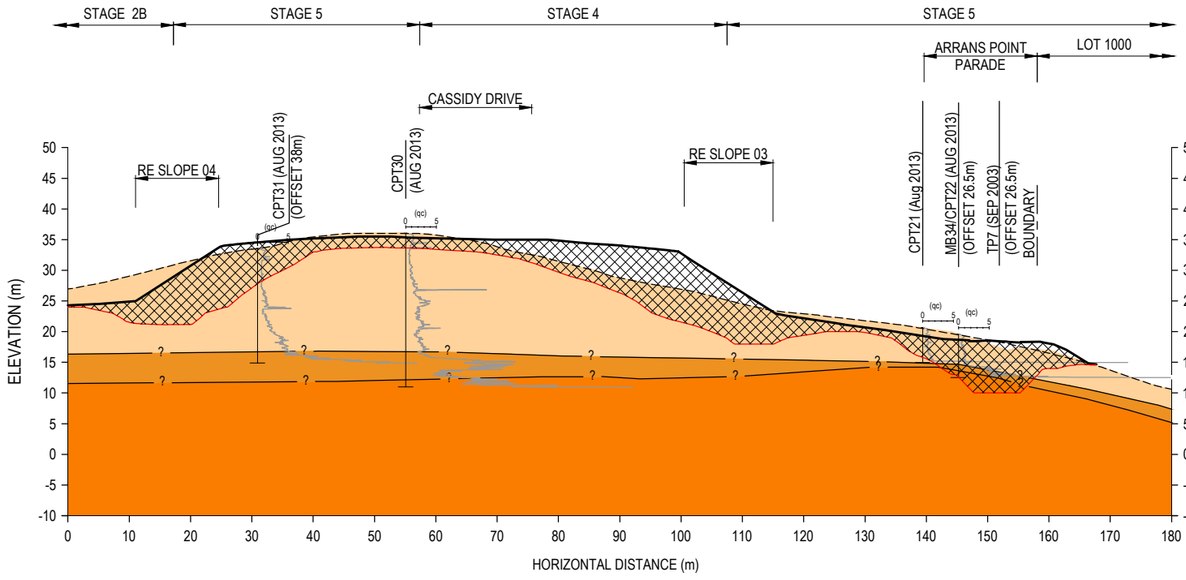


SECTION 3
SCALE 1: 1000 101

LEGEND

- ORIGINAL 2009 GROUND PROFILE
- 2015 GROUND PROFILE
- STAGE 5 FINISHED GROUND LEVEL
- ? INFERRED GEOLOGICAL BOUNDARY
- SHEARKEY/UNDERCUTS
- ENGINEERED FILL
- COLLUVIUM
- RESIDUAL SOILS/ COMPLETELY WEATHERED ECBF
- HIGHLY TO SLIGHTLY WEATHERED ECBF
- SLIGHTLY WEATHERED TO UNWEATHERED ECBF

GEOLOGICAL SECTIONS ARE AN INTERPRETATION OF THE INVESTIGATION DATA WHICH IS AVAILABLE ONLY AT DISCRETE LOCATIONS. ADDITIONAL PALEO-VALLEYS AND VARIABILITY IN SOIL LAYERS AND ECBF ROCK INTERFACE MAY BE PRESENT IN AREAS BETWEEN TEST LOCATIONS.



SECTION 5
SCALE 1: 1000 101

SECTION 6
SCALE 1: 1000 101

A3 SCALE 1:1000
0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

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

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

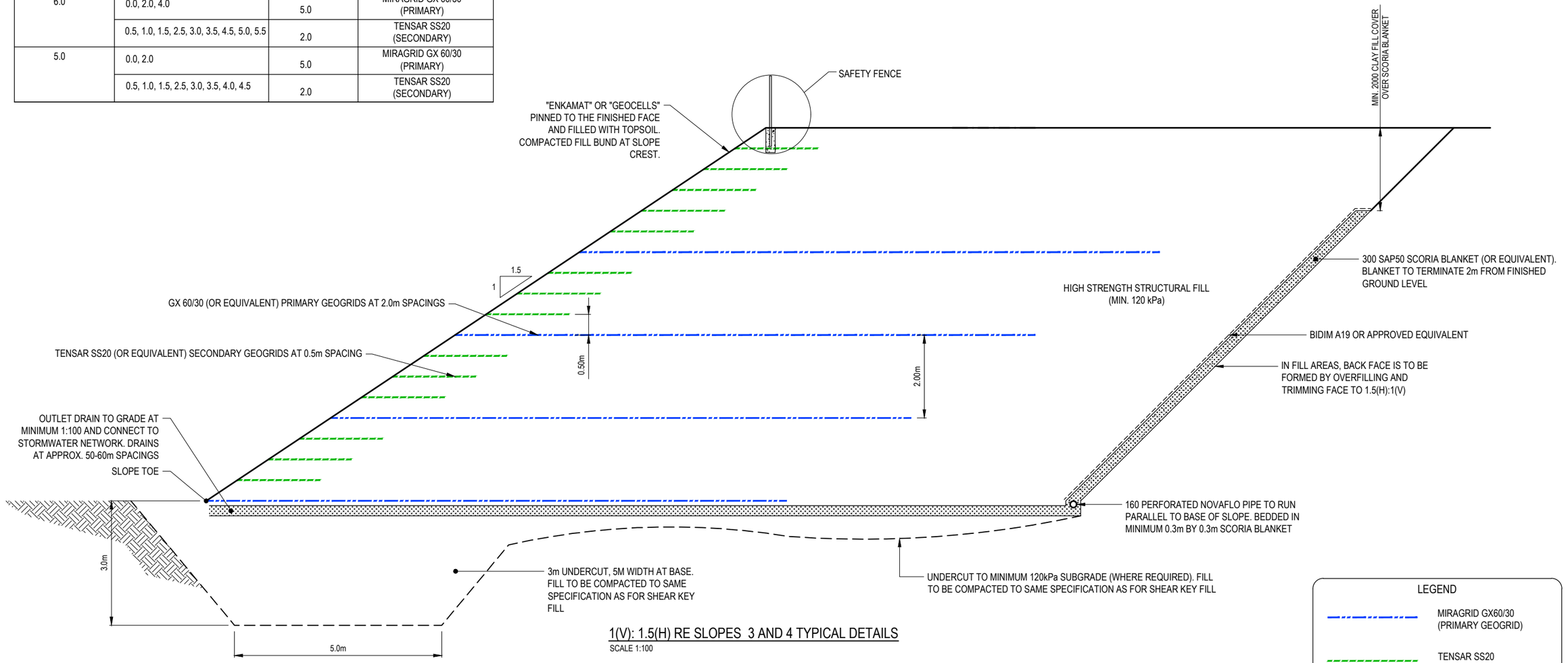
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5)
GEOLOGICAL CROSS SECTIONS 3, 5 & 6

SCALE (A3) 1:1000 DWG No. 21854.0037-APP7S5-104 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-105.dwg 2019-Apr-08 9:28:27 AM Plotted By: JONALD CASTRO

GEOGRIDS REQUIREMENTS FOR A 1.5:1 (H:V) REINFORCED EARTH SLOPE

SLOPE HEIGHTS (m)	GEOGRID REQUIREMENTS		
	HEIGHT ABOVE SLOPE TOE (m)	GEOGRID LENGTH (m)	GEOGRID TYPE
9.0	0.0, 2.0, 4.0, 6.0	14.0	MIRAGRID GX 60/30 (PRIMARY)
	0.5, 1.0, 1.5, 2.5, 3.0, 3.5, 4.5, 5.0, 5.5, 6.5, 7.0, 7.5, 8.0, 8.5	2.0	TENSAR SS20 (SECONDARY)
8.0	0.0, 2.0, 4.0, 6.0	12.0	MIRAGRID GX 60/30 (PRIMARY)
	0.5, 1.0, 1.5, 2.5, 3.0, 3.5, 4.5, 5.0, 5.5, 6.5, 7.0, 7.5	2.0	TENSAR SS20 (SECONDARY)
7.0	0.0, 2.0, 4.0	7.0	MIRAGRID GX 60/30 (PRIMARY)
	0.5, 1.0, 1.5, 2.5, 3.0, 3.5, 4.5, 5.0, 5.5, 6.0, 6.5	2.0	TENSAR SS20 (SECONDARY)
6.0	0.0, 2.0, 4.0	5.0	MIRAGRID GX 60/30 (PRIMARY)
	0.5, 1.0, 1.5, 2.5, 3.0, 3.5, 4.5, 5.0, 5.5	2.0	TENSAR SS20 (SECONDARY)
5.0	0.0, 2.0	5.0	MIRAGRID GX 60/30 (PRIMARY)
	0.5, 1.0, 1.5, 2.5, 3.0, 3.5, 4.0, 4.5	2.0	TENSAR SS20 (SECONDARY)



1(V): 1.5(H) RE SLOPES 3 AND 4 TYPICAL DETAILS

SCALE 1:100

A3 SCALE 1:100

0 1 2 3 4 5 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

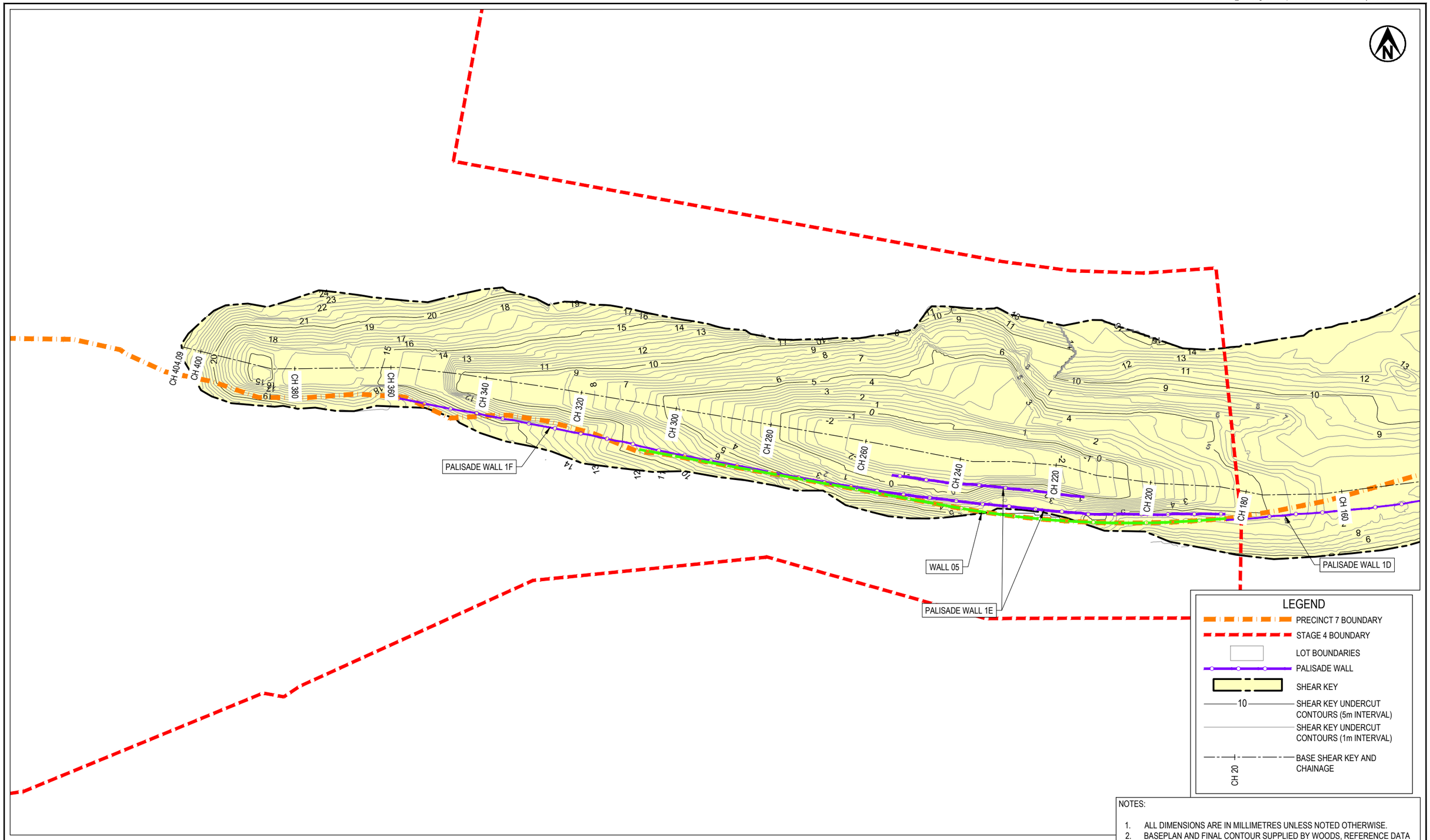
CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) RE SLOPES 3 AND 4 TYPICAL DETAILS

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-105 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-106_107.dwg 2019-Apr-11 2:43:50 PM Plotted By: JONALD CASTRO



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

SHEAR KEY 01 PLAN

SCALE 1:500

A3 SCALE 1:750

0 5 10 15 20 25 30 35 40 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS
DRAWN	JC	Mar.19	COMPLETION REPORT
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

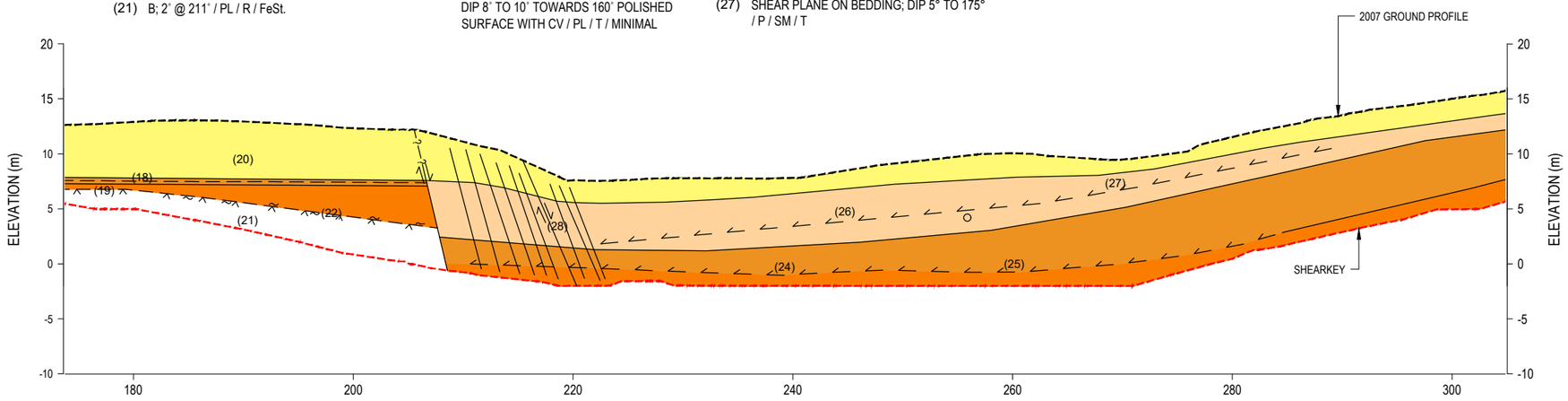
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) SHEAR KEY 1 PLAN

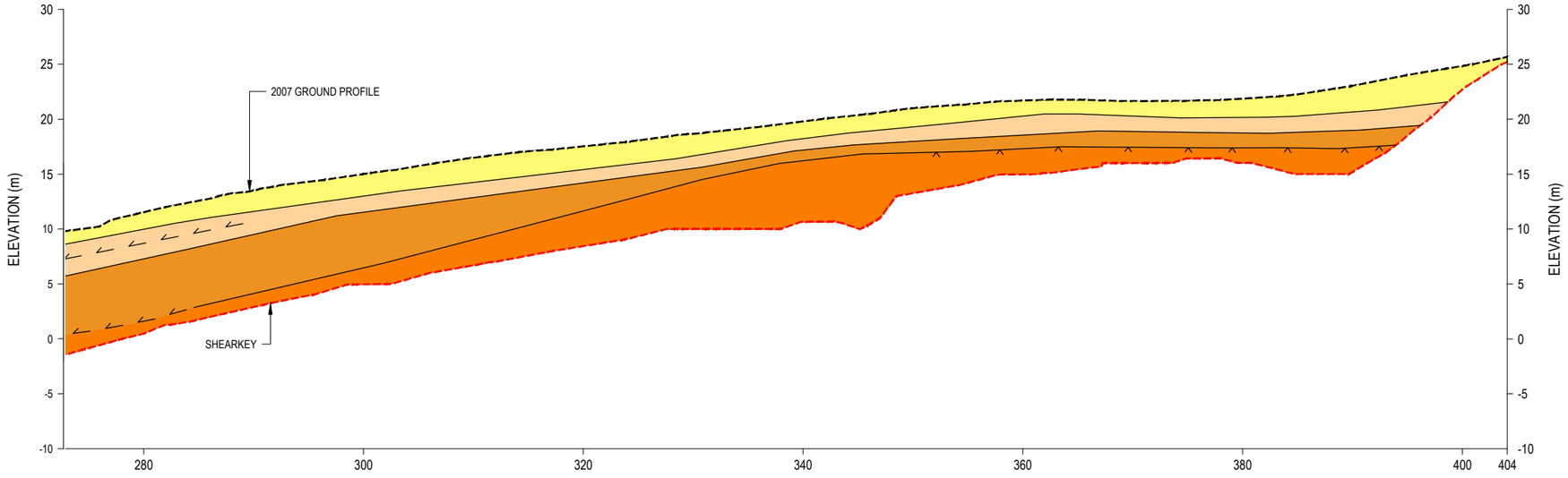
SCALE (A3) 1:750 DWG No. 21854.0037-APP7S5-106 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-106_107.dwg 2019-Apr-11 2:43:50 PM Plotted By: JONALD CASTRO

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. REFER TO DWG.21854.0037-APP7S4-109 FOR GEOLOGY LEGEND AND DEFINITION OF TERMS.
3. NATURE AND CONTINUITY OF SUBSOIL CONDITIONS AWAY FROM THESE BOREHOLES ARE INFERRED AND IT MUST BE APPRECIATED THAT ACTUAL CONDITIONS COULD VARY FROM THE ASSUMED MODEL.

(18) SHEAR PLANE; 2-5° @ 198-215° / UN / R / FeSt.
(19) SHEAR PLANE; 4-17° @ 211-217° / UN / SM / CV (CLAY) / FeSt.
(20) B; 2° @ 215° / UN / R / CN.
(21) B; 2° @ 211° / PL / R / FeSt.
(22) SHEAR PLANE; 11° @ 137° / PL / SM / CV (CLAY) / SLOW SEEPAGE.
(23) B; 9° @ 189° / PL / R / FeSt.
(24) SHEAR PLANE IN ROCK, ON BEDDING PLANE. DIP 8° TO 10° TOWARDS 160° POLISHED SURFACE WITH CV / PL / T / MINIMAL
(25) BEDDING PLANE; DIP 6° TO 180°/ PL / SM / T
(26) SHEAR PLANE ON BEDDING; DIP 6-9° TOWARDS 180° /POLISHED SURFACE, STRIATIONS TO 180° TIGHT TO SLIGHTLY OPEN
(27) SHEAR PLANE ON BEDDING; DIP 5° TO 175° / P / SM / T
(28) FAULT. DIP 80° TO 230°, MULTIPLE PARALLEL JOINTS. BROKEN FABRIC, OPEN SOME CLAY VENEER.





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

ORIGINAL IN COLOUR

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

REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

APPROVED _____ DATE _____

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

CLIENT **WFH PROPERTIES LTD**
PROJECT **RESIDENTIAL SUBDIVISION**
TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5)
SHEAR KEY 1 LONGSECTION
SCALE (A3) 1:500 DWG No. 21854.0037-APP7S5-107 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-108.dwg 2019-Apr-08 9:28:45 AM Plotted By: JONALD CASTRO

LONGSECTION MATERIAL LEGEND

- COLLUVIUM
  LANDSLIP DEBRIS TYPICALLY COMPOSED OF EAST COAST BAYS FORMATION SOILS
- EAST COAST BAYS FORMATION SOILS
  STIFF TO VERY STIFF SILTY CLAY, CLAYEY SILT AND MINOR SILTY SAND, MOIST TO WET, LIGHT YELLOW TO LIGHT GREY
- MW EAST COAST BAYS FORMATION
  MODERATELY WEATHERED ECBF, SILTY CLAY AND CLAYEY SILT, MINOR SILTY SAND, VERY STIFF, WET, DARK GREY, THINLY BEDDED
- SW-UW EAST COAST BAYS FORMATION
  SLIGHTLY TO UNWEATHERED ECBF. INTERBEDDED SANDSTONE, SILTSTONE AND MUDSTONE.
  SANDSTONE, SILTY, VERY WEAK, DARK GREY.
  SILTSTONE AND MUDSTONE, EXTREMELY WEAK TO VERY WEAK, DARK GREY
- ENGINEERED FILL
- GROUNDWATER SEEPAGE
- SHEAR SURFACE
- EXISTING GROUND LEVEL
- UNDERCUT LEVEL
- BEDDING FEATURE

DEFECT CODE LEGEND

SHAPE

TERM	CODE
PLANAR	PL
SLIGHTLY CURVED	SC
CURVED	CV
IRREGULAR	IR
STEPPED	ST
WAVY	WV
UNDULATING	UN

ROUGHNESS

DESCRIPTION OF JOINT SURFACE	CODE
SLICKENSIDED	SL
SMOOTH	SM
DEFINED RIDGES	DR
SMALL STEPS	ST
ROUGH	R
VERY ROUGH	VR

APERTURE

TERM	SYMBOL	DESCRIPTION (SEPERATION)
VERY TIGHT	VT	LESS THAN 0.1mm
TIGHT	T	0.1 TO 1.0mm
OPEN	O	1.0 TO 10.0mm
VERY OPEN	VO	MORE THAN 10mm
VERY NARROW	VN	
MODERATELY NARROW	MN	
NARROW	N	

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:

(3) J60/152°, PL, SL, T, CV, STIFF GREEN CLAY

- NO. IN DEFECT SET
- TYPE
- DIP ANGLE
- DIP DIRECTION
- SHAPE
- ROUGHNESS
- APERTURE
- INFILLING/COATING TYPE
- INFILLING DESCRIPTION (AS PER SOIL DESCRIPTION)

ORIGINAL IN COLOUR

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

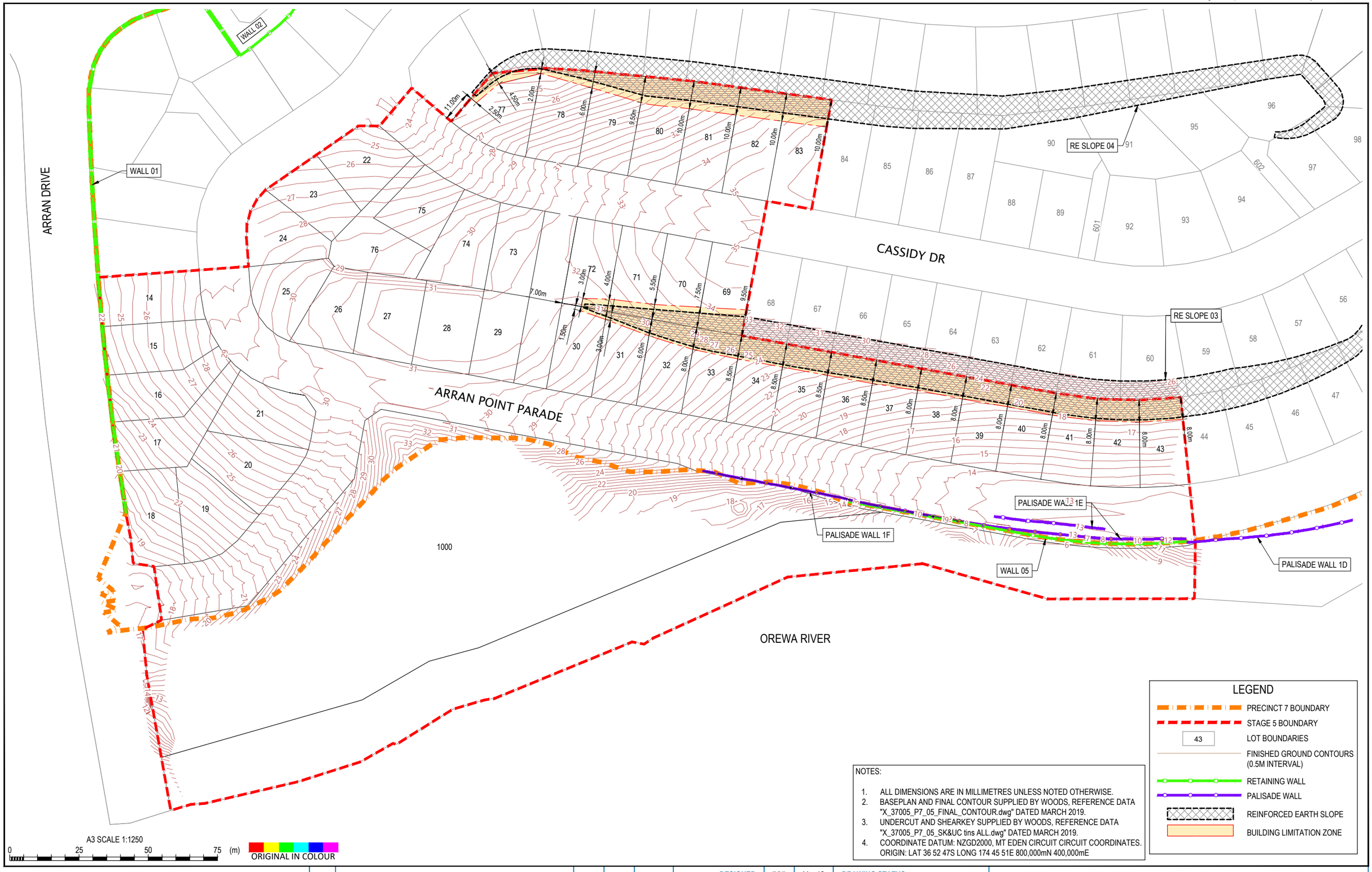
CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) GEOLOGY LEGEND AND DEFINITION OF TERMS

SCALE (A3) 1:1000 DWG No. 21854.0037-APP7S5-108 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-110.dwg 2019-Apr-11 3:51:20 PM Plotted By: JONALD CASTRO



LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- REINFORCED EARTH SLOPE
- BUILDING LIMITATION ZONE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	COMPLETION REPORT ISSUE			

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

APPROVED DATE

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) BUILDING LIMITATION PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-110 REV 1

TABLE 1: Reinforcement Details

Retained Height 'H' (m)	Geogrid Type	Min Geogrid Length 'L' (m)	Max. Vertical Spacing 'S' (m)
1.0 – 3.0	Tensar RE540	3.0	0.4

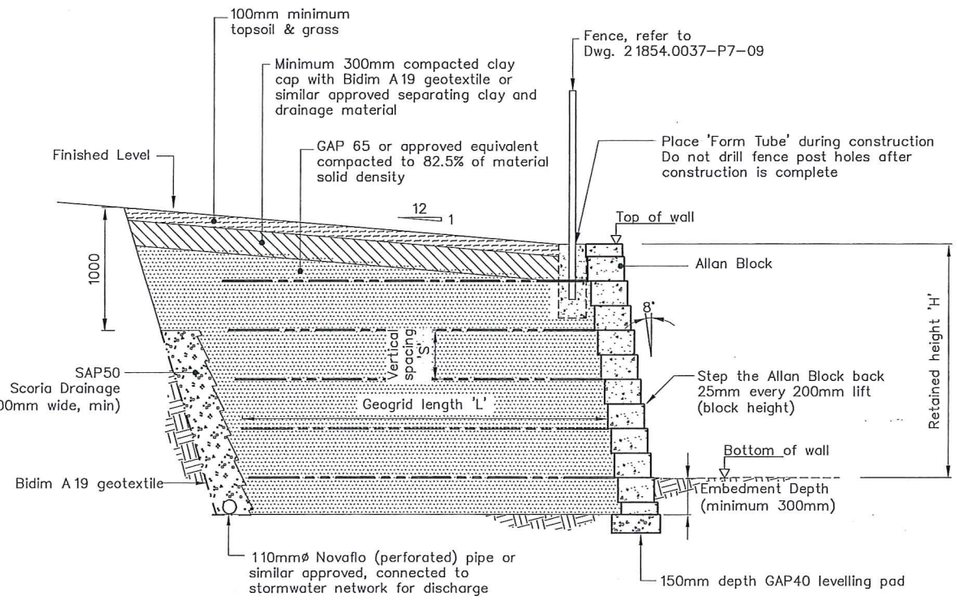
NOTE: Refer to Table 2 for walls with retained height less than 1m

TABLE 2: Minimum wall width for walls ≤1m height

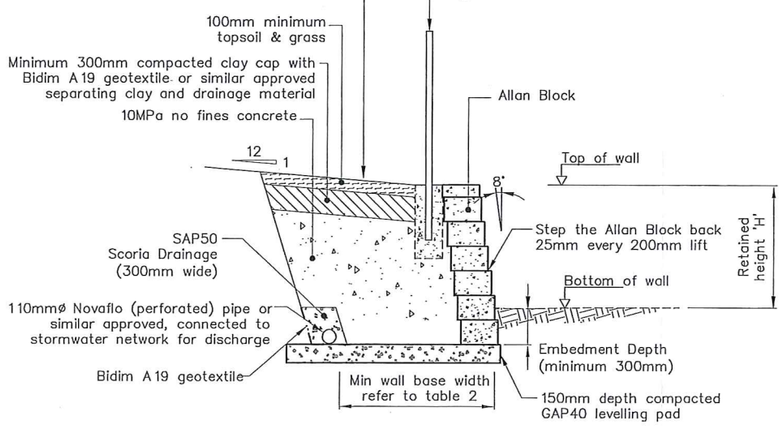
Reinforced height 'H' (m)	Min. base width (m)
< 0.5	1.1
0.5 – 1.0	1.4

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. See Drawing 21854.0037–P7–03 for long section.
3. Foundation to be inspected by T&T geotechnical engineer. The subgrade material shall have minimum undrained shear strength of greater than 120 kPa
4. The bottom geogrid layer shall start at finished ground level.
5. All fill shall be placed and compacted according to the construction specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with compacted, engineered fill.
8. Hard fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the hard fill to cascade onto the grids.
9. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the Allan Block. The plant used for compacting this zone shall be restricted to:–
   a) Vibrating rollers having a total mass not exceeding 1000kg
   b) Vibrating plate compactors having a total mass not exceeding 100kg
   c) Vibro tampers having a mass not exceeding 75kg
10. Density testing of backfill around grids is required (refer to Specification)
11. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of GAP65 fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of GAP65 fill on, or staking, the free end. They shall remain tensioned whilst the balance of GAP65 fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
12. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
13. Wall setout to be as provided by Woods and confirmed on site by the Engineer.



SECTION 2/04 SCALE 1:50 TYPICAL ALLAN BLOCK WALL (FOR WALLS > 1m HEIGHT)



DETAIL 3/04 SCALE 1:50 TYPICAL ALLAN BLOCK WALL (FOR WALLS <1m HEIGHT)

Engineering plans approved
20 NOV 2014
MB
R62000
Refer covering letter and ensure meeting held with council's Development Engineer prior to works commencing
Auckland Council

RDC 21438

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

DRAWING STATUS: DESIGN REPORT ISSUE

REVISION	DESCRIPTION	BY	DATE
0	Design Report Issue		

DESIGNED :	JKK	Nov. 14
DRAWN :	AGI	Nov. 14
DESIGN CHECKED :		
DRAFTING CHECKED :		
CADFILE : \\21854.0037–S1–04.dwg		
APPROVED :		

NOT FOR CONSTRUCTION
This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkin.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
RETAINING WALLS
Retaining Wall 01 Typical Cross Section Details

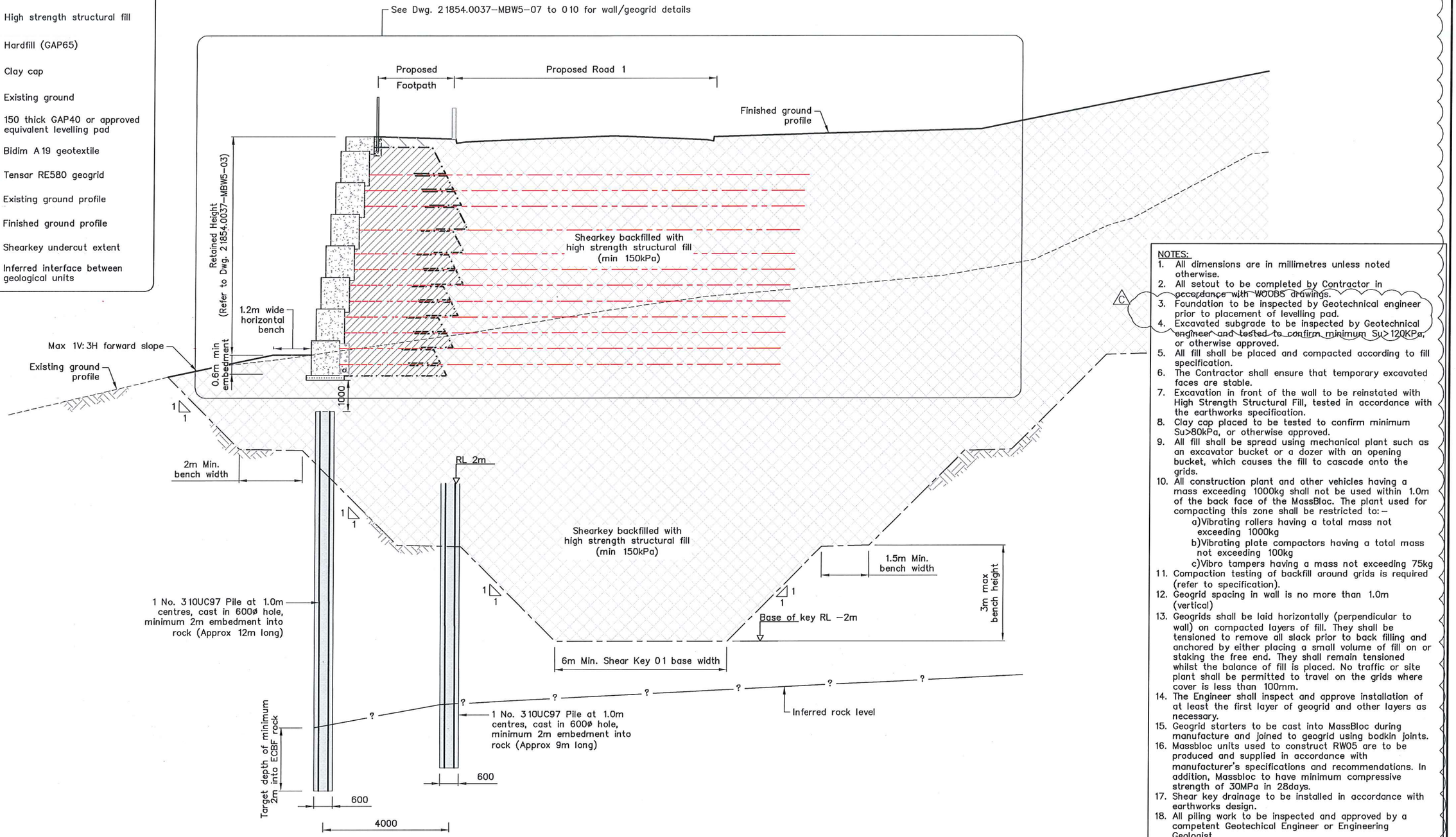
SCALES (AT A3 SIZE)	DWG. No.	REV.
AS SHOWN	21854.0037–S1–04	0

L:\21854\21854.0037\CAD\STAGE 1\21854.0037-S1-04.dwg, 04, 6/11/2014 9:36:31 a.m., agi

C

LEGEND

- High strength structural fill
- Hardfill (GAP65)
- Clay cap
- Existing ground
- 150 thick GAP40 or approved equivalent levelling pad
- Bidim A19 geotextile
- Tensar RE580 geogrid
- Existing ground profile
- Finished ground profile
- Shearkey undercut extent
- ? Inferred interface between geological units



NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOOD5 drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su> 120KPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:-
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

SECTION 1 / 03 TYPICAL CROSS SECTION (SHEAR KEY 1 & PALISADE WALL 3)
SCALE 1:125 CH 53.50m TO 93.83m

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

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REVISION	DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :		8/16
DRAFTING CHECKED :		8/16
CADFILE : \\21854.0037-MBW5-03_12.dwg		
APPROVED :		12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

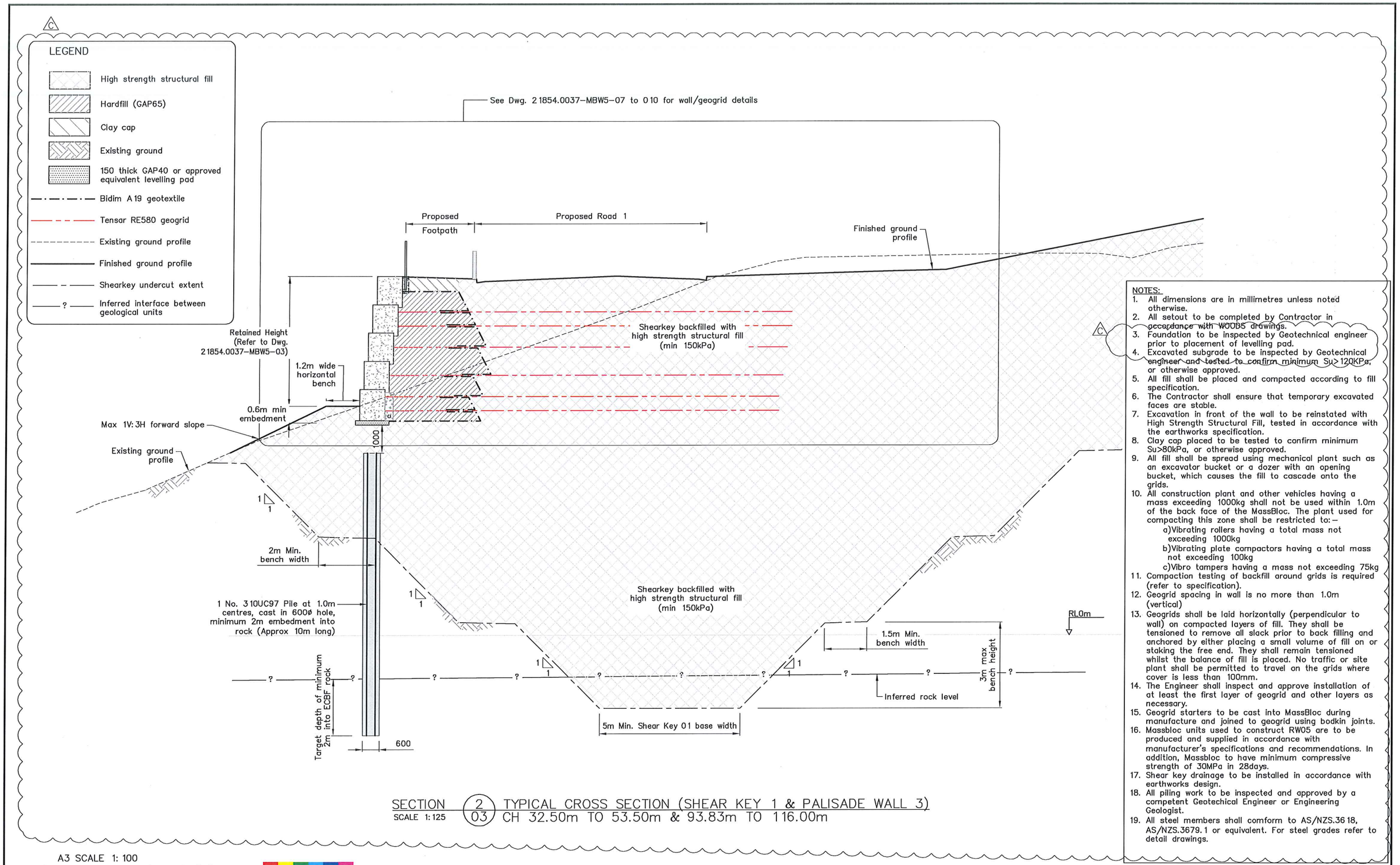
Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 - RETAINING WALL 05 C
Retaining Wall 05 - Typical Cross Section (Sheet 1 of 3)

SCALES (AT A3 SIZE)	DWG. No.	REV.
1: 125	21854.0037-MBW5-04	C

T:\Auckland\CAD\21854\21854.0037 - Arrans Point Precinct 7\CAD\P7 S2-RW5\21854.0037-MBW5-03_12.dwg, 04, 2/08/2016 11:10:42 a.m., dwm, 1:1



SECTION 2 03 TYPICAL CROSS SECTION (SHEAR KEY 1 & PALISADE WALL 3)
SCALE 1:125 CH 32.50m TO 53.50m & 93.83m TO 116.00m

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

ORIGINAL IN COLOUR

NOTES:
1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOOBS drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su> 120KPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

REVISION	DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :		10/16
DRAFTING CHECKED :		8/16
CADFILE : \\21854.0037-MBW5-03_12.dwg		
APPROVED :		12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

DRAWING STATUS: CONSTRUCTION ISSUE

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

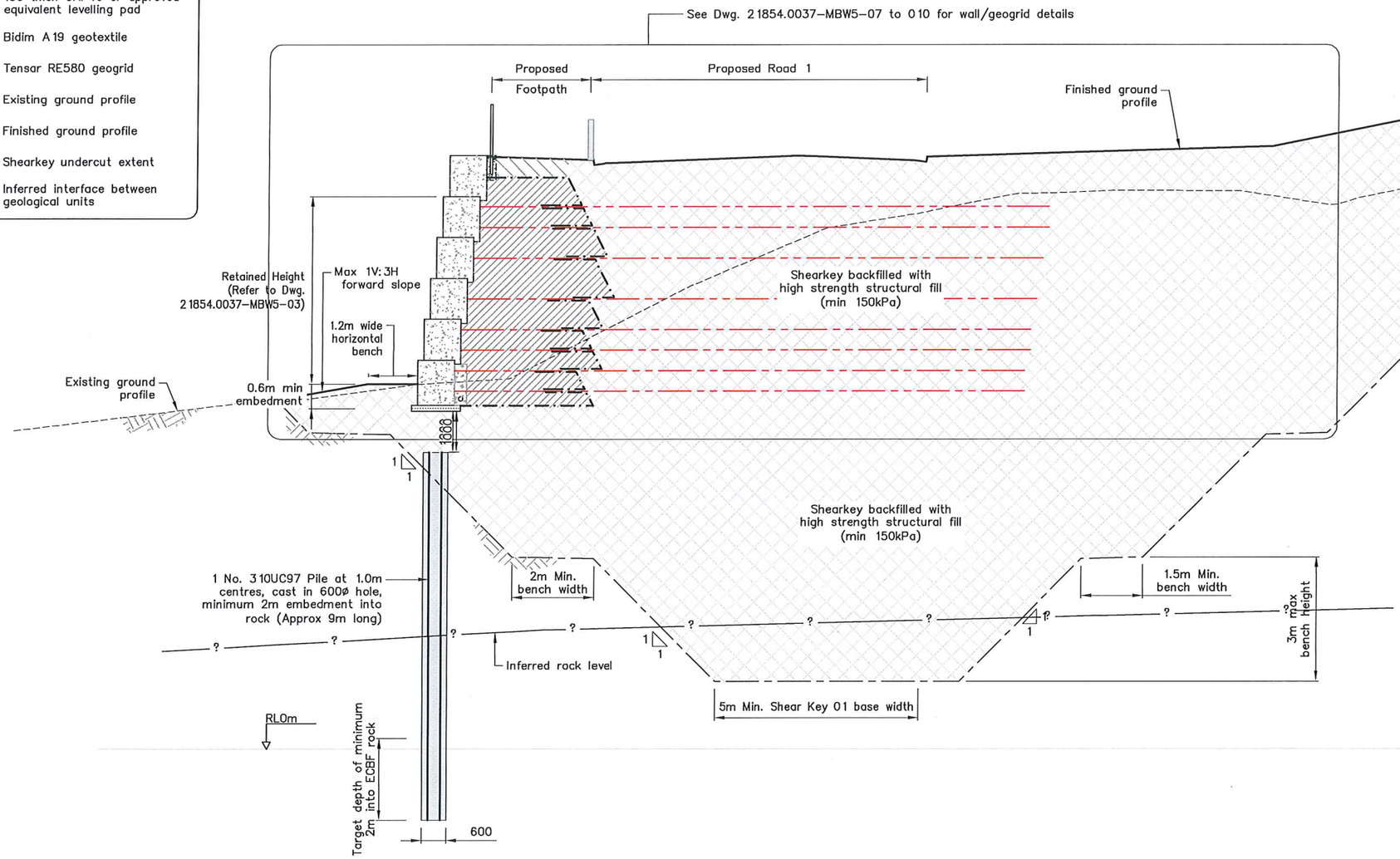
TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (Sheet 2 of 3)

SCALES (AT A3 SIZE)	DWG. NO.	REV.
1:125	21854.0037-MBW5-05	C

C

LEGEND

- High strength structural fill
- Hardfill (GAP65)
- Clay cap
- Existing ground
- 150 thick GAP40 or approved equivalent levelling pad
- Bidim A19 geotextile
- Tensar RE580 geogrid
- Existing ground profile
- Finished ground profile
- Shearkey undercut extent
- ? Inferred interface between geological units



SECTION 3 / 03 SCALE 1:125 — TYPICAL CROSS SECTION (SHEAR KEY 1 & PALISADE WALL 3)
CH 0.00m TO 32.50m & 116.00m TO 123.28m

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOOD5 drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su> 120KPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

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

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REVISION	DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :		8/16
DRAFTING CHECKED :		8/16
CADFILE : \\21854.0037-MBW5-03_12.dwg		
APPROVED :		12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (Sheet 3 of 3)

SCALES (AT A3 SIZE)	DWG. No.	REV.
1: 125	21854.0037-MBW5-06	C

T:\Auckland\CAD\21854\21854.0037 - Arrans Point Precinct 7\CAD\P7 S2-RW5\21854.0037-MBW5-03_12.dwg, 06, 2/08/2016 11:10:49 a.m., dwm, 1:1

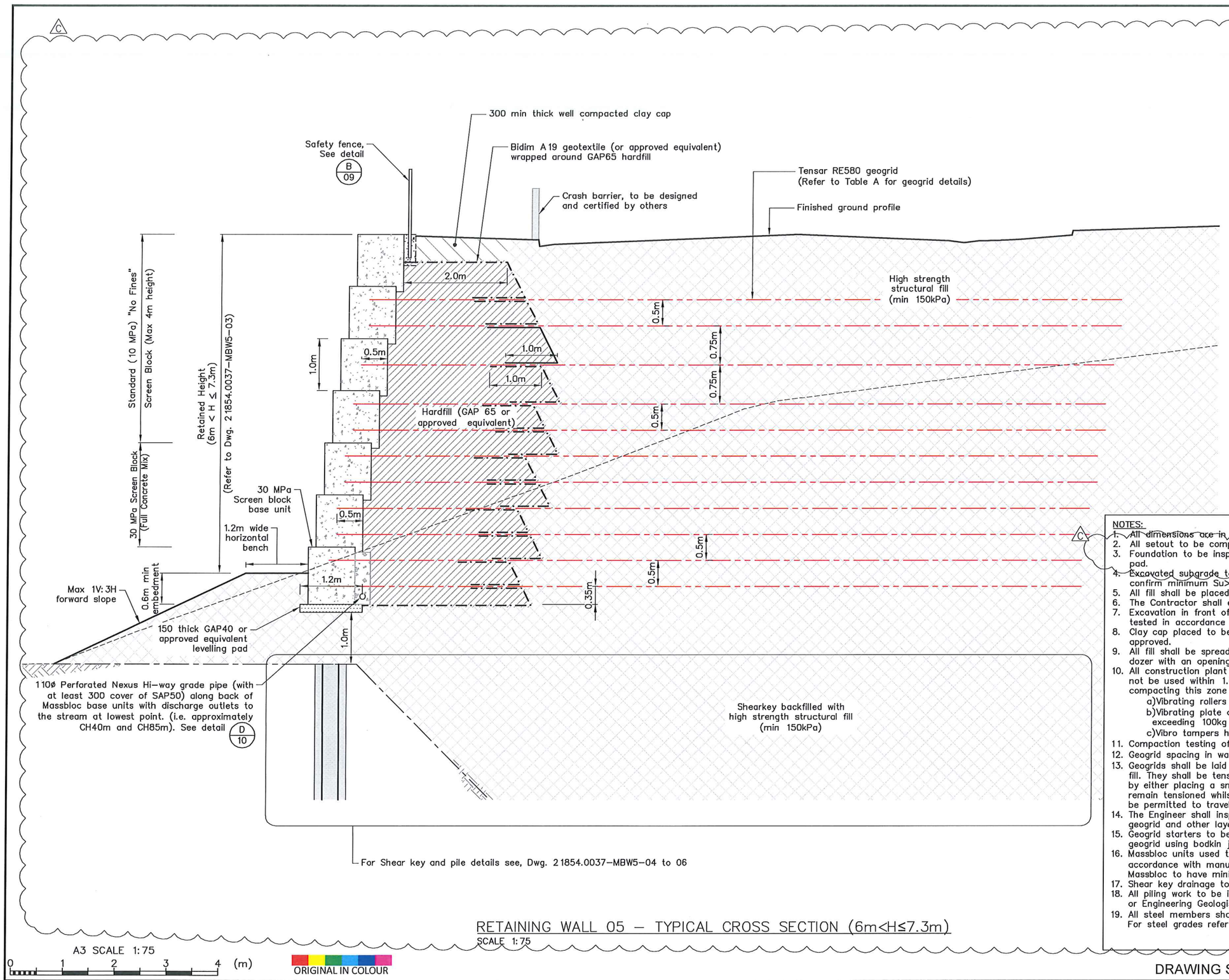


TABLE A: Geogrid Requirements for Retaining Wall 5 (Massbloc)

Retained Height (m)	Min. Geogrid Length (m)	Note
6 to 6.5	13	2 Geogrid per massbloc for bottom 3 rows of massbloc units
6.5 to 7.3	14	2 Geogrid per massbloc for bottom 4 rows of massbloc units

LEGEND

- High strength structural fill
- Hardfill (GAP65)
- Clay cap
- Existing ground
- 150 thick GAP40 or approved equivalent levelling pad
- Bidim A19 geotextile
- Tensar RE580 geogrid
- Existing ground profile
- Finished ground profile
- Shearkey undercut extent

NOTES:
1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOODS drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su>120KPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:-
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

RETAINING WALL 05 – TYPICAL CROSS SECTION (6m<H≤7.3m)
SCALE 1:75

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

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REV	REVISION DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :		8/16
DRAFTING CHECKED :		8/16
CADFILE :	\\21854.0037-MBW5-03_12.dwg	
APPROVED :		12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

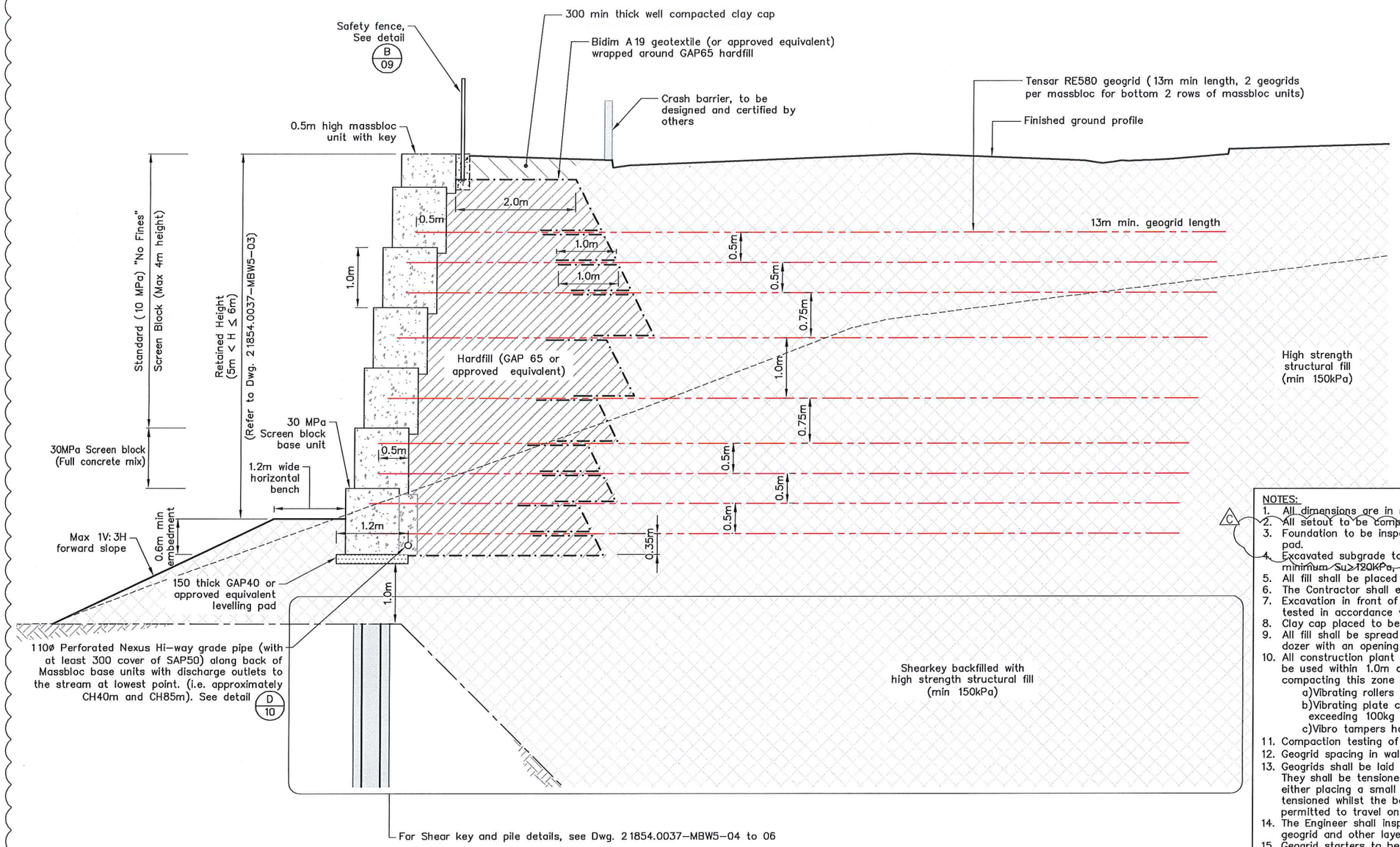
REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (6m<H<7.3m)

SCALES (AT A3 SIZE)	DWG. No.	REV.
1:75	21854.0037-MBW5-07	C



RETAINING WALL 05 – TYPICAL CROSS SECTION (5m<H≤6m)

SCALE 1:75

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOODS drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su>120kPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

A3 SCALE 1:75

0 1 2 3 4 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REVISION	DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED : JXXL Aug. 16
DRAWN : JC Aug. 16
DESIGN CHECKED :
DRAFTING CHECKED :
CADFILE : \\21854.0037-MBW5-03_12.dwg
APPROVED : 12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

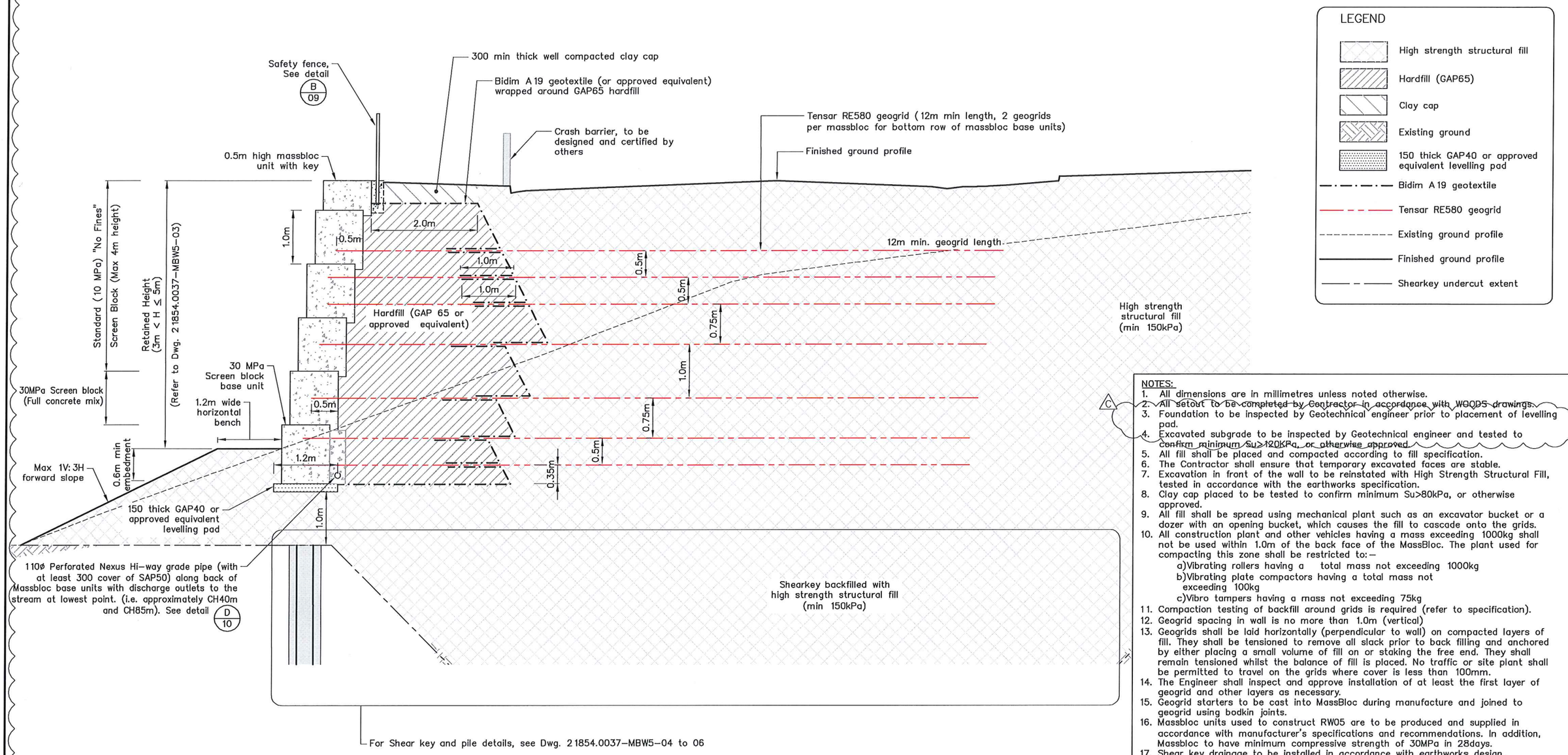
CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (5m<H≤ 6m)

SCALES (AT A3 SIZE) 1:75

DWG. No. 21854.0037-MBW5-08

REV. C



RETAINING WALL 05 – TYPICAL CROSS SECTION (3m<H≤5m)

SCALE 1:75

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOODS drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su>120KPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

A3 SCALE 1:75

0 1 2 3 4 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REVISION	DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :		12/16
DRAFTING CHECKED :		8/16
CADFILE :	\\21854.0037-MBW5-03_12.dwg	
APPROVED :		12/8/16

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

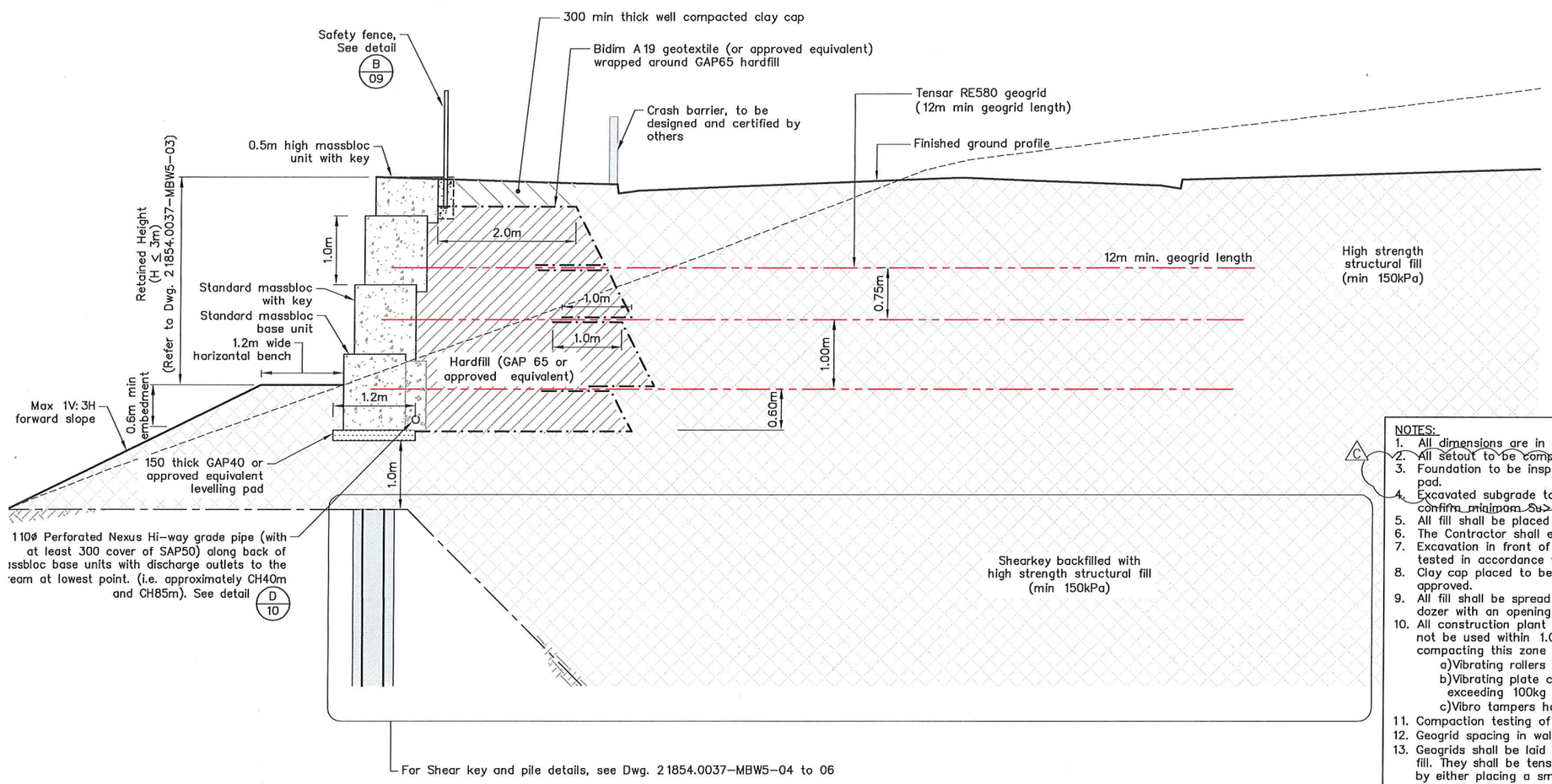
Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (3m<H≤ 5m)

SCALES (AT A3 SIZE)	DWG. No.	REV.
1:75	21854.0037-MBW5-09	C

T:\Auckland\CAD\21854\21854.0037 - Arrans Point Precinct 7\CAD\P7 S2-RW5\21854.0037-MBW5-03_12.dwg, 09, 2/08/2016 11:11:01 a.m., dwm, 1:1



RETAINING WALL 05 – TYPICAL CROSS SECTION (H<3m)

SCALE 1:75

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All setout to be completed by Contractor in accordance with WOODS drawings.
3. Foundation to be inspected by Geotechnical engineer prior to placement of levelling pad.
4. Excavated subgrade to be inspected by Geotechnical engineer and tested to confirm minimum Su>120kPa, or otherwise approved.
5. All fill shall be placed and compacted according to fill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill, tested in accordance with the earthworks specification.
8. Clay cap placed to be tested to confirm minimum Su>80kPa, or otherwise approved.
9. All fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the fill to cascade onto the grids.
10. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
    a) Vibrating rollers having a total mass not exceeding 1000kg
    b) Vibrating plate compactors having a total mass not exceeding 100kg
    c) Vibro tampers having a mass not exceeding 75kg
11. Compaction testing of backfill around grids is required (refer to specification).
12. Geogrid spacing in wall is no more than 1.0m (vertical)
13. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
14. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
15. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
16. Massbloc units used to construct RW05 are to be produced and supplied in accordance with manufacturer's specifications and recommendations. In addition, Massbloc to have minimum compressive strength of 30MPa in 28days.
17. Shear key drainage to be installed in accordance with earthworks design.
18. All piling work to be inspected and approved by a competent Geotechical Engineer or Engineering Geologist.
19. All steel members shall comform to AS/NZS.3618, AS/NZS.3679.1 or equivalent. For steel grades refer to detail drawings.

A3 SCALE 1:75

0 1 2 3 4 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: CONSTRUCTION ISSUE

REV	REVISION DESCRIPTION	BY	DATE
C	Revise Pile Requirements		
B	Revised Wall 5 Pile	AJL	Mar. 16
A	Construction Issue	AJL	Dec. 15

DESIGNED :	JXXL	Aug. 16
DRAWN :	JC	Aug. 16
DESIGN CHECKED :	[illegible]	8/16
DRAFTING CHECKED :	[illegible]	8/16
CADFILE : \\21854.0037-MBW5-03_12.dwg		
APPROVED : [illegible]	12/8/16	

This drawing is not to be used for construction purposes unless signed as approved

NOTES :

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
MILLWATER ARRANS HILL PRECINCT 7

TITLE
STAGE 2 – RETAINING WALL 05 C
Retaining Wall 05 – Typical Cross Section (H<3m)

SCALES (AT A3 SIZE) 1:75

DWG. No. 21854.0037-MBW5-10

REV. C

Appendix B: Contractors Certificates

- **Hick Bros Civil Construction Ltd – Sixth Schedule – Contract 37000-02 (Stages 4 & 5 Bulk Earthworks)**
- **JG Civil Ltd – Sixth Schedule – Stage 5 Civil Earthworks**
- **ICB Retaining & Construction - Producer Statement PS3 – Construction of Palisade Wall 1E**
- **ICB Retaining & Construction - Producer Statement PS3 – Construction of Palisade Wall 1F**
- **ICB Retaining & Construction - Producer Statement PS3 – Construction of Allan Block Wall 01**
- **ICB Retaining & Construction - Producer Statement PS3 – Construction of Screen Block Wall 05**
- **North Harbour Fencing Ltd – Producer Statement PS3 (Fencing for RE Slopes 3 and 4, and Screen Block Wall 05)**
- **Getgroup.co.nz Ltd – Producer Statement PS3 (Fencing for Allan Block 01)**

Schedule 6 – Form of Producer Statement – Construction

ISSUED BY HICK BROS CIVIL CONSTRUCTION Ltd *(Contractor)*

TO WFH PROPERTIES Ltd *(Principal)*

IN RESPECT OF PRECINCT 7 OREWA WEST 37000-02 BULK EARTHWORKS AND GEOTECHNICAL REMEDIATION *(Description of Contract Works)*

AT ARRAN POINT *(Address)*

HICK BROS CIVIL CONSTRUCTION Ltd (Contractor) has contracted to *WFH PROPERTIES Ltd Principal)* to carry out and complete certain building works in accordance with a Contract titled *PRECINCT 7 OREWA WEST CONTRACT 37000-02* ('the Contract')

I JAMES BILKEY *(Duly Authorised Agent)* a duly authorised representative of *HICK BROS CIVIL CONSTRUCTION Ltd (Contractor)* believe on reasonable grounds that *HICK BROS CIVIL CONSTRUCTION Ltd (Contractor)* has carried out and completed:

☐ All

☑ Part only as specified in the attached particulars of the contract works in accordance with the Contract

(Signature of Authorised Agent on behalf of)

Date 27/04/2018

HICK BROS CIVIL CONSTRUCTION Ltd
(Contractor)

42 FORGE RD, SILVERDALE
(Address)

- ALL EARTHWORKS WITHIN STAGES 4+5
- PART ONLY WORKS OF RE WALLS 2+3 (EARTHWORKS ONLY) NO FENCING / PLANTING / TOPSOIL

NZS 3910:2013 Conditions of contract for building and civil Engineering construction

Schedule 6 – Form of Producer Statement – Construction

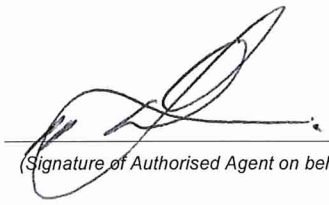
ISSUED BY	JG Civil Ltd	*(Contractor)*
TO	WFH PROPERTIES Ltd	*(Principal)*
IN RESPECT OF	Millwater Precinct 7, Orewa West Stage 5	*(Description of Contract Works)*
AT	Arran Point, Millwater	*(Address)*

JG Civil Ltd *(Contractor)* has contracted to *WFH PROPERTIES Ltd* *(Principal)* to carry out and complete certain building works in accordance with a Contract titled *PRECINCT 7 STAGE 5* ('the Contract')

I *Joel Giddy* *(Duly Authorised Agent)* a duly authorised representative of *JG Civil Ltd* *(Contractor)* believe on reasonable grounds that *JG Civil Ltd* *(Contractor)* has carried out and completed:

☑ All

☐ Part only as specified in the attached particulars of the contract works in accordance with the Contract



(Signature of Authorised Agent on behalf of)

Date *28 February 2019*

JG Civil Ltd

(Contractor)

180 Foundry Road, Silverdale

(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

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

TO **Hick Bros Civil**
(Principal)

IN RESPECT OF **Shear Key Wall 1E, Stage 5 at Precinct 7, Millwater, Arran Point, Auckland**
(Description of Contract Works)

AT **Precinct 7, Millwater, Arran Point**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Bros Civil**
(Principal)

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

Supply and Installation of Palisade walls at Precinct 7, Millwater, Arran Point, Auckland – 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 and any Authorised Instruction / Variations that have been issued during the course of the work

(Signature of Authorised Agent on Behalf of)

29 October 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 **Hick Bros Civil**
(Principal)

IN RESPECT OF **Shear Key Wall 1F, Stage 5 at Precinct 7, Millwater, Arran Point, Auckland**
(Description of Contract Works)

AT **Precinct 7, Millwater, Arran Point**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Bros Civil**
(Principal)

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

Supply and Installation of Palisade walls at Precinct 7, Millwater, Arran Point, Auckland – 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 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

29 October 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 **Hick Brothers**
(Principal)

IN RESPECT OF **Allen Block Wall No. 1**
(Description of Contract Works)

AT **Lot 1 DP 463561, Silverdale 0931, (Arran Point, Millwater Precent 7)**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

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

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

Allen Block Wall No. 1, Arran Point, Millwater Precent 7 *(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. and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

15 August 2016
(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**
(Principal)

IN RESPECT OF **Mass Block Wall 5 at Precinct 7, Millwater, Arran Point, Auckland**
(Description of Contract Works)

AT **Precinct 7, Millwater, Arran Point**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

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

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

Supply and Installation of Mass Block Wall 5 at Precinct 7, Millwater, Arran Point, Auckland – 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 and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

9 October 2018
(Date)

ICB 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 LTD
(Building Contractor)

TO: J. G. CIVIL LTD
(Owner/Principal)

IN RESPECT OF: PANEL FENCING ON BATTER
(Description of Contract Works)

AT: CASIDY RD., MILLWATER.
(Address)

T/A: ..... **BUILDING CONSENT No:** .....
(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)

01/11/18
(Date)

20A MANGA RD
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.

20393-1

Producer statement construction (PS3)
General construction work

Auckland Council
Te Kaunihera o Tāmaki Makaurau

All sections of this form must be completed

TO BE COMPLETED BY THE PERSON WHO HAS UNDERTAKEN THE BUILDING WORK

Author name:	DAN WRIGHT	Building consent No:	
Author company:	GETGROUP.CO.NZ LTD	Author Registration No:	
Description of building work:	WALL 1 FENCE		
Performance standard for maintenance and inspection, if applicable	SUBJECT TO ONGOING CORROSION PROTECTION ☐ N/A		
Legal description:			
Site address:	PRECINCT 7, OREWA WEST STAGE 1+2 CIVIL WORKS		

NZBC clauses: (select as applicable)

(B1)	(B2)	C1	C2	C3	C4	C5	C6	D1	D2	E1	E2	E3
F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3	G4	G5
G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	H1		

I have sighted the above building consent and read the attached conditions of consent and confirm that I have undertaken the building work described above in accordance with the consented plans and specifications.

I understand that Council will rely upon this producer statement, for the purposes of establishing compliance with the above building consent.

Signature: [signature] Date: 17/8/16

Tradesperson's contact details:

Address: 17 KAHIKATEA FLAT ROAD, DAIRY FLAT Postcode: 0794

Business: 09 4275421 Fax:

Mobile: 027 25 25 227 Email dan@getgroup.co.nz

COUNCIL USE ONLY

☐ Central ☐ Henderson ☐ Manukau ☐ Orewa ☐ Papakura ☐ Pukekohe ☐ Takapuna

☐ Accepted in support of inspection ☐ Accepted instead of inspection

Register checked: Council ☐ LBP ☐ N/A ☐

Name: Date:

Producer statement accepted as establishing compliance with the consented plans: YES ☐ NO ☐

Producer statements are accepted solely at Auckland Council's discretion; please refer to the Producer Statement Policy which can be found on Councils website for further details

http://www.aucklandcouncil.govt.nz/EN/ratesbuildingproperty/consents/Consent%20documents/ac2301producerstatementpolicy.pdf

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: INSTALLATION OF FENCING - WALL 05
(Description of Contract Works)

AT: LOT 1 DP 463561 ARRAN DR SILVERDALE 0931
(Address)

T/A:..... **BUILDING CONSENT No:**.....
(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

PRECINCT 7 ORCHA 4 WEST ("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)

30.04.2018
(Date)

20A MANGA RD
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 to H1 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).

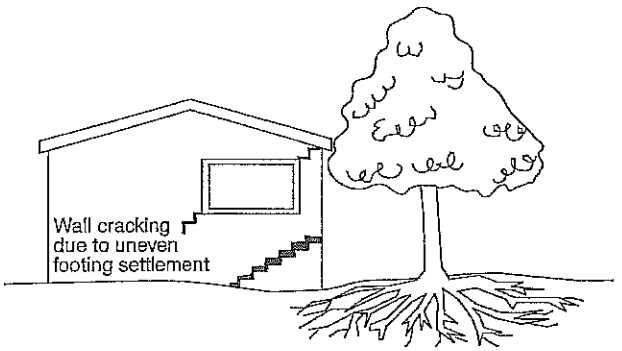
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

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.

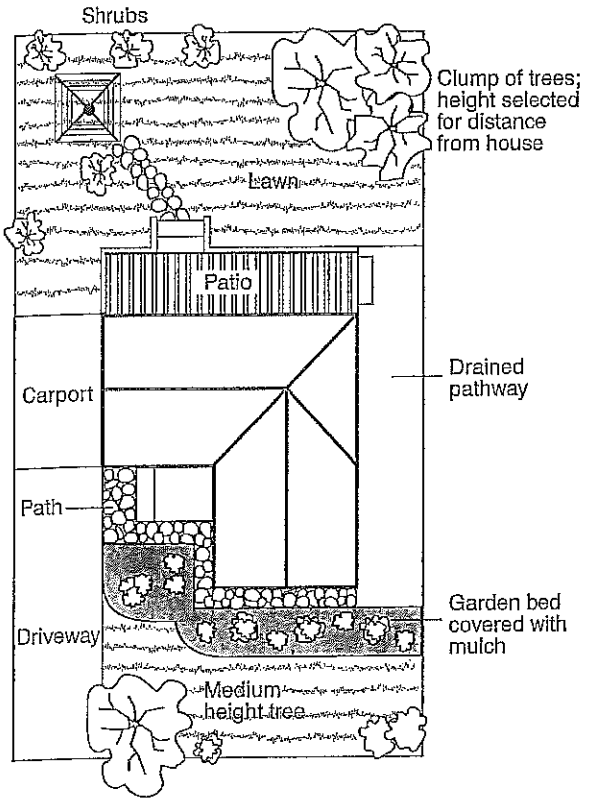
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

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.

Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

Appendix E: Test Results

- **21854.0037–APPP7S5–111 Post Earthworks Investigation Plan**
- **21854.0037–APPP7S5–112 Topsoil Depths Plan**
- **21854.0037–APPP7S5–113 Earthworks Testing Location Plan**
- **Soil Expansion Test Results**
- **Post Earthworks Investigation Borehole Logs (HA5–01 to HA5–12)**
- **Earthworks Test Results**

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-111.dwg 2019-Apr-08 9:29:02 AM Plotted By: JONALD CASTRO

ARRAN DRIVE

WALL 01

WALL 02

ARRAN POINT PARADE

CASSIDY DR

RESERVE TO VEST

RE SLOPE 03

RE SLOPE 04

PALISADE WALL 1E

PALISADE WALL 1F

PALISADE WALL 1D

WALL 05

OREWA RIVER

1000

HA5-1 E5-1

HA5-2 E5-2

HA5-3 E5-3

HA5-4 E5-4

HA5-5 E5-5

HA5-6 E5-6

HA5-7 E5-7

HA5-8 E5-8

HA5-9 E5-9

HA5-10 E5-10

HA5-11 E5-11

HA5-12 E5-12

A3 SCALE 1:1250

0 25 50 75 (m)

ORIGINAL IN COLOUR

LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- REINFORCED EARTH SLOPE
- E4-6 EXPANSIVE SOIL TEST SAMPLES@ 0.5m AND 1.0m DEPTH
- HA4-1 HAND AUGER TO 3m DEPTH

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) POST EARTHWORKS INVESTIGATION PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-111 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-112.dwg 2019-Apr-11 2:44:08 PM Plotted By: JONALD CASTRO

ARRAN DRIVE

WALL 01

WALL 02

ARRAN POINT PARADE

CASSIDY DR

RESERVE TO VEST

RE SLOPE 04

RE SLOPE 03

PALISADE WALL 1E

PALISADE WALL 1F

WALL 05

PALISADE WALL 1D

1000

OREWA RIVER

A3 SCALE 1:1250

0 25 50 75 (m)

ORIGINAL IN COLOUR

LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- REINFORCED EARTH SLOPE
- 100 TOPSOIL DEPTH (mm) TAKEN AT CENTRE OF EACH LOT

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) TOPSOIL DEPTHS PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-112 REV 1

L:\21854\21854.0037 - Arrans Point Precinct 7\CAD\STAGE 5\21854.0037-APP7S5-113.dwg 2019-Apr-08 9:29:22 AM Plotted By: JONALD CASTRO

ARRAN DRIVE

WALL 01

WALL 02

ARRAN POINT PARADE

RESERVE TO VEST

CASSIDY DR

RE SLOPE 03

RE SLOPE 04

PALISADE WALL 1F

WALL 05

PALISADE WALL 1E

PALISADE WALL 1D

OREWA RIVER

1000

A3 SCALE 1:1250

0 25 50 75 (m)

ORIGINAL IN COLOUR

LEGEND

- PRECINCT 7 BOUNDARY
- STAGE 5 BOUNDARY
- 43 LOT BOUNDARIES
- FINISHED GROUND CONTOURS (0.5M INTERVAL)
- RETAINING WALL
- PALISADE WALL
- 2.0 FILL CONTOURS
- 0.0 ZERO CONTOURS
- -2.0 CUT CONTOURS
- REINFORCED EARTH SLOPE
- S14-5612 EARTHWORKS TESTING LOCATION (URN NUMBER)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BASEPLAN AND FINAL CONTOUR SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_FINAL_CONTOUR.dwg" DATED MARCH 2019.
3. UNDERCUT AND SHEARKEY SUPPLIED BY WOODS, REFERENCE DATA "X_37005_P7_05_SK&UC tins ALL.dwg" DATED MARCH 2019.
4. COORDINATE DATUM: NZGD2000, MT EDEN CIRCUIT CIRCUIT COORDINATES. ORIGIN: LAT 36 52 47S LONG 174 45 51E 800,000mN 400,000mE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	COMPLETION REPORT ISSUE					

DESIGNED	JXXL	Mar.19	DRAWING STATUS: COMPLETION REPORT
DRAWN	JC	Mar.19	
DESIGN CHECKED			
DRAWING CHECKED			

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

CLIENT **WFH PROPERTIES LTD**

PROJECT **RESIDENTIAL SUBDIVISION**

TITLE MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 5) EARTHWORKS TESTING LOCATION PLAN

SCALE (A3) 1:1250 DWG No. 21854.0037-APP7S5-113 REV 1

GEOTECHNICS

Our Ref: 1009253.0.0.0/Rep 1
Customer Ref: 21854.0037
08 January 2019

Tonkin & Taylor
PO Box 5271, Wellesley Street,
Auckland 1141

Attention: Mr James Lee

Dear James

Arran Point - Precinct 7, Stage 5, Millwater

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
2019.01.11 15:11:05 +13'00'

.....
Sim Tirunahari
Soils Laboratory Manager
Approved Signatory

Report checked by:

.....
James Kimiangatau
Laboratory Technician

Authorised for Geotechnics by:

.....
Vic O'Connor
Project Director

IANZ ACCREDITED LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

This document consists of 4 pages.
11-Jan-19
t:\geotechnicsgroup\projects\1009253\issueddocuments\20190111.arran point p7_stage 5.st.final.rep1.docx

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: Arran Point - Precinct 7, Stage 5, Millwater

Your Job No: 21854.0037

Our Job No: 1009253.0.0.0

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)**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
SWELL TEST	Initial Water Content	(%)	38.0	41.5	27.1	33.5	30.9	26.7	31.3	34.2
	Bulk Density	(t/m³)	1.79	1.78	1.91	1.84	1.82	1.87	1.86	1.81
	Dry Density	(t/m³)	1.30	1.26	1.50	1.38	1.39	1.48	1.42	1.35
	Final Water Content	(%)	38.7	43.2	28.9	34.2	32.2	27.5	32.1	34.8
	Swelling Strain	(%)	0.06	-0.04	0.44	0.03	0.11	0.04	0.09	0.04
SHRINKAGE TEST	Initial Water Content	(%)	37.9	37.4	26.5	30.7	30.1	29.0	26.3	29.5
	Shrinkage Strain	(%)	2.6	3.0	2.3	1.6	2.4	2.8	2.0	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		Moderate	Moderate	Moderate	Major	Moderate	Major	Moderate	Moderate
SHRINK - SWELL INDEX		**(%)**	**1.4**	**1.7**	**1.4**	**0.9**	**1.4**	**1.5**	**1.1**	**0.6**

Remarks: The test results are IANZ accredited.

Entered by: JK Date: 11/01/2019 Checked by: ST Date: 11/01/2019

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: Arran Point - Precinct 7, Stage 5, Millwater

Your Job No: 21854.0037

Our Job No: 1009253.0.0.0

Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**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)**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
SWELL TEST	Initial Water Content	(%)	24.7	27.1	27.6	29.2	28.2	35.8	25.3	27.4
	Bulk Density	(t/m³)	1.93	1.88	1.82	1.88	1.88	1.86	1.87	1.89
	Dry Density	(t/m³)	1.55	1.48	1.43	1.46	1.47	1.37	1.49	1.48
	Final Water Content	(%)	26.5	28.8	30.5	30.5	29.7	37.2	27.7	28.2
	Swelling Strain	(%)	0.58	0.03	0.37	0.02	0.06	0.07	0.09	0.03
SHRINKAGE TEST	Initial Water Content	(%)	29.1	27.7	28.9	26.4	29.8	24.2	28.2	23.8
	Shrinkage Strain	(%)	3.4	2.4	1.4	1.8	3.7	0.9	2.7	0.7
	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		Moderate	Major	Moderate	Moderate	Moderate	Major	Major	Major
SHRINK - SWELL INDEX		**(%)**	**2.1**	**1.3**	**0.9**	**1.0**	**2.1**	**0.5**	**1.5**	**0.4**

Remarks: The test results are IANZ accredited.

Entered by: JK Date: 11/01/2019 Checked by: ST Date: 11/01/2019

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: Arran Point - Precinct 7, Stage 5, Millwater

Your Job No: 21854.0037

Our Job No: 1009253.0.0.0

Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

HA No.:			**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)**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
SWELL TEST	Initial Water Content	(%)	35.1	30.3	31.3	46.8	27.3	29.6	37.0	32.4
	Bulk Density	(t/m³)	1.77	1.89	1.84	1.66	1.91	1.84	1.74	1.80
	Dry Density	(t/m³)	1.31	1.45	1.40	1.13	1.50	1.42	1.27	1.36
	Final Water Content	(%)	37.3	32.5	32.8	49.2	28.8	32.0	39.0	33.8
	Swelling Strain	(%)	0.13	0.62	0.04	0.18	0.17	0.03	0.08	0.10
SHRINKAGE TEST	Initial Water Content	(%)	37.2	33.1	30.7	46.5	28.2	29.1	35.3	34.5
	Shrinkage Strain	(%)	1.8	1.8	2.8	7.5	1.7	4.4	2.5	5.9
	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	Moderate	Moderate	Moderate	Moderate	Major	Major	Moderate
SHRINK - SWELL INDEX		**(%)**	**1.1**	**1.2**	**1.6**	**4.2**	**1.0**	**2.5**	**1.4**	**3.3**

Remarks: The test results are IANZ accredited.

Entered by: JK Date: 11/01/2019 Checked by: ST Date: 11/01/2019

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-01**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948790.00 mN 1749515.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	31.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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										D	H		SILT, dark brown. Hard, dry, non plastic
Residual Soil	DRY: 28/11/2018 on completion				● UTP ● >224 kPa ● >224 kPa ● 100/71 kPa ● 88/48 kPa ● UTP ● UTP		30 29 28	0.5 1.0 1.5 2.0 2.5 3.0 3.5		M D-M	St H		SILT, brown and yellow, some clay & gravel. Hard, dry, non plastic. Friable Clayey SILT, greenish yellow brown, some gravel. Stiff to hard, moist, low to moderate plasticity 1.5m: light grey/white SILT, greenish grey, some gravel. Hard, dry-moist, non plastic 2m: Refusal

COMMENTS

Hole Depth 2m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-02**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948850.00 mN 1749502.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	38.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: RBE CHECKED: OP

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						H		SILT, dark brown. Hard, moist, non plastic
													SILT, yellow brown, minor angular gravel. Hard, moist, non plastic
											VSt-H		SILT, yellow brown and grey. Very stiff to hard, moist, non plastic
					172/60 kPa			0.5					
					>201 kPa		37	1.0					SILT, dark grey. Very stiff to hard, moist, non plastic
Residual East Coast Bays Formation	DRY: 28/11/2018 trace water				>201 kPa								1.3m: Sandy SILT, dark grey. moist, non plastic
					>201 kPa			1.5					1.4m: SILT, dark grey, moist. Non plastic.
					>201 kPa		36	2.0					
					>201 kPa								2.1m: Sandy SILT, grey. moist, non plastic
					184/46 kPa			2.5					2.2m: SILT, grey, moist, non plastic
					201/66 kPa								2.4m: moist to wet
					>201 kPa		35	3.0					
													3.1m: Target depth
								3.5					

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-03**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5	LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000) 5948854.00 mN 1749562.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		HOLE FINISHED: 28/11/2018
R.L.: 38.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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					●>201 kPa			0.5		M	H		Clayey SILT, dark brown with yellowish brown inclusions. Hard, moist, low plasticity
					●201/43 kPa						St-VSt		SILT some clay, minor gravel, grey dark brown. Stiff to hard, moist, low plasticity
					●129/66 kPa		37	1.0					0.7m: grey some gravel 0.8m: grey non to low plasticity minor yellow brown inclusions and grey weak sandstone gravel
					●83/37 kPa								1.1m: yellowish brown with grey inclusions
					●135/52 kPa			1.5					1.3m: grey, minor yellow brown inclusions
					●75/34 kPa		36	2.0					2.1m: yellow brown and grey
Residual Soil					●173/49 kPa						VSt		Sandy SILT, grey. Very stiff, moist, non plastic
Residual East Coast Bays Formation	DRY: 28/11/2018 trace water				●175/60 kPa			2.5		M-W	VSt-H		SILT, grey. Very stiff to hard, moist to wet, non plastic
					●>201 kPa								
					●>201 kPa		35	3.0					3.1m: Target depth
								3.5					

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-04**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948905.00 mN 1749571.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	33.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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 - 28/11/2018 on completion				● >224 kPa ● 192/99 kPa			0.5		M	H		Clayey SILT, brown with yellow brown speckles. Hard, moist, low plasticity
											VSt-H		Clayey SILT, yellow brown with grey streaks. Hard to very stiff, moist, low plasticity
Residual Soil					● UTP		32	1.0		D			Sandy SILT, greenish brown. Very stiff to hard, dry, non plastic. Friable, very difficult to auger and recover
													1m: Refusal
							31	2.0					
							30	3.0					
								1.5					
								2.5					
								3.5					

COMMENTS

Hole Depth 1m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-05**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948882.00 mN 1749611.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	41.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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: 28/11/2018 on completion				● >224 kPa				TS T TS	D	H		SILT, brown. Hard, dry, non plastic
										M			Clayey SILT, blue grey, brown. Hard, moist, non plastic 0.4m: streaked grey and brown
Residual East Coast Bays Formation					● 193/33 kPa			0.5			VSt		Clayey SILT, grey. Very stiff, moist, non to low plasticity 0.7m: orange brown mottles
					● 192/71 kPa		40						
East Coast Bays Formation								1.0		D-M	H		SILT, grey. Hard, dry-moist, non plastic. Friable, low recovery
					● UTP								1.2m: Refusal
								1.5					
							39	2.0					
								2.5					
							38	3.0					
								3.5					

COMMENTS

Hole Depth 1.2m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-06**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948847.00 mN 1749620.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	41.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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: 28/11/2018 on completion				>201 kPa UTP 122/50 kPa 167/58 kPa 98/53 kPa 86/46 kPa		40 39 38	0.5 1.0 1.5 2.0 2.5 3.0 3.5	TS T TS	M	H VSt St-VSt		SILT, dark brown with yellow brown inclusions. Hard, moist, non plastic SILT, yellow brown with grey inclusions, some grey gravel . Hard, moist, non plastic 0.7m: dry to moist, hard to auger Clayey SILT, yellow brown grey. Very stiff, moist, low plasticity SILT, grey minor yellow brown inclusions. Stiff to very stiff, moist, non plastic
Residual East Coast Bays Formation											H		Sandy SILT, dark grey orange mottles.Hard, moist, non plastic 2m: Refusal

COMMENTS

Hole Depth 2m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-07**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948928.00 mN 1749641.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
			HOLE FINISHED: 28/11/2018
R.L.:	35.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: OP

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
Topsoil									TS T TS	D	VSt		SILT, brown. Very stiff, dry, non plastic
Fill					132/64 kPa					D-M			SILT yellow brown, some clay. Very stiff, dry-moist, non plastic 0.3m: greenish brown grey, some gravel
					176/84 kPa			0.5		M	VSt-H		SILT, grey, trace gravel. Very stiff to hard, moist, non plastic
					208/49 kPa		34	1.0					SILT, yellow orange brown. Hard, moist, non plastic
Residual East Coast Bays Formation	DRY: 28/11/2018 on completion				174/59 kPa						VSt		Sandy SILT, grey. Very stiff, moist, non plastic
					164/54 kPa			1.5					
					168/61 kPa						VSt-H		SILT, grey, some clay. Very stiff to hard, moist, medium to low plasticity
					>224 kPa		33	2.0					
					195/68 kPa			2.5					
					206/59 kPa								
					160/65 kPa		32	3.0					
													3.1m: Target depth
								3.5					

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-08**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948871.00 mN 1749675.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		DRILL METHOD: HA	HOLE FINISHED: 28/11/2018
R.L.:	37.00m		DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: JASM

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					● 190/80 kPa			0.5	TS T	M	VSt		Silty CLAY, dark brown, some organics. Very stiff, moist, low plasticity
					● >214 kPa						VSt-H		SILT minor clay, brownish grey. Very stiff to hard, moist, low plasticity
					● >214 kPa		36	1.0					SILT minor clay, grey. Very stiff to hard, moist, low plasticity
					● 184/52 kPa								
					● 187/77 kPa			1.5					
					● UTP								
Residual East Coast Bays Formation	DRY: 28/12/2018 on completion				● UTP		35	2.0			H		SILT, grey, minor clay, trace sand. Hard, moist, low plasticity
					● UTP			2.5					2.4 - 2.6m: limonite rust brownish orange
					● UTP								2.7 - 2.9m: limonite rust
					● UTP		34	3.0					3m: Target depth
								3.5					

COMMENTS

Hole Depth 3m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-09**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948834.00 mN 1749675.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018 HOLE FINISHED: 28/11/2018
R.L.:	29.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: JASM

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: 28/11/2018 on completion				>224 kPa UTP 170/112 kPa UTP 212/100 kPa		28	0.5 1.0 1.5	TS T	M	H VSt-H		SILT, brown. Hard, moist, non to low plasticity Clayey SILT, yellow brown, some fine gravel. Very stiff to hard, moist, non to low plasticity 0.35m: green white, dry, friable 1.0m: mottled grey 1.3m: grey silt
Residual Soil					88/55 kPa 80/32 kPa 112/29 kPa 126/26 kPa 113/35 kPa		27 26	2.0 2.5 3.0			St-VSt		Silty CLAY, yellow brown, grey splotches, some gravel. Stiff to very stiff, moist, moderate plasticity 2.3m: rusty brown sand 2.5m: dark orange brown, white splotches, moist- 3.0m: white/light grey
								3.5					3.2m: Target depth

COMMENTS

Hole Depth 3.2m

Scale 1:20

Rev.: A

HandAugerLog - 5/04/2019 4:40:12 PM - Produced with Core-GS by GeRoc

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-10**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5	LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000) 5948916.00 mN 1749710.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		HOLE FINISHED: 28/11/2018
R.L.: 35.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM AUCKHT1946		LOGGED BY: JOTI CHECKED: JASM

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					● 168/70 kPa			0.5	TS T	M	VSt		Silty CLAY, dark brown. Very stiff, moist, moderate plasticity. Some rootlets
					● >214 kPa						VSt-H		Clayey SILT, light orange, minor gravel. Very stiff to hard, moist, moderate plasticity
					● >214 kPa		34	1.0			H		Gravelly SILT, light orange, some clay. Hard, moist, low plasticity
					● >214 kPa								
					● >214 kPa			1.5					
					● >214 kPa		33	2.0					
					● >214 kPa								
Residual Soil	DRY: 28/11/2018 on completion				● 77/34 kPa			2.5			St-VSt		Clayey SILT, brownish orange, minor fine gravel and organic material. Stiff to very stiff, moist, moderate plasticity
					● 80/34 kPa								
					● 116/28 kPa		32	3.0					3.1m: Target depth
								3.5					

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-11**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5		LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000)	5948826.00 mN 1749551.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018 HOLE FINISHED: 28/11/2018
R.L.:	20.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM	AUCKHT1946		LOGGED BY: JOTI CHECKED: JASM

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
								0.0	TS T	D	H		SILT, dark brown. Hard, dry, no to low plasticity
										M			SILT, yellow brown, minor clay. Hard, moist, no to low plasticity 0.4m: silt grey non plastic inclusions
					>201 kPa			0.5					0.6m: layer of sandstone/siltstone gravel, penetrated with difficulty. Gravel is medium to
					>201 kPa								SILT, yellowish brown and grey. Hard, moist, non plastic
					>201 kPa		19	1.0					1.0m: inclusions of fine to medium gravel, grey (sandstone)
					175/106 kPa						VSt		Sandy SILT, grey, with yellow brown inclusions. Very stiff, moist, non plastic
Fill					172/83 kPa			1.5			VSt-H		Clayey SILT, yellow brown. Very stiff to hard, moist, non plastic, with inclusions of grey non plastic silt. Minor angular gravel
	DRY: 28/11/2018 on completion				>201 kPa		18	2.0					
					155/99 kPa								
					>201 kPa			2.5					
					161/89 kPa						VSt		Clayey SILT,yellow brown. Very stiff, moist low plasticity
					118/66 kPa		17	3.0					
													3.1m: Target depth
								3.5					

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

HandAugerLog - 5/04/2019 4:40:12 PM - Produced with Core-GS by GeRoc

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA5-12**

SHEET: 1 OF 1

PROJECT: Arran Point Precinct 7 - Stage 5	LOCATION: Arran Point, Millwater	JOB No.: 21854.0037/s3
CO-ORDINATES: (NZTM2000) 5948813.00 mN 1749816.00 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/2018
		HOLE FINISHED: 28/11/2018
R.L.: 12.00m	DRILL METHOD: HA	DRILLED BY: GEOTECHNICS
DATUM AUCKHT1946		LOGGED BY: JOTI CHECKED: JASM

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: 28/11/2018 on completion				UTP 135/96 kPa >224 kPa 173/103 kPa 152/81 kPa 113/62 kPa 129/94 kPa UTP >224 kPa 155/93 kPa		11 10 9	0.5 1.0 1.5 2.0 2.5 3.0 3.5	TS T	M D-M D M	H VSt-H H VSt-H		SILT, brown. Hard, moist, non plastic SILT, some clay, yellow brown. Hard, dry-moist, non plastic. Friable Silty CLAY, trace fine gravel, yellow brown. Very stiff to Hard, dry-moist, low plasticity SILT, mottled rusty orange white. Hard, dry, non plastic Clayey SILT, yellow brown. Very stiff to Hard, moist, low plasticity 1.0m: grey streaks, trace gravel 1.4m: grey blue silt 2.4m: grey blue silt 2.8m: grey silt 3.1m: Target depth

COMMENTS

Hole Depth 3.1m

Scale 1:20

Rev.: A

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S16 174-4	2660276.243	6510511.975	9.859	Behind Wall 6	TA	28/11/2016	1.81	1.33	35.8	2.7	**3.0**	176	173	183	214	**187**		P	
							1.80	1.33	35.8	2.7	**3.3**								
S16 177-6	2660270.85	6510508.408	8.595	Behind Wall 6	TA	1/12/2016	1.82	1.38	31.3	2.7	**5.5**	199	214	214	214	**210**		P	
							1.81	1.38	31.3	2.7	**5.7**								
S16 180-1	2660311.614	6510496.424	2.178	Shear Key 1D	TA	6/12/2016	1.89	1.42	33.1	2.7	**0.5**	199	177	214	214	**201**		P	
							1.90	1.43	33.1	2.7	**0.0**								
S16 180-2	2660323.233	6510499.589	2.142	Shear Key 1D	TA	6/12/2016	1.87	1.42	31.2	2.7	**3.0**	214	214	214	214	**214**		P	
							1.86	1.42	31.2	2.7	**3.0**								
S16 185-10	2660097.51	6510634.766	25.485	Pond Undercut	TA	13/12/2016	1.82	1.37	33.2	2.7	**4.1**	214	214	214	214	**214**		P	
							1.83	1.37	33.2	2.7	**3.5**								
S16 185-11	2660079.907	6510628.254	25.193	Pond Undercut	TA	13/12/2016	1.89	1.45	30.8	2.7	**1.8**	214	214	214	214	**214**		P	
							1.89	1.44	30.8	2.7	**2.2**								
S16 185-12	2660061.55	6510612.499	25.498	Pond Undercut	TA	13/12/2016	1.90	1.49	27.4	2.7	**3.7**	214	214	214	214	**214**		P	
							1.91	1.50	27.4	2.7	**3.5**								
S16 186-7	2660079.628	6510617.894	26.084	Pond Undercut	TA	14/12/2016	1.79	1.37	30.8	2.7	**7.2**	199	194	183	159	**184**		P	
							1.77	1.35	30.8	2.7	**8.3**								
S16 186-8	2660049.179	6510616.917	25.987	Pond Undercut	TA	14/12/2016	1.97	1.59	23.7	2.7	**3.4**	214	214	214	214	**214**		P	
							1.95	1.57	23.7	2.7	**4.4**								
S16 186-9	2660080.638	6510636.874	25.28	Pond Undercut	TA	14/12/2016	1.87	1.40	34.1	2.7	**0.7**	214	214	214	214	**214**		P	
							1.86	1.38	34.1	2.7	**1.6**								
S17 007-2	2660083.769	6510645.691	24.613	Fill next to Pond 7-9	PO	12/01/2017	1.96	1.52	29.4	2.7	**0.0**	214	214	214	214	**214**		P	
							1.91	1.48	29.4	2.7	**1.8**								
S17 007-3	2660093.289	6510635.516	27.94	Fill next to Pond 7-9	PO	12/01/2017	1.88	1.43	31.3	2.7	**2.2**	214	214	214	214	**214**		P	
							1.87	1.42	31.3	2.7	**2.8**								
S17 007-4	2660346.337	6510492.613	4.847	Shear Key 1E	PO	12/01/2017	1.89	1.48	27.6	2.7	**4.5**	214	214	214	214	**214**		P	
							1.89	1.48	27.6	2.7	**4.1**								
S17 007-10				Shear Key 1E	PO	12/01/2017	1.90	1.45	31.2	2.7	**1.3**	153	186	214	199	**188**		P	
							1.90	1.45	31.2	2.7	**1.4**								
S17 008-1				Shear Key 1E	PO	13/01/2017	1.84	1.44	27.8	2.7	**6.7**	168	168	186	214	**184**		P	
							1.84	1.44	27.8	2.7	**6.5**								
S17 008-2				Shear Key 1E	PO	13/01/2017	1.87	1.44	29.6	2.7	**3.7**	168	214	214	214	**203**		P	
							1.88	1.45	29.6	2.7	**3.6**								
S17 008-11				Shear Key 1E	PO	13/01/2017	1.83	1.39	32.4	2.7	**3.8**	199	214	214	214	**210**		P	
							1.84	1.39	32.4	2.7	**3.6**								
S17 008-12				Shear Key 1E	PO	13/01/2017	1.86	1.37	35.8	2.7	**0.2**	186	199	214	214	**203**		P	
							1.86	1.37	35.8	2.7	**0.5**								
S17 009-2	2660358.685	6510483.258	9.977	Shear Key 1E	PO	16/01/2017	1.78	1.31	36.1	2.7	**4.2**	214	214	214	214	**214**		P	
							1.79	1.31	36.1	2.7	**3.9**								
S17 009-8	2660363.434	6510498.325	9.658	Shear Key 1E	PO	16/01/2017	1.82	1.39	30.9	2.7	**5.7**	168	199	214	214	**199**		P	
							1.82	1.39	30.9	2.7	**5.6**								
S17 009-9	2660360.228	6510484.887	10.458	Shear Key 1E	PO	16/01/2017	1.81	1.38	31.3	2.7	**5.6**	199	214	214	214	**210**		P	
							1.82	1.39	31.3	2.7	**5.2**								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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) Test 1	Test 2	Test 3	Test 4	Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
S17 010-3	2660361.248	6510488.887	10.994	Shear Key 1E	PO	17/01/2017	1.91	1.46	30.9	2.7	**0.9**	199	214	214	214	**210**		P	
							1.90	1.45	30.9	2.7	**1.5**								
S17 011-1	2660362.228	6510508.09	10.69	Shear Key 1E	TA	18/01/2017	1.87	1.45	28.5	2.7	**4.7**	186	199	214	214	**203**		P	
							1.87	1.45	28.5	2.7	**4.7**								
S17 019-7	2660310.911	6510504.874	4.798	Shear Key 1E	TA	31/01/2017	1.84	1.37	34.3	2.7	**2.5**	141	153	153	186	**158**		P	
							1.83	1.36	34.3	2.7	**3.0**								
S17 019-8	2660325.82	6510504.747	4.458	Shear Key 1E	TA	31/01/2017	1.80	1.35	33.3	2.7	**5.1**	130	141	153	214	**160**		P	
							1.80	1.35	33.3	2.7	**5.2**								
S17 019-9	2660330.567	6510498.221	4.906	Shear Key 1E	TA	31/01/2017	1.79	1.35	32.8	2.7	**5.7**	168	199	214	214	**199**		P	
							1.80	1.35	32.8	2.7	**5.4**								
S17 024-1	2660202.569	6510521.138	19.626	West of Wall 6	CBEN	7/02/2017	1.78	1.28	38.9	2.7	**2.8**	141	153	183	214	**173**		P	
							1.80	1.29	38.9	2.7	**1.7**								
S17 025-1	2660196.714	6510524.292	21.492	West of Wall 7	CBEN	8/02/2017	1.80	1.34	34.0	2.7	**4.5**	171	189	214	214	**197**		P	
							1.81	1.35	34.0	2.7	**4.1**								
S17 036-1				Fill E of Hole Above Shear Key 1E	CBEN	28/02/2017	1.92	1.51	27.5	2.7	**2.7**	214	214	214	214	**214**		P	
							1.94	1.52	27.5	2.7	**2.0**								
S17 036-2	2660347.806	6510538.04	14.433	Fill E of Hole Above Shear Key 1E	CBEN	28/02/2017	1.81	1.34	34.5	2.7	**3.8**	214	214	214	214	**214**		P	
							1.81	1.34	34.5	2.7	**4.0**								
S17 037-13	2660356.331	6510538.998	17.442	Fill E of Hole Above Shear Key 1E	CBEN	1/03/2017	1.87	1.45	29.0	2.7	**4.3**	214	214	214	214	**214**		P	
							1.87	1.45	29.0	2.7	**4.4**								
S17 038-10	2660321.043	6510508.03	6.225	Shear Key 1E	CBEN	2/03/2017	1.86	1.42	31.6	2.7	**2.8**	191	214	214	214	**208**		P	
							1.85	1.41	31.6	2.7	**3.5**								
S17 038-11	2660313.506	6510509.334	6.385	Shear Key 1E	CBEN	2/03/2017	1.87	1.41	32.4	2.7	**2.1**	199	214	214	191	**205**		P	
							1.88	1.42	32.4	2.7	**1.6**								
S17 039-2	2660310.285	6510502.668	6.495	Shear Key 1E	CBEN	3/03/2017	1.84	1.38	32.9	2.7	**3.3**	199	199	214	214	**207**		P	
							1.83	1.38	32.9	2.7	**3.7**								
S17 039-6				Shear Key 1E	CBEN	3/03/2017	1.86	1.39	34.0	2.7	**1.5**	153	214	214	199	**195**		P	
							1.85	1.38	34.0	2.7	**1.7**								
S17 041-1	2660330.021	6510500.182	6.475	Shear Key 1E	CBEN	6/03/2017	1.83	1.43	27.8	2.7	**7.0**	214	214	214	214	**214**		P	
							1.83	1.43	27.8	2.7	**7.3**								
S17 046-1	2660335.247	6510496.044	7.263	Shear Key 1E	CBEN	15/03/2017	1.74	1.20	44.5	2.7	**1.8**	108	108	120	125	**115**	Y	F	Removal of failed material occurred and retested as Test S17 046-5
							1.75	1.21	44.5	2.7	**1.4**								
S17 046-2	2660313.518	6510500.012	8.384	Shear Key 1E	CBEN	15/03/2017	1.74	1.22	42.40	2.7	**2.8**	125	204	168	193	**173**		P	
							1.74	1.22	42.40	2.7	**3.0**								
S17 046-3	2660329.964	6510495.02	7.234	Shear Key 1E	CBEN	15/03/2017	1.77	1.34	31.7	2.7	**7.7**	163	204	204	131	**176**		P	
							1.77	1.35	31.7	2.7	**7.4**								
S17 046-4	2660305.386	6510503.604	8.358	Shear Key 1E	CBEN	15/03/2017	1.80	1.29	39.0	2.7	**1.6**	134	147	176	92	**137**	Y	F	Retested as Test S17 046-6
							1.80	1.29	39.0	2.7	**1.7**								
S17 046-5	2660323.053	6510499.771	7.534	Shear Key 1E	CBEN	15/03/2017	1.88	1.46	28.2	2.7	**4.5**	184	140	174	160	**165**		P	Retest of Test S17 046-1
							1.88	1.47	28.2	2.7	**4.4**								
S17 046-6				Shear Key 1E	CBEN	15/03/2017						98	149	109	118	**119**	Y	F	Retest of Test S17 046-4, further failure lead to removal of material.
S17 047-1	2660290.241	6510502.57	8.541	Shear Key 1E	CBEN	16/03/2017	1.74	1.31	33.4	2.7	**8.0**	214	171	173	168	**182**		P	Retest of Test S17 046-6
							1.75	1.31	33.4	2.7	**7.8**								
S17 047-5	2660324.794	6510497.059	7.97	Behind Wall 5	CBEN	16/03/2017	1.84	1.46	26.3	2.7	**7.8**	214	214	214	214	**214**		P	
							1.83	1.45	26.3	2.7	**8.0**								
S17 048-1				Behind Wall 5	CMO	17/03/2017	1.74	1.28	36.4	2.7	**6.3**	214	214	214	214	**214**		P	
							1.74	1.28	35.7	2.7	**6.7**								
S17 050-1	2660279.994	6510493.811	7.419	Behind Wall 5	CMO	20/03/2017	1.77	1.35	31.5	2.7	**7.7**	214	214	214	214	**214**		P	
							1.76	1.32	33.2	2.7	**7.2**								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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) Test 1	Test 2	Test 3	Test 4	Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
S17 050-6	2660327.393	6510496.426	4.924	Shear Key 1E	CMO	20/03/2017	1.78	1.34	32.4	2.7	**6.6**	199	214	176	183	**193**		P	
							1.77	1.35	31.3	2.7	**7.9**								
S17 052-9	2660337.085	6510509.305	8.908	Shear Key 1E	CMO	22/03/2017	1.89	1.46	29.5	2.7	**2.9**	214	214	214	214	**214**		P	
							1.89	1.48	28.1	2.7	**3.9**								
S17 059 -1				Shear Key 1E	CMO	31/03/2017	1.84	1.40	31.5	2.7	**4.1**	183	168	176	199	**182**		P	
							1.85	1.41	31.1	2.7	**3.8**								
S17-060-4	2660334.546	6510500.35	9.912	Shear Key 1E	CMO	3/04/2017	1.97	1.47	29.8	2.7	**1.7**	160	214	168	176	**180**		P	
							1.91	1.48	29.4	2.7	**1.9**								
S17-060-5	2660311.545	6510502.79	9.892	Shear Key 1E	CMO	3/04/2017	1.87	1.43	31.1	2.7	**2.8**	191	214	183	168	**189**		P	
							1.87	1.44	30.0	2.7	**3.6**								
S17-060-6	2660266.555	6510511.695	10.644	Shear Key 1E	CMO	3/04/2017	1.87	1.39	34.4	2.7	**0.6**	183	191	168	176	**180**		P	
							1.86	1.38	34.5	2.7	**1.1**								
				Trench behind wall 5	CBEN	10/04/2017						141	214	214	191	**190**		P	~2m deep around Manhole
				Trench behind wall 5	CBEN	10/04/2017						183	199	214	191	**197**		P	~1m deep around manhole
				Trench behind wall 5	CBEN	10/04/2017						186	180	189	208	**191**		P	
				Trench behind wall 5	CBEN	11/04/2017						214	214	214	214	**214**		P	ground level
S17 067-4				Shear Key 1E - Trench Backfill	TA	20/04/2017	1.79	1.36	31.8	2.7	**6.6**	183	214	191	183	**193**		P	
							1.79	1.36	31.8	2.7	**6.7**								
S17 067-5				Shear Key 1E - Trench Backfill	TA	20/04/2017	1.84	1.38	33.2	2.7	**3.0**	183	199	176	153	**178**		P	
							1.85	1.39	33.2	2.7	**2.7**								
S17 069-1				Shear Key 1E - Trench Backfill	TA	22/04/2017	1.87	1.39	34.0	2.7	**1.0**	168	214	168	183	**183**		P	
							1.86	1.38	34.0	2.7	**1.6**								
S17 070-1	2660299.655	6510513.621	9.733	Shear Key 1E - Trench Backfill	TA	24/04/2017	1.86	1.38	34.7	2.7	**1.0**	153	160	168	160	**160**		P	
							1.86	1.38	34.7	2.7	**0.7**								
S17 070-4	2660321.308	6510507.427	9.814	Shear Key 1E - Trench Backfill	TA	24/04/2017	1.87	1.40	33.50	2.7	**1.2**	214	214	214	214	**214**		P	
							1.88	1.41	33.50	2.7	**0.8**								
S17 070-5	2660303.158	6510512.624	9.793	Shear Key 1E - Trench Backfill	TA	24/04/2017	1.87	1.42	31.8	2.7	**2.4**	141	183	150	160	**159**		P	
							1.87	1.42	31.8	2.7	**2.4**								
S17 072-1	2660360.803	6510508.896	10.61	Shear Key 1E	TA	27/04/2017	1.82	1.36	34.3	2.7	**3.3**	214	153	170	168	**176**		P	
							1.84	1.37	34.3	2.7	**2.5**								
S17 072-6	2660279.441	6510508.566	10.823	Shear Key 1E	TA	27/04/2017	1.84	1.39	32.1	2.7	**3.8**	214	214	214	214	**214**		P	
							1.83	1.39	32.1	2.7	**4.1**								
S17 078-7	2660360.56	6510522.238	15.347	Shear Key 1E	CMO	6/05/2017	1.88	1.43	31.1	2.7	**2.6**	168	183	186	199	**184**		P	
							1.87	1.45	28.8	2.7	**4.5**								
S17 077-7	2660362.301	6510507.268	13.535	Shear Key 1E	CMO	8/05/2017	1.86	1.43	30.0	2.7	**4.1**	214	199	191	214	**205**		P	
							1.87	1.44	29.7	4.0	**21.6**								
S17 079 -4	2660330.061	6510528.805	12.9	Shear Key 1E	CMO	9/05/2017	1.86	1.47	26.4	2.7	**6.7**	183	214	199	214	**203**		P	
							1.87	1.48	26.5	2.7	**6.0**								
S17 080-3	2660329.675	6510536.278	15.514	Shear Key 1E	CMO	15/05/2017	1.82	1.37	33.1	2.7	**3.9**	141	168	183	183	**169**		P	
							1.82	1.37	32.8	2.7	**4.3**								
S17 083-3	2660299.832	6510501.175	10.966	Shear Key 1E	CMO	23/05/2017	1.89	1.46	29.1	2.7	**3.2**	214	199	214	168	**199**		P	
							1.90	1.48	28.7	2.7	**3.0**								
S17 084-1	2660302.499	6510521.157	7.969	Shear Key 1E Undercut	CMO	24/05/2017	1.90	1.45	30.7	2.7	**1.5**	145	160	145	199	**162**		P	
							1.80	1.38	30.1	2.7	**7.1**								
S17 084-2	2660313.762	6510518.293	8.233	Shear Key 1E Undercut	CMO	24/05/2017	1.78	1.37	30.3	2.7	**8.0**	191	214	214	183	**201**		P	
							1.79	1.41	27.1	2.7	**9.7**								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S17 085-4	2660327.709	6510515.819	13.06	Shear Key 1E Undercut	CMO	25/05/2017	1.81	1.35	33.6	2.7	**4.3**	153	168	183	214	**180**		P	
							1.84	1.39	31.9	2.7	**3.8**								
S17 086 -1	2660326.459	6510516.023	13.147	Shear Key 1E Undercut	CMO	26/05/2017	1.77	1.30	36.4	2.7	**4.7**	186	179	196	214	**194**		P	
							1.77	1.28	38.5	2.7	**3.5**								
S17 086 -2	2660312.215	6510516.296	11.106	Shear Key 1E Undercut	CMO	26/05/2017	1.77	1.30	35.9	2.7	**5.0**	214	180	189	214	**199**		P	
							1.80	1.33	35.0	2.7	4.0								
S17 086-6	2660292.151	6510505.293	12.021	Shear Key 1E Undercut	CMO	26/05/2017	1.79	1.32	35.4	2.7	4.2	186	183	174	206	**187**		P	
							1.78	1.31	36.0	2.7	4.4								
S17 086-7	2660304.23	6510503.319	12.258	Shear Key 1E Undercut	CMO	26/05/2017	1.79	1.32	35.70	2.7	4.10	206	214	179	214	**203**		P	
							1.78	1.30	37.10	2.7	3.70								
S17 089-1	2660305.016	6510516.271	11.587	Behind Wall 5	TA	1/06/2017	1.78	1.28	38.4	2.7	3.1	153	168	141	199	**165**		P	
							1.79	1.29	38.4	2.7	2.4								
S17 089-1	2660305.552	6510536.651	13.882	Behind Wall 5	TA	7/06/2017	1.77	1.33	33.10	2.7	6.8	199	176	214	214	**201**		P	
							1.79	1.34	33.10	2.7	5.9								
S17 093-1				Behind Wall 5	TA	12/06/2017	1.80	1.32	36.30	2.7	3.2	161	153	183	176	**168**		P	
							1.80	1.32	36.30	2.7	3.2								
S17 093-2				Behind Wall 5	TA	12/06/2017	1.86	1.36	36.1	2.7	0.3	168	183	183	214	**187**		P	
							1.86	1.36	36.1	2.7	0.2								
S17 096-7	2660321.772	6510502.941	12.544	Behind Wall 5	TA	15/06/2017	1.80	1.32	36.2	2.7	3.4	214	183	199	153	**187**		P	
							1.79	1.32	36.2	2.7	3.6								
S17 098-4	2660285.862	6510519.272	10.986	Behind Wall 5	TA	19/06/2017	1.82	1.35	35.3	2.7	2.5	214	214	214	214	**214**		P	
							1.82	1.35	35.3	2.7	2.5								
S17 100-1	2660299.507	6510517.751	12.511	Undercut Behind Wall 5	TA	21/06/2017	1.87	1.43	30.9	2.7	3.0	153	183	191	214	**185**		P	
							1.89	1.44	30.9	2.7	2.0								
S17 102-2	2660269.53	6510511.608	12.852	Behind Wall 5	TA	29/06/2017	1.81	1.32	37.7	2.7	1.7	199	214	153	168	**184**		P	
							1.82	1.32	37.7	2.7	1.0								
S17 104-1	2660290.105	6510532.376	13.514	Behind Wall 5	TA	30/06/2017	1.82	1.41	29.0	2.7	7.0	145	191	199	161	**174**		P	
							1.81	1.41	29.0	2.7	7.1								
S17 108-1	2660350.11	6510500.997	13.515	Behind Wall 5	TA	1/08/2017	1.84	1.32	39.6	2.7	0.0	199	214	183	141	**184**		P	
							1.83	1.31	39.6	2.7	0.0								
S17 108-2	2660315.747	6510502.73	13.495	Behind Wall 5	TA	1/08/2017	1.83	1.31	39.8	2.7	0.0	168	183	183	214	**187**		P	
							1.83	1.31	39.8	2.7	0.0								
				Infront of wall 5	TA	4/08/2017	1.84	1.33	38.20	2.7	0.0	145	168	183	199	**174**		P	
							1.84	1.33	38.20	2.7	0.0								
S17 113-1	2660268.381	6510508.331	13.575	Behind Wall 5	TA	23/08/2017	1.85	1.39	33.5	2.7	2.0	183	199	214	214	**203**		P	
							1.86	1.40	33.5	2.7	1.5								
S17 114-1				Behind Wall 5	TA	25/08/2017	1.83	1.36	34.4	2.7	2.6	183	199	214	167	**191**		P	
							1.84	1.37	34.4	2.7	2.3								
S17 115-3	2660262.531	6510513.385	13.679	Behind Wall 5	TA	5/09/2017	1.78	1.33	33.9	2.7	5.5	141	168	153	153	**154**		P	
							1.78	1.33	33.9	2.7	5.9								
S17 115-4	2660249.561	6510514.197	13.789	Behind Wall 5	TA	5/09/2017	1.80	1.35	34.0	2.7	4.4	153	168	141	150	**153**		P	
							1.80	1.34	34.0	2.7	4.7								
S17 118-1	2660250.110	6510513.048	14.674	Behind Wall 5	CBEN	20/09/2017	1.87	1.44	29.7	2.7	3.8	183	168	153	214	**180**		P	
							1.87	1.44	29.7	2.7	3.7								
S17 122-1	2660227.393	6510518.128	15.432	Behind Wall 5	CBEN	4/10/2017	1.83	1.34	36.8	2.7	1.2	102	117	117	131	**117**		P	
							1.83	1.34	36.8	2.7	1.1								
S17 122-6				Behind Wall 5	CBEN	4/10/2017	1.82	1.37	33.3	2.7	4.0	146	160	175	175	**164**		P	
							1.84	1.38	33.3	2.7	3.1								
S17 124	2660239.721	6510518.267	15.981	Behind Wall 5 W End	CBEN	6/10/2017	1.85	1.39	32.7	2.7	3.0	153	128	120	131	**133**		P	
							1.86	1.40	32.7	2.7	2.4								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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) Test 1	Test 2	Test 3	Test 4	Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
S17 124	2660371.068	6510522.322	15.951	Behind Wall 5 W End	CBEN	6/10/2017	1.81	1.31	38.5	2.7	1.3	134	137	175	204	**163**		P	
							1.81	1.31	38.5	2.7	1.1								
S17 128-2	2660230.294	6510519.133	16.946	Behind Wall 5	CBEN	13/10/2017	1.84	1.34	37.2	2.7	0.5	146	160	175	190	**168**		P	
							1.84	1.34	37.2	2.7	0.2								
S17 131-3	GPS ERROR			Behind Wall 5 W End	CBEN	18/10/2017	1.78	1.30	37.0	2.7	4.0	204	204	204	204	**204**		P	
							1.77	1.29	37.0	2.7	4.3								
S17 131-4	GPS ERROR			Behind Wall 5 W End	CBEN	18/10/2017	1.76	1.29	36.2	2.7	5.2	204	204	204	204	**204**		P	
							1.77	1.30	36.2	2.7	4.9								
S17 132-7	2660240.228	6510527.118	17.924	Behind wall 5	CBEN	19/10/2017	1.80	1.35	33.2	2.7	5.1	204	204	204	204	**204**		P	
							1.81	1.36	33.2	2.7	4.4								
S17 134-6	2660229.173	6510522.502	18.170	Behind wall 5	CBEN	25/10/2017	1.89	1.47	28.5	2.7	3.4	175	175	190	204	**186**		P	
							1.91	1.48	28.5	2.7	2.8								
S17 140-5	2660229.876	6510504.906	15.361	Infront of wall 5	CBEN	1/11/2017	1.72	1.26	37.3	2.7	6.7	160	175	175	204	**179**		P	
							1.71	1.25	37.3	2.7	7.4								
S17 142-1	2660246.859	6510535.204	16.609	W of slip remediation	CBEN	3/11/2017	1.80	1.35	33.5	2.7	4.8	190	190	160	204	**186**		P	
							1.82	1.36	33.5	2.7	3.8								
S17 143-1	2660227.120	6510531.117	19.222	W of slip remediation	CBEN	6/11/2017	1.85	1.39	33.4	2.7	2.4	204	160	160	175	**175**		P	
							1.85	1.39	33.4	2.7	2.1								
S17 143-2	2660241.690	6510541.521	19.237	W of slip remediation	CBEN	6/11/2017	1.83	1.38	33.1	2.7	3.5	204	204	204	160	**193**		P	
							1.84	1.38	33.1	2.7	3.1								
S17 144-1	2660336.054	6510533.507	12.077	Slip Remediation	CBEN	7/11/2017	1.78	1.34	33.4	2.7	5.9	146	160	204	204	**179**		P	
							1.79	1.34	33.4	2.7	5.6								
S17 144-2	2660339.677	6510538.046	12.758	Slip Remediation	CBEN	7/11/2017	1.78	1.36	30.9	2.7	7.8	204	146	182	160	**173**		P	
							1.79	1.37	30.9	2.7	7.2								
S17 144-5	2660341.266	6510529.198	14.364	Slip Remediation	CBEN	7/11/2017	1.90	1.45	30.7	2.7	1.6	175	175	175	175	**175**		P	
							1.89	1.45	30.7	2.7	1.9								
S17 144-7				Slip Remediation	CBEN	7/11/2017	1.86	1.37	35.5	2.7	0.5	146	160	204	197	**177**		P	
							1.85	1.36	35.5	2.7	1.1								
S17 145-1	2660342.099	6510538.419	16.242	Slip Remediation	CBEN	9/11/2017	1.91	1.48	29.3	2.7	2.1	142	149	156	170	**154**		P	
							1.91	1.47	29.3	2.7	2.2								
S17 145-9	2660307.226	6510537.126	6.281	Slip Remediation	CBEN	9/11/2017	1.83	1.39	31.7	2.7	4.4	149	170	199	199	**179**		P	
							1.83	1.39	31.7	2.7	4.7								
S17 145-10	2660308.156	6510537.818	5.799	Slip Remediation RL5	CBEN	9/11/2017	1.79	1.34	33.60	2.7	5.4	170	170	184	199	**181**		P	
							1.80	1.34	33.60	2.7	5.1								
S17 145-11	2660307.100	6510534.642	7.211	Slip Remediation RL6	CBEN	9/11/2017	1.83	1.39	31.5	2.7	4.5	156	170	184	199	**177**		P	
							1.83	1.39	31.5	2.7	4.8								
S17 145-12	2660307.987	6510540.487	7.565	Slip Remediation RL7	CBEN	9/11/2017	1.79	1.33	34.0	2.7	5.2	156	184	199	199	**185**		P	
							1.77	1.32	34.0	2.7	6.1								
S17 146-1	2660308.911	6510537.798	10.273	Slip Remediation	CBEN	10/11/2017	1.87	1.41	32.4	2.7	2.0	160	204	204	204	**193**		P	
							1.86	1.41	32.4	2.7	2.4								
S17 148-1	2660194.384	6510515.069	20.516	RE Wall W of Wall 5	CBEN	14/11/2017	1.81	1.37	32.4	2.7	5.0	160	175	204	204	**186**		P	
							1.81	1.37	32.4	2.7	4.9								
S17 148-2	2660181.336	6510512.432	20.293	RE Wall W of Wall 5	CBEN	14/11/2017	1.81	1.38	31.40	2.7	5.6	204	190	160	160	**179**		P	
							1.81	1.37	31.40	2.7	6.0								
S17 148-3	2660177.952	6510521.298	23.032	RE Wall W of Wall 5	CBEN	14/11/2017	1.83	1.38	32.6	2.7	3.8	204	175	168	146	**173**		P	
							1.82	1.37	32.6	2.7	4.6								
S17 148-4	2660169.666	6510520.966	22.232	RE Wall W of Wall 5	CBEN	14/11/2017	1.83	1.38	32.3	2.7	4.3	204	204	160	204	**193**		P	
							1.82	1.37	32.3	2.7	4.8								
S17 150-8	2660318.248	6510532.330	9.857	Slip Remediation	CBEN	16/11/2017	1.82	1.33	37.1	2.7	1.7	160	175	190	204	**182**		P	
							1.82	1.33	37.1	2.7	1.4								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point | Client: Tonkin & Taylor | Job # 21854.037

T&T Job #: 21854.0370 | Entered By: TA/CBEN/CMO | 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) Test 1	Test 2	Test 3	Test 4	Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
S17 150-9	2660318.720	6510540.405	9.246	Slip Remediation	CBEN	16/11/2017	1.83	1.36	34.4	2.7	2.9	168	160	204	204	**184**		P	
							1.83	1.36	34.4	2.7	2.7								
S17 150-12	2660318.512	6510532.041	10.924	Slip Remediation	CBEN	16/11/2017	1.84	1.38	33.9	2.7	2.5	175	175	160	175	**171**		P	
							1.84	1.37	33.9	2.7	2.7								
S17 151-4	2660323.234	6510530.582	12.560	Slip Remediation	CBEN	17/11/2017	1.77	1.31	34.8	2.7	5.8	146	160	160	204	**168**		P	
							1.77	1.31	34.8	2.7	5.8								
S17 151-5				Slip Remediation	CBEN	17/11/2017	1.84	1.40	31.3	2.7	4.2	146	160	160	190	**164**		P	
							1.84	1.40	31.3	2.7	4.0								
S17 153-2	2660328.216	6510535.531	15.350	Slip Remediation	CBEN	21/11/2017	1.89	1.41	33.5	2.7	0.3	160	146	204	204	**179**		P	
							1.88	1.41	33.5	2.7	0.4								
S17 154-1	2660308.558	6510535.489	9.246	Slip Remediation	CBEN	22/11/2017	1.87	1.41	32.0	2.7	2.4	146	204	182	204	**184**		P	
							1.88	1.42	32.0	2.7	1.9								
S17 154-2	2660298.159	6510537.922	7.327	Slip Remediation	CBEN	22/11/2017	1.86	1.40	33.1	2.7	1.8	146	160	160	204	**168**		P	
							1.86	1.40	33.1	2.7	2.0								
S17 154-3	2660303.972	6510533.580	9.404	Slip Remediation	CBEN	22/11/2017	1.87	1.43	31.2	2.7	2.7	175	182	190	160	**177**		P	
							1.88	1.43	31.2	2.7	2.5								
S17 154-8	2660333.876	6510538.316	32.018	Slip Remediation	CBEN	22/11/2017	1.85	1.39	32.6	2.7	2.9	160	175	204	160	**175**		P	
							1.86	1.40	32.6	2.7	2.2								
S17 155-1	2660302.608	6510539.793	8.139	Slip Remediation	CBEN	23/11/2017	1.86	1.39	33.6	2.7	1.9	160	160	204	204	**182**		P	
							1.85	1.38	33.6	2.7	2.2								
S17 155-3	2660285.007	6510533.688	7.460	Slip Remediation	CBEN	23/11/2017	1.85	1.46	27.4	2.7	6.2	175	160	146	204	**171**		P	
							1.86	1.46	27.4	2.7	5.8								
S17 155-4				Slip Remediation	CBEN	23/11/2017	1.84	1.40	32.0	2.7	3.7	204	204	204	204	**204**		P	
							1.86	1.41	32.0	2.7	3.0								
S17 156-8	2660298.486	6510533.013	10.180	Slip Remediation	TA	24/11/2017	1.85	1.45	28.10	2.7	5.7	160	190	204	146	**175**		P	
							1.87	1.46	28.10	2.7	5.1								
S17 156-9	2660278.300	6510532.057	10.037	Slip Remediation	TA	24/11/2017	1.84	1.39	32.10	2.7	3.6	204	146	146	190	**172**		P	
							1.84	1.39	32.10	2.7	3.6								
S17 157-1	2660271.580	6510532.252	9.958	Slip Remediation	CBEN	27/11/2017	1.94	1.50	29.70	2.7	0.2	182	182	204	204	**193**		P	
							1.94	1.50	29.70	2.7	0.1								
S17 157-2				Slip Remediation	CBEN	27/11/2017	1.91	1.51	25.90	2.7	4.8	160	190	204	204	**190**		P	
							1.91	1.52	25.90	2.7	4.3								
S17 157-3	2660301.647	6510533.987	11.512	Slip Remediation	CBEN	27/11/2017	1.91	1.49	27.60	2.7	3.4	204	204	204	204	**204**		P	
							1.91	1.50	27.60	2.7	3.2								
S17 157-4	2660292.544	6510531.294	11.949	Slip Remediation	CBEN	27/11/2017	1.88	1.45	30.0	2.7	3.0	160	204	160	175	**175**		P	
							1.87	1.44	30.0	2.7	3.8								
S17 157-5	2660273.522	6510532.665	12.006	Slip Remediation	CBEN	27/11/2017	1.91	1.44	32.8	2.7	0.0	146	146	175	204	**168**		P	
							1.88	1.42	32.8	2.7	0.9								
S17 158-1	2660289.906	6510537.714	11.988	Slip Remediation	CBEN	28/11/2017	1.90	1.51	26.2	2.7	4.6	146	204	204	204	**190**		P	
							1.88	1.49	26.2	2.7	5.8								
S17 158-2				Slip Remediation	CBEN	28/11/2017	1.86	1.54	21.0	2.7	10.6	146	204	204	204	**190**		P	
							1.91	1.58	21.0	2.7	8.6								
S17 158-5				Slip Remediation	CBEN	28/11/2017	1.82	1.35	34.5	2.7	3.5	139	153	160	204	**164**		P	
							1.81	1.35	34.5	2.7	3.7								
S17 158-6				Slip Remediation	CBEN	28/11/2017	1.88	1.42	32.7	2.7	1.2	139	153	160	204	**164**		P	
							1.87	1.41	32.7	2.7	1.5								
S17 159-1	2660272.525	6510528.943	13.656	Slip Remediation	CBEN	29/11/2017	1.89	1.42	32.8	2.7	0.6	146	160	204	146	**164**		P	
							1.91	1.44	32.8	2.7	0.0								
S17 159-2	2660290.806	6510524.728	14.600	Slip Remediation	CBEN	29/11/2017	1.91	1.42	34.6	2.7	0.0	204	146	146	175	**168**		P	
							1.90	1.41	34.6	2.7	0.0								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S17 159-9				Slip Remediation	CBEN	29/11/2017	1.86	1.40	33.0	2.7	2.0	175	175	160	204	**179**		P	
							1.87	1.41	33.0	2.7	1.4								
S17 159-10				Slip Remediation	CBEN	29/11/2017	1.87	1.41	32.7	2.7	1.6	175	160	175	204	**179**		P	
							1.86	1.40	32.7	2.7	2.0								
S17 160-1	2660302.768	6510543.686	14.525	Slip Remediation	CBEN	30/11/2017	1.88	1.43	31.0	2.7	2.6	175	146	204	204	**182**		P	
							1.87	1.43	31.0	2.7	3.0								
S17 160-2	2660271.592	6510543.383	17.185	Slip Remediation	CBEN	30/11/2017	1.86	1.41	32.2	2.7	2.5	160	160	146	175	**160**		P	
							1.86	1.41	32.2	2.7	2.4								
S17 161-1	2660268.192	6510524.045	10.643	Slip Remediation	CBEN	1/12/2017	1.86	1.41	32.2	2.7	2.4	204	204	204	204	**204**		P	
							1.87	1.41	32.2	2.7	2.2								
S17 161-2	2660304.163	6510521.469	14.638	Slip Remediation	CBEN	1/12/2017	1.83	1.39	32.3	2.7	3.9	204	204	204	204	**204**		P	
							1.82	1.38	32.3	2.7	4.4								
S17 161-7	2660260.205	6510539.472	17.487	Slip Remediation	CBEN	1/12/2017	1.94	1.47	31.5	2.7	0.0	146	204	204	204	**190**		P	
							1.95	1.48	31.5	2.7	0.0								
S17 161-8	2660300.821	6510536.493	16.701	Slip Remediation	CBEN	1/12/2017	1.80	1.34	34.7	2.7	3.9	146	160	204	204	**179**		P	
							1.81	1.34	34.7	2.7	3.5								
S17 162-2	2660276.831	6510542.221	17.56	Slip Remediation	CBEN	4/12/2017	1.87	1.39	34.8	2.7	0.3	204	204	204	204	**204**		P	
							1.88	1.40	34.8	2.7	0.0								
S17 162-8	2660257.378	6510537.578	18.425	Slip Remediation	CBEN	4/12/2017	1.89	1.54	23.3	2.7	7.3	204	204	204	204	**204**		P	
							1.89	1.54	23.3	2.7	7.3								
S17 162-10	2660282.463	6510544.274	19.099	Slip Remediation	CBEN	4/12/2017	1.88	1.42	32.6	2.7	1.4	160	160	175	190	**171**		P	
							1.89	1.42	32.6	2.7	0.8								
S17 164-9	2660272.014	6510551.314	20.625	Slip Remediation	CBEN	6/12/2017	1.89	1.49	27.2	2.7	4.5	204	204	204	204	**204**		P	
							1.91	1.50	27.2	2.7	3.5								
S17 168-1	2660355.238	6510536.396	18.454	RE Wall 3 RL 18	CBEN	11/12/2017	1.90	1.41	34.6	2.7	0.0	204	204	204	204	**204**		P	
							1.91	1.42	34.6	2.7	0.0								
S17 169-1	2660326.436	6510537.513	20.15	RE Wall 3 RL19	CBEN	12/12/2017	1.87	1.48	25.7	2.7	6.9	204	204	204	204	**204**		P	
							1.87	1.48	25.7	2.7	6.9								
S17 171-2	2660310.664	6510542.643	20.357	RE Wall 3 RL 20	CBEN	14/12/2017	1.89	1.50	26.2	2.7	5.1	160	190	175	204	**182**		P	
							1.90	1.50	26.2	2.7	4.8								
S17 172-1	2660270.684	6510551.266	19.165	RE Wall 3 RL 20.5	CBEN	15/12/2017	1.85	1.45	27.1	2.7	6.8	204	204	204	204	**204**		P	
							1.86	1.46	27.1	2.7	6.2								
S17 172-2	2660357.51	6510538.94	20.737	RE Wall 3 RL 20.5	CBEN	15/12/2017	1.88	1.47	28.1	2.7	4.5	204	204	204	204	**204**		P	
							1.86	1.45	28.1	2.7	5.4								
S17 174-5	2660271.7	6510550.1	21.36	RE Wall 3 RL 21.5	CBEN	19/12/2017	1.87	1.39	34.5	2.7	0.7	204	175	140	160	**170**		P	
							1.86	1.38	34.5	2.7	1.1								
S18 006-8	2660025.847	6510498.896	22.994	RE Wall 3 RL 30	CBEN	15/01/2018	1.85	1.38	33.9	2.7	1.9	204	204	204	204	**204**		P	
							1.86	1.39	33.9	2.7	1.3								
S18 006-9	2660041.077	6510531.932	26.037	RE Wall 3 RL 30	CBEN	15/01/2018	1.86	1.38	34.1	2.7	1.5	204	204	204	204	**204**		P	
							1.87	1.39	34.1	2.7	1.0								
S18 008-9	2660003.789	6510489.795	19.081	West Boundary by Site Office	CBEN	17/01/2018	1.85	1.38	34.4	2.7	1.7	140	110	120	100	**118**		P	
							1.85	1.37	34.4	2.7	1.9								
S18 015-9	2660010.933	6510481.032	19.625	SW Bondary Corner	CBEN	26/01/2018	1.90	1.38	37.4	2.7	0.0	146	204	204	204	**190**		P	
							1.89	1.37	37.4	2.7	0.0								
S18 017-3	2660022.945	6510480.925	21.427	SW Bondary Corner	CBEN	30/01/2018	1.83	1.35	34.8	2.7	2.7	146	175	204	204	**182**		P	
							1.82	1.35	34.8	2.7	3.3								
S18 020-1	2660211.584	6510561.992	17.832	Shear Key 2018	CBEN	7/02/2018	1.91	1.46	31.1	2.7	0.7	204	204	204	204	**204**		P	
							1.91	1.46	31.1	2.7	0.7								
S18 020-4	2660211.319	6510557.399	20.426	Shear Key 2018	CBEN	7/02/2018	1.91	1.46	31.1	2.7	0.7	190	175	204	204	**193**		P	
							1.91	1.46	31.1	2.7	0.8								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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) Test 1	Test 2	Test 3	Test 4	Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
S18 021-1	2660205.889	6510562.837	21.852	Shear Key 2018	CBEN	8/02/2018	1.89	1.45	30.5	2.7	2.4	160	146	140	140	**147**		P	
							1.88	1.44	30.5	2.7	2.8								
S18 021-2	2660193.9	6510560.713	22.245	Shear Key 2018	CBEN	8/02/2018	1.88	1.45	30.0	2.7	3.0	146	140	140	160	**147**		P	
							1.88	1.45	30.0	2.7	3.0								
S18 021-3	2660224.953	6510555.526	22.344	Shear Key 2018	CBEN	8/02/2018	1.83	1.37	33.2	2.7	3.6	140	140	146	160	**147**		P	
							1.85	1.39	33.2	2.7	2.5								
S18 021-4	2660096.963	6510545.566	30.043	Undercut S Boundary	CBEN	8/02/2018	1.87	1.43	30.4	2.7	3.4	140	140	160	204	**161**		P	
							1.87	1.43	30.4	2.7	3.3								
S18 021-5	2660086.401	6510539.734	30.185	Undercut S Boundary	CBEN	8/02/2018	1.87	1.44	29.8	2.7	3.7	204	160	160	140	**166**		P	
							1.86	1.44	29.8	2.7	4.1								
S18 025-1	2660211.035	6510556.95	23.196	Undercut S Boundary	CBEN	15/02/2018	1.83	1.37	34.0	2.7	2.8	204	204	204	204	**204**		P	
							1.84	1.37	34.0	2.7	2.5								
S18 025-2	2660203.631	6510567.483	23.623	Undercut S Boundary	CBEN	15/02/2018	1.81	1.34	34.8	2.7	3.8	204	204	204	204	**204**		P	
							1.82	1.35	34.8	2.7	3.0								
S18 026-1	2660182.056	6510564.049	24.951	Shear Key 2018	CBEN	16/02/2018	1.84	1.36	35.3	2.7	1.5	140	146	146	140	**143**		P	
							1.83	1.36	35.3	2.7	1.9								
S18 027-2	2660177.696	6510564.491	26.292	RE Wall RL 25.5	CBEN	19/02/2018	1.90	1.48	28.2	2.7	3.3	160	204	204	204	**193**		P	
							1.90	1.49	28.2	2.7	3.1								
S18 027-4	2660203.974	6510569.238	26.055	RE Wall RL 26	CBEN	19/02/2018	1.88	1.40	34.6	2.7	0.0	140	140	204	204	**172**		P	
							1.88	1.40	34.6	2.7	0.0								
S18 028-1	2660189.972	6510571.374	26.751	RE Wall RL 27	CBEN	20/02/2018	1.91	1.50	27.3	2.7	3.3	160	160	204	204	**182**		P	
							1.91	1.50	27.3	2.7	3.7								
S18 029-4	2660197.702	6510569.15	28.565	RE Wall RL 28.5	CBEN	21/02/2018	1.86	1.44	29.5	2.7	4.4	204	204	204	204	**204**		P	
							1.87	1.44	29.5	2.7	3.9								
S18 031-1	2660173.033	6510581.17	29.639	RE Wall RL 29.5	CBEN	23/02/2018	1.93	1.55	24.5	2.7	4.4	204	204	204	204	**204**		P	
							1.96	1.57	24.5	2.7	3.4								
S18 033-7	2660189.708	6510585.08	39.795	RE Wall RL 32.5	CBEN	27/02/2018	1.84	1.46	26.2	2.7	7.8	204	204	204	204	**204**		P	
							1.84	1.46	26.2	2.7	7.6								
S18 034-1	2660193.61	6510583.545	33.092	RE Wall RL	CBEN	28/02/2018	1.97	1.58	24.5	2.7	2.7	204	204	204	204	**204**		P	
							1.95	1.57	24.5	2.7	3.4								
S18 035-1	2660203.901	6510581.345	34.597	RE Wall RL	CBEN	1/03/2018	1.95	1.52	28.3	2.7	0.8	204	204	204	204	**204**		P	
							1.94	1.51	28.3	2.7	1.1								
S18 035-5	2660184.89	6510578.234	27.624	RE Wall RL	CBEN	1/03/2018	1.86	1.42	31.1	2.7	3.5	204	204	204	204	**204**		P	
							1.87	1.42	31.1	2.7	3.0								
S18 036-1	2660095.511	6510545.359	30.353	Between Site Entrance and RE Wall	CBEN	2/03/2018	1.86	1.44	29.1	2.7	4.8	204	204	204	204	**204**		P	
							1.84	1.43	29.1	2.7	5.6								
S18 036-2	2660076.174	6510556.661	30.732	Between Site Entrance and RE Wall	CBEN	2/03/2018	1.88	1.41	33.3	2.7	0.8	175	175	204	204	**190**		P	
							1.88	1.41	33.3	2.7	0.6								
S18 037-1	2660107.784	6510562.958	30.915	N of RE Wall	CBEN	5/03/2018	1.86	1.41	31.7	2.7	2.9	204	204	204	204	**204**		P	
							1.85	1.41	31.7	2.7	3.2								
S18 037-2	2660084.333	6510572.84	30.436	N of RE Wall	CBEN	5/03/2018	1.87	1.42	31.3	2.7	2.8	204	204	204	204	**204**		P	
							1.86	1.42	31.3	2.7	3.2								
S18 038-1	2660110.631	6510583.871	30.113	Between Site Entrance and RE Wall	CBEN	6/03/2018	1.83	1.39	31.8	2.7	4.3	146	146	160	175	**157**		P	
							1.83	1.39	31.8	2.7	4.3								
S18 038-2	2660080.616	6510593.233	28.612	Between Site Entrance and RE Wall	CBEN	6/03/2018	1.86	1.43	29.5	2.7	4.6	175	160	146	146	**157**		P	
							1.85	1.43	29.5	2.7	4.8								
S18 038-3	2660086.984	6510578.306	31.334	Between Site Entrance and RE Wall	CBEN	6/03/2018	1.86	1.44	29.3	2.7	4.4	190	175	160	146	**168**		P	
							1.86	1.44	29.3	2.7	4.4								
S18 038-4	2660099.594	6510572.35	31.257	Between Site Entrance and RE Wall	CBEN	6/03/2018	1.90	1.52	24.6	2.7	6.1	146	160	160	146	**153**		P	
							1.90	1.52	24.6	2.7	6.2								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point
Client: Tonkin & Taylor
T&T Job #: 21854.0370
Job # 21854.037
Entered By: TA/CBEN/CMO
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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S18 040-1	2660167.245	6510512.39	20.838	RE Wall W of Wall 5	CBEN	8/03/2018	1.83	1.37	33.8	2.7	2.9	160	160	190	204	**179**		P	
							1.85	1.38	33.8	2.7	2.1								
S18 040-2	2660157.675	6510515.002	21.266	RE Wall W of Wall 5	CBEN	8/03/2018	1.84	1.38	33.8	2.7	2.4	204	190	160	160	**179**		P	
							1.85	1.38	33.8	2.7	2.0								
S18 041-1	2660162.112	6510516.382	21.565	RE Wall W of Wall 5	CBEN	9/03/2018	1.80	1.35	33.3	2.7	4.9	160	160	146	175	**160**		P	
							1.80	1.35	33.3	2.7	4.8								
S18 041-7	2660149.973	6510515.954	22.638	RE Wall W of Wall 5	CBEN	9/03/2018	1.83	1.39	32.1	2.7	4.1	204	204	204	204	**204**		P	
							1.82	1.38	32.1	2.7	4.6								
S18 041-8	2660156.802	6510516.659	22.924	RE Wall W of Wall 5	CBEN	9/03/2018	1.83	1.39	31.7	2.7	4.5	204	204	204	204	**204**		P	
							1.84	1.40	31.7	2.7	3.9								
S18 042-1	2660148.068	6510518.58	23.9	RE Wall W of Wall 5	CBEN	12/02/2018	1.90	1.51	25.6	2.7	5.4	204	204	204	204	**204**		P	
							1.89	1.51	25.6	2.7	5.6								
S18 042-2	2660161.891	6510521.068	25.335	RE Wall W of Wall 5	CBEN	12/03/2018	1.89	1.48	28.3	2.7	3.5	204	204	204	204	**204**		P	
							1.89	1.47	28.3	2.7	3.9								
S18 043-1	2660148.96	6510519.535	24.395	RE Wall W of Wall 5	CBEN	13/03/2018	1.82	1.38	32.0	2.7	4.6	204	204	204	204	**204**		P	
							1.84	1.39	32.0	2.7	3.8								
S18 043-2	2660158.184	6510519.349	24.838	RE Wall W of Wall 5	CBEN	13/03/2018	1.84	1.39	32.2	2.7	3.9	204	204	204	204	**204**		P	
							1.83	1.38	32.2	2.7	4.2								
S18 044-1	2660137.844	6510521.326	26.69	RE Wall W of Wall 5	CBEN	14/03/2018	1.88	1.43	31.1	2.7	2.3	160	160	175	190	**171**		P	
							1.88	1.44	31.1	2.7	2.1								
S18 044-2	2660154.8	6510521.823	26.278	RE Wall W of Wall 5	CBEN	14/03/2018	1.88	1.44	30.9	2.7	2.4	204	204	204	204	**204**		P	
							1.88	1.43	30.9	2.7	2.5								
S18 045-1	2660149.334	6510523.992	27.261	RE Wall W of Wall 5	CBEN	15/03/2018	1.85	1.41	31.2	2.7	3.8	175	175	204	204	**190**		P	
							1.84	1.40	31.2	2.7	4.3								
S18 045-4	2660169.034	6510623.96	34.613	E of Pond 7/9	CBEN	15/03/2018	1.84	1.42	29.5	2.7	5.5	160	160	146	175	**160**		P	
							1.85	1.43	29.5	2.7	5.0								
S18 049-10	2660050.11	6510607.924	25.569	Pond 7/9	CBEN	21/03/2018	1.81	1.33	36.2	2.7	2.4	204	204	204	204	**204**		P	
							1.83	1.35	36.2	2.7	1.4								
S18 049-11	2660064.277	6510614.738	25.336	Pond 7/9	CBEN	21/03/2018	1.83	1.35	36.0	2.7	1.5	204	204	204	204	**204**		P	
							1.83	1.34	36.0	2.7	2.0								
S18 050-1	2660045.145	6510611.176	25.797	Pond 7/9	CBEN	22/03/2018	1.83	1.40	31.0	2.7	5.0	204	204	204	204	**204**		P	
							1.82	1.39	31.0	2.7	5.3								
S18 050-2	2660065.881	6510616.036	25.588	Pond 7/9	CBEN	22/03/2018	1.83	1.37	34.0	2.7	2.8	204	204	204	204	**204**		P	
							1.83	1.37	34.0	2.7	2.8								
S18 050-5	2660056.563	6510611.38	27.895	Pond 7/9	CBEN	22/03/2018	1.84	1.42	29.6	2.7	5.6	204	204	204	204	**204**		P	
							1.85	1.43	29.6	2.7	5.0								
S18 052-5	2660060.252	6510615.17	27.017	Pond 7/9	CBEN	27/03/2018	1.86	1.42	31.2	2.7	3.1	204	204	204	204	**204**		P	
							1.87	1.42	31.2	2.7	2.9								
S18 052-6	2660051.253	6510592.829	29.243	Pond 7/9	CBEN	27/03/2018	1.86	1.42	30.8	2.7	3.5	204	204	204	204	**204**		P	
							1.85	1.42	30.8	2.7	3.9								
S18 065-10	2660177.307	6510609.673	33.868	Undercut Road 3	ELHO	20/04/2018	1.83	1.36	34.9	2.7	2.3	204	204	204	204	**204**		P	
							1.83	1.36	34.9	2.7	2.2								
S18 065-11	2660175.468	6510609.559	32.775	Undercut Road 3	ELHO	20/04/2018	1.84	1.35	36.1	2.7	1.0	204	204	204	204	**204**		P	
							1.84	1.35	36.1	2.7	1.1								
S18 065-12	2660139.895	6510616.278	31.191	Undercut Road 3	ELHO	20/04/2018	1.88	1.43	31.0	2.7	2.5	204	204	204	204	**204**		P	
							1.86	1.42	31.0	2.7	3.3								
S18 065-13	2660139.368	6510617.935	30.254	Undercut Road 3	ELHO	20/04/2018	1.87	1.43	31.0	2.7	2.6	204	204	204	204	**204**		P	
							1.86	1.42	31.0	2.7	3.5								
S18 156-2	2659993.679	6510500.708	19	Stage 5 SW Corner	CBEN	9/10/2018	1.88	1.48	27.0	2.7	5.4	168	196	168	168	**175**		P	
							1.89	1.49	27.0	2.7	4.6								
S18 156-3	2659992.23	6510520.426	20.076	Stage 5 SW Corner	CBEN	9/10/2018	1.80	1.35	33.1	2.7	5.1	154	168	168	182	**168**		P	
							1.80	1.35	33.1	2.7	5.1								
S18 157-4	2659990.997	6510516.239	21.085	Stage 5 SW Corner	CBEN	10/10/2018	1.87	1.52	22.9	2.7	8.9	196	196	196	196	**196**		P	
							1.86	1.51	22.9	2.7	9.4								
S18 157-5	2659993.745	6510501.037	19.944	Stage 5 SW Corner	CBEN	10/10/2018	1.88	1.48	27.5	2.7	4.8	196	196	196	196	**196**		P	
							1.88	1.48	27.5	2.7	4.7								
S18 160-6	2659995.702	6510523.871	22.431	Stage 5 SW Corner	CBEN	17/10/2018	1.87	1.45	29.1	2.7	4.4	154	154	196	154	**165**		P	
							1.85	1.44	29.1	2.7	5.0								
S18 162-3	2659988.28	6510505.149	20.905	Stage 5 SW Corner	CBEN	18/10/2018	1.82	1.45	25.6	2.7	9.3	196	196	196	196	**196**		P	
							1.81	1.44	25.6	2.7	9.6								
S18 162-4	2659993.199	6510527.411	23.071	Stage 5 SW Corner	CBEN	18/10/2018	1.83	1.45	26.3	2.7	8.1	196	196	196	196	**196**		P	
							1.84	1.46	26.3	2.7	7.6								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point **Client: Tonkin & Taylor** **Job # 614089.032/1**

T&T Job #: 21854.0037 **Entered By:** YA

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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S14-021/3	2659982.342	6510566.312	23.837	Bulk Earthworks	YA	30/09/2014	1.79	**1.35**	**32.8**	2.7	**5.8**	154	157	140	150	**150**		**P**	
							1.79	**1.35**	**32.8**	2.7	**5.9**								
S14-025/1	2659983.9	6510558.757	24.28	Bulk Earthworks	YA	2/10/2014	1.76	**1.29**	**36.3**	2.7	**5.4**	127	137	154	157	**144**		**P**	
							1.76	**1.29**	**36.3**	2.7	**5.6**								
S14-025/2	2659984.222	6510588.862	24.47	Bulk Earthworks	YA	2/10/2014	1.78	**1.30**	**36.2**	2.7	**4.5**	130	147	154	161	**148**		**P**	
							1.77	**1.30**	**36.2**	2.7	**5.1**								
S14-044/2	2659986.544	6510580.69	27.417	Bulk Earthworks	YA	10/10/2014	1.76	**1.27**	**38.8**	2.7	**3.9**	137	154	171	188	**163**		**P**	
							1.76	**1.27**	**38.8**	2.7	**3.8**								
S14-044/3	2659983.738	6510558.36	26.898	Bulk Earthworks	YA	10/10/2014	1.75	**1.28**	**36.5**	2.7	**5.6**	137	144	154	168	**151**		**P**	
							1.76	**1.29**	**36.5**	2.7	**5.2**								
S14-138/1	2660336.172	6510536.081	12.726	Shear Key	HA	4/12/2014	1.79	**1.30**	**37.7**	2.7	**2.6**	171	180	205	154	**178**		**P**	
							1.82	**1.32**	**37.7**	2.7	**1.2**								
S14-138/2	2660325.847	6510539.432	10.922	Shear Key	HA	4/12/2014	-	-	**-**	-	-	111	120	103	140	**119**	**Y**	**F**	Removal of failed material, retested as Test S14-142/2.
							-	-	**-**	-	-								
S14-142/1	2660335.864	6510536.489	8.101	Shear Key	HA	5/12/2014	1.80	**1.30**	**38.2**	2.7	**2.1**	154	137	162	197	**163**		**P**	
							1.80	**1.30**	**38.2**	2.7	**2.0**								
S14-142/2	2660325.788	6510542.289	7.951	Shear Key	HA	5/12/2014	1.81	**1.33**	**36.5**	2.7	**2.3**	162	171	137	162	**158**		**P**	Retest of Test S14-138/2
							1.80	**1.32**	**36.5**	2.7	**2.9**								
S14-145/2	2660335.918	6510540.439	12.306	Shear Key	HA	5/12/2014	1.71	**1.25**	**37.0**	2.7	**7.7**	145	205	188	171	**177**		**P**	
							1.71	**1.25**	**37.0**	2.7	**7.7**								
S14-148/2	2660332.127	6510539.332	15.389	Shear Key	YA	6/12/2014	1.78	**1.30**	**36.5**	2.7	**4.4**	140	137	154	137	**142**		**P**	
							1.78	**1.30**	**36.5**	2.7	**4.1**								
S14-152/1	2660316.673	6510543.682	16.068	Shear Key	HA	8/12/2014	1.84	**1.32**	**38.5**	2.7	**0.0**	188	205	171	188	**188**		**P**	
							1.84	**1.33**	**38.5**	2.7	**0.0**								
S14-152/2	2660333.843	6510537.812	16.27	Shear Key	HA	8/12/2014	1.81	**1.31**	**37.7**	2.7	**1.8**	137	188	145	205	**169**		**P**	
							1.80	**1.31**	**37.7**	2.7	**2.1**								
S14-155/2	2660329.848	6510532.968	14.945	Shear Key	HA	8/12/2014	1.80	**1.31**	**37.9**	2.7	**2.2**	137	137	188	205	**167**		**P**	
							1.80	**1.30**	**37.9**	2.7	**2.5**								
S14-162/1	2660327.576	6510535.627	15.903	Shear Key	HA	9/12/2014	1.87	**1.38**	**34.8**	2.7	**0.6**	188	154	154	171	**167**		**P**	
							1.86	**1.38**	**34.8**	2.7	**0.8**								
S14-162/2	2660348.096	6510527.459	13.29	Shear Key	HA	9/12/2014	1.74	**1.29**	**34.9**	2.7	**7.1**	188	188	205	137	**180**		**P**	
							1.75	**1.29**	**34.9**	2.7	**6.9**								
S14-166/1	2660337.428	6510537.993	15.332	Shear Key	HA	10/12/2014	1.85	**1.36**	**35.9**	2.7	**0.7**	145	205	180	188	**180**		**P**	
							1.84	**1.36**	**35.9**	2.7	**1.1**								
S14-169/2	2660362.186	6510533.142	14.796	Shear Key	HA	10/12/2014	1.78	**1.27**	**40.3**	2.7	**2.0**	137	154	154	205	**163**		**P**	
							1.78	**1.27**	**40.3**	2.7	**2.0**								
S14-174/1	2660350.436	6510538.277	16.358	Shear Key	HA	11/12/2014	1.83	**1.36**	**34.9**	2.7	**2.5**	162	154	188	205	**177**		**P**	
							1.82	**1.35**	**34.9**	2.7	**2.7**								
S14-195	2660348.265	6510533.371	17.219	Bulk Earthworks	HA	16/12/2014	1.78	**1.30**	**36.9**	2.7	**3.8**	137	137	188	205	**167**		**P**	
							1.79	**1.31**	**36.9**	2.7	**3.2**								
S14-267	2660304.887	6510536.404	9.06	Shear Key	HA	15/01/2015	1.88	**1.45**	**30.1**	2.7	**2.9**	188	205	205	171	**192**		**P**	
							1.88	**1.44**	**30.1**	2.7	**3.2**								
S14-268	2660306.493	6510537.422	10.015	Shear Key	HA	16/01/2015	1.77	**1.31**	**34.8**	2.7	**5.6**	145	205	188	205	**186**		**P**	
							1.77	**1.31**	**34.8**	2.7	**5.7**								
S14-312/1	2660296.735	6510533.815	6.179	Shear Key	HA	23/01/2015	1.89	**1.43**	**32.0**	2.7	**1.0**	205	205	205	205	**205**		**P**	
							1.89	**1.43**	**32.0**	2.7	**1.0**								
S14-316/1	2660296.042	6510535.028	7.652	Shear Key	YA	23/01/2015	1.85	**1.41**	**30.9**	2.7	**3.9**	205	205	205	205	**205**		**P**	
							1.86	**1.42**	**30.9**	2.7	**3.6**								
S14-316/2	2660303.183	6510538.32	9.757	Shear Key	YA	23/01/2015	1.86	**1.43**	**29.4**	2.7	**4.7**	205	205	205	205	**205**		**P**	
							1.86	**1.43**	**29.4**	2.7	**4.7**								
S14-319/1	2660305.135	6510538.977	12.079	Shear Key	YA	24/01/2015	1.87	**1.34**	**39.4**	2.7	**0.0**	154	171	188	205	**180**		**P**	
							1.88	**1.35**	**39.4**	2.7	**0.0**								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point **Client: Tonkin & Taylor** **Job #** **614089.032/1**

T&T Job #: **21854.0037** **Entered By:** YA

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)	Comments These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
												Test 1	Test 2	Test 3	Test 4				
S14-324/1	2660328.237	6510537.338	15.465	Shear Key	HA	27/01/2015	1.86	**1.41**	**31.9**	2.7	**2.6**	205	205	205	205	**205**		**P**	
							1.86	**1.41**	**31.9**	2.7	**3.0**								
S14-324/2	2660314.962	6510538.856	12.225	Shear Key	HA	27/01/2015	1.77	**1.32**	**34.1**	2.7	**6.4**	171	205	205	205	**197**		**P**	
							1.76	**1.31**	**34.1**	2.7	**6.5**								
S14-328/1	2660329.796	6510539.914	15.227	Shear Key	HA	27/01/2015	1.89	**1.42**	**33.3**	2.7	**0.4**	188	205	205	205	**201**		**P**	
							1.90	**1.42**	**33.3**	2.7	**0.0**								
S14-328/2	2660303.98	6510537.537	14.126	Shear Key	HA	27/01/2015	1.72	**1.27**	**35.1**	2.7	**8.4**	205	205	205	205	**205**		**P**	Pass following discussion with AJL, confirming that close to target Air voids.
							1.71	**1.27**	**35.1**	2.7	**8.6**								
S14-328/3	2660304.184	6510538.076	12.38	Shear Key	HA	27/01/2015	1.75	**1.32**	**32.2**	2.7	**8.4**	205	205	205	205	**205**		**P**	Pass following discussion with AJL, confirming that close to target Air voids.
							1.75	**1.32**	**32.2**	2.7	**8.6**								
S14-554/1	2660359.715	6510527.933	16.138	Silt Pond	HA	9/03/2015	1.85	**1.45**	**27.5**	2.7	**6.3**	205	205	205	205	**205**		**P**	
							1.84	**1.44**	**27.5**	2.7	**6.8**								

GEOTECHNICS
23 Morgan Street, Newmarket
Auckland 1023, New Zealand
p. +64 9 356 3510
w. www.geotechnics.co.nz

Job: Silverdale Arran's Point **Client: Tonkin & Taylor** **Job # 614089.032/1**

T&T Job #: 21854.0037 **Entered By:** YA

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)	Comments
												Test 1	Test 2	Test 3	Test 4				
S15-095/1	2660310.217	6510545.523	20.307	Re Wall	TAJ	19/11/2015	1.77	**1.31**	**35.7**	2.7	**5.0**	196	196	196	196	**196**		**P**	These results have not yet passed our entire quality assurance process. They should be used with caution and may be subject to change.
				Re Wall			1.77	**1.30**	**35.7**	2.7	**5.2**								
S15-095/2	2660334.012	6510540.809	20.866	Re Wall	TAJ	19/11/2015	1.86	**1.42**	**31.4**	2.7	**3.1**	196	196	196	196	**196**		**P**	
				Re Wall			1.87	**1.42**	**31.4**	2.7	**2.7**								
S15-105/9	2660287.151	6510549.486	21.322	Re Wall	TAJ	3/12/2015	1.82	**1.36**	**33.5**	2.7	**4.1**	196	196	196	196	**196**		**P**	
							1.82	**1.36**	**33.5**	2.7	**3.9**								
S16 031/2	2660140.178	6510662.460	19.568	Shear Key	TAJ	13/02/2016	1.85	**1.43**	**29.7**	2.7	**4.6**	205	205	205	205	**205**		**P**	
							1.87	**1.44**	**29.7**	2.7	**3.9**								
S16 055/8	2660189.951	6510657.852	21.623	Wall4	TAJ	21/03/2016	1.89	**1.44**	**31.8**	2.7	**1.2**	196	196	196	196	**196**		**P**	
							1.89	**1.44**	**31.8**	2.7	**1.2**								
S16 057/13	2660199.537	6510656.857	22.418	P7 Shear key	TAJ	29/03/2016	1.84	**1.36**	**34.9**	2.7	**2.1**	160	196	140	154	**163**		**P**	
							1.84	**1.36**	**34.9**	2.7	**2.0**								
S16 057/15	2660146.52	6510661.182	22.511	P7 Shear key	TAJ	29/03/2016	1.85	**1.39**	**33.3**	2.7	**2.3**	150	167	154	175	**162**		**P**	
							1.85	**1.39**	**33.3**	2.7	**2.3**								
S16 059/21	2660168.003	6510656.595	23.122	P7 RE Wall	TA	31/03/2016	1.85	**1.42**	**29.6**	2.7	**5.1**	196	196	196	196	**196**		**P**	
							1.86	**1.43**	**29.6**	2.7	**4.4**								
S16 060/11	2660132.936	6510659.66	24.18	P7 RE Wall	TA	1/04/2016	1.85	**1.35**	**37.4**	2.7	**0.0**	196	196	196	196	**196**		**P**	
							1.85	**1.34**	**37.4**	2.7	**0.0**								
S16 060/12	2660164.024	6510652.566	24.187	P7 RE Wall	TA	1/04/2016	1.85	**1.37**	**34.8**	2.7	**1.5**	196	196	196	196	**196**		**P**	
							1.85	**1.37**	**34.8**	2.7	**1.3**								
S16 060/13	2660181.243	6510658.102	24.216	P7 RE Wall	TA	1/04/2016	1.82	**1.34**	**35.9**	2.7	**2.2**	196	196	196	196	**196**		**P**	
							1.82	**1.34**	**35.9**	2.7	**2.2**								
S16 061/9	2660152.064	6510657.176	24.715	P7 RE Wall	TA	4/04/2016	1.78	**1.29**	**37.6**	2.7	**3.7**	196	196	196	196	**196**		**P**	
							1.77	**1.28**	**37.6**	2.7	**4.3**								
S16 061/10	2660177.519	6510656.646	25.05	P7 RE Wall	TA	4/04/2016	1.76	**1.27**	**38.1**	2.7	**4.5**	196	196	196	196	**196**		**P**	
							1.77	**1.28**	**38.1**	2.7	**4.0**								
S16 061/11	2660190.183	6510647.301	24.282	P7 RE Wall	TA	4/04/2016	1.76	**1.29**	**36.7**	2.7	**5.0**	196	196	196	196	**196**		**P**	
							1.76	**1.29**	**36.7**	2.7	**5.1**								
S16 061/12	2660158.459	6510649.251	24.784	P7 RE Wall	TA	4/04/2016	1.74	**1.27**	**36.8**	2.7	**6.1**	196	196	196	196	**196**		**P**	
							1.75	**1.28**	**36.8**	2.7	**5.5**								
S16 062/21	2660227.169	6510648.609	24.968	P7 RE Wall	TA	5/04/2016	1.81	**1.33**	**36.1**	2.7	**2.5**	168	168	154	196	**172**		**P**	
							1.80	**1.32**	**36.1**	2.7	**3.1**								
S16 062/22	2660200.129	6510648.122	24.978	P7 RE Wall	TA	5/04/2016	1.85	**1.35**	**37.3**	2.7	**0.0**	168	154	196	196	**179**		**P**	
							1.85	**1.35**	**37.3**	2.7	**0.0**								
S16 063/8	2660159.786	6510653.497	24.605	P7 Re Wall	TA	6/04/2016	1.83	**1.36**	**34.7**	2.7	**2.8**	150	154	196	168	**167**		**P**	
							1.82	**1.35**	**34.7**	2.7	**3.1**								
S16 063/9	2660183.681	6510648.556	25.059	P7 Re Wall	TA	6/04/2016	1.87	**1.39**	**34.0**	2.7	**1.1**	154	182	168	196	**175**		**P**	
							1.84	**1.37**	**34.0**	2.7	**2.4**								
S16 063/10	2660203.408	6510650.193	24.907	P7 Re Wall	TA	6/04/2016	1.87	**1.43**	**31.2**	2.7	**2.7**	150	150	151	182	**158**		**P**	
							1.86	**1.42**	**31.2**	2.7	**3.1**								
S16 064/17	2660202.663	6510646.758	25.14	P7 RE Wall	TA	7/04/2016	1.79	**1.29**	**38.2**	2.7	**2.7**	168	155	196	196	**179**		**P**	
							1.78	**1.29**	**38.2**	2.7	**3.0**								
S16 064/18	2660182.097	6510646.26	25.434	P7 RE Wall	TA	7/04/2016	1.80	**1.31**	**37.8**	2.7	**2.2**	168	155	196	196	**179**		**P**	
							1.81	**1.31**	**37.8**	2.7	**1.8**								
S16 064/19	2660146.189	6510656.134	26.01	P7 RE Wall	TA	7/04/2016	1.75	**1.31**	**33.8**	2.7	**7.1**	168	155	196	196	**179**		**P**	
							1.77	**1.33**	**33.8**	2.7	**6.1**								
S16 070/6	2660194.789	6510652.437	27.401	P7 RE Wall	TA	14/04/2016	1.76	**1.32**	**33.3**	2.7	**7.0**	192	192	164	151	**175**		**P**	
							1.77	**1.33**	**33.3**	2.7	**6.8**								
S16 070/7	2660229.713	6510650.938	27.288	P7 RE Wall	TA	14/04/2016	1.89	**1.44**	**31.5**	2.7	**1.3**	151	151	164	192	**165**		**P**	
							1.91	**1.45**	**31.5**	2.7	**0.3**								
S16 070/9	2660149.131	6510649.984	26.455	P7 RE Wall	TA	14/04/2016	1.82	**1.37**	**32.7**	2.7	**4.1**	164	151	192	181	**172**		**P**	
							1.82	**1.37**	**32.7**	2.7	**4.4**								
S16 074/28	2660169.603	6510646.433	29.297	P7 RE Wall	TA	21/04/2016	1.80	**1.33**	**35.5**	2.7	**3.6**	151	151	164	178	**161**		**P**	
							1.80	**1.33**	**35.5**	2.7	**3.9**								
S16 074/29	2660208.445	6510644.156	28.757	P7 RE Wall	TA	21/04/2016	1.78	**1.30**	**36.4**	2.7	**4.3**	151	151	164	178	**161**		**P**	
							1.80	**1.32**	**36.4**	2.7	**3.3**								
S16 075/9	2660232.203	6510649.377	28.949	P7 Re Wall	TA	22/04/2016	1.83	**1.38**	**32.7**	2.7	**3.7**	192	192	192	192	**192**		**P**	
							1.85	**1.39**	**32.7**	2.7	**3.0**								

www.tonkintaylor.co.nz