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29 August 2023

Andrew McAlister
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Dear Andrew,

DESKTOP REVIEW BLOCK A – 1401, 1419 AND 1379 TRAM ROAD, SWANNANOA (LOT 1, DP323637 AND LOTS 5 AND 7, DP321133)

1.0 Introduction

Pattle Delamore Partners (PDP) was commissioned by Andrew McAllister to undertake a desktop review of available data to assess any potential geotechnical risks associated with the proposed rezoning of approximately 15.7 ha of land comprising 1401, 1419 and 1379 Tram Road, Swannanoa (Lot 1, DP323637 and Lots 5 and 7, DP321133) from rural zoned to residential zoned. For the purposes of this review the foregoing Lots will be collectively referred to as "Block A".

The Waimakariri district plan indicates Block A is currently zoned for rural land use. It is understood that it is proposed to rezone Block A to residential land use. The property details of the properties which comprise Block A are summarised in Table 1.

Table 1: Summary Block A Property Details

Physical Addresss	Legal Description	Approximate Land Area (ha)	Existing Landuse
1379 Tram Road, Swannanoa	Lot 1, DP323637	7.7 ha	Rural (pine plantation)
1401 Tram Road, Swannanoa	Lot 5, DP321133	4.0 ha	Rural (Lifestyle Block)
1419 Tram Road, Swannanoa	Lot 7, DP321133	4.0 ha	Rural (Lifestyle Block)

2.0 Desktop Review

The following sections outline findings of the desktop review.

2.1 Groundwater

A review of Environment Canterbury (Ecan) Well Search Database indicates that the groundwater level beneath Block A is generally encountered between approximately 6.9 and 7.2 metres below ground level (m bgl) based on wells M35/18638, M35/9653 and M35/9655. Groundwater wells M35/9654 and M35/9652 located in the adjacent properties to the west of Block A, indicate groundwater depths of 6.4 and 7.8 m bgl respectively, and well M35/9021 located in the adjacent property to the east indicates a groundwater depth of 7.3 m bgl.

The locations of the wells are indicated on Figure 1. A summary of the well details is presented in Table 2 and the full Ecan data sheets presented in Appendix A.

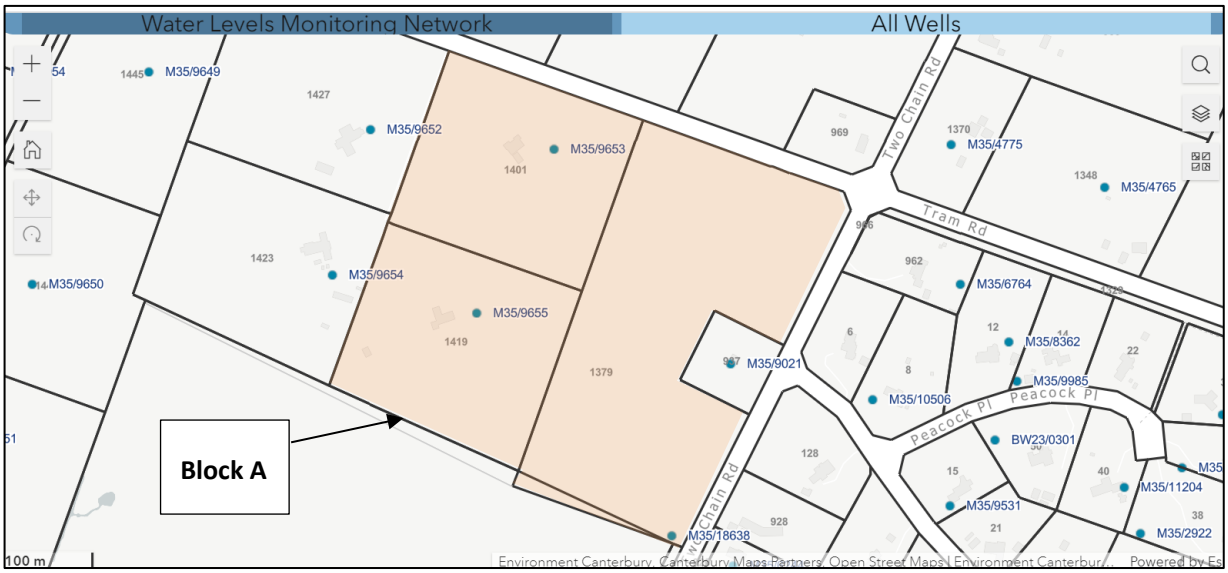


Figure 1: Screenshot from Ecan well search indicating well locations. The approximate location of Block A is highlighted. Source: https://www.ecan.govt.nz/data/well-search/ (accessed 10/08/2023).

Table 2: Summary Groundwater Depths Block A

Physical Address	ECAN well ID	Drilled Depth (m bgl)	Groundwater level (m bgl)
1379 Tram Road, Swannanoa	M35/18638	77 m	7.1 m
1401 Tram Road, Swannanoa	M35/9653	18 m	7.2 m
1419 Tram Road, Swannanoa	M35/9655	15 m	6.9 m
937 Two Chain Road, Swannanoa	M35/9021	106 m	7.3 m
1427 Tram Road, Swannanoa	M35/9652	18 m	7.8 m
1423 Tram Road, Swannanoa	M35/9654	21 m	6.4 m

Notes

1. *Data sourced from Environment Canterbury (Ecan) online database https://www.ecan.govt.nz/data/well-search/, accessed on 10/08/2023.*
2. *Groundwater depths reported as depth below top of casing (Toc).*

2.2 Geological Setting

A review of the published geological map by Geological and Nuclear Science (Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers), 2008; 1:250,000 scale) Geology of the Christchurch Area indicates that the investigation area is underlain by brownish-grey river alluvium (Q2a) the approximate location of Block A is indicated on Figure 2.

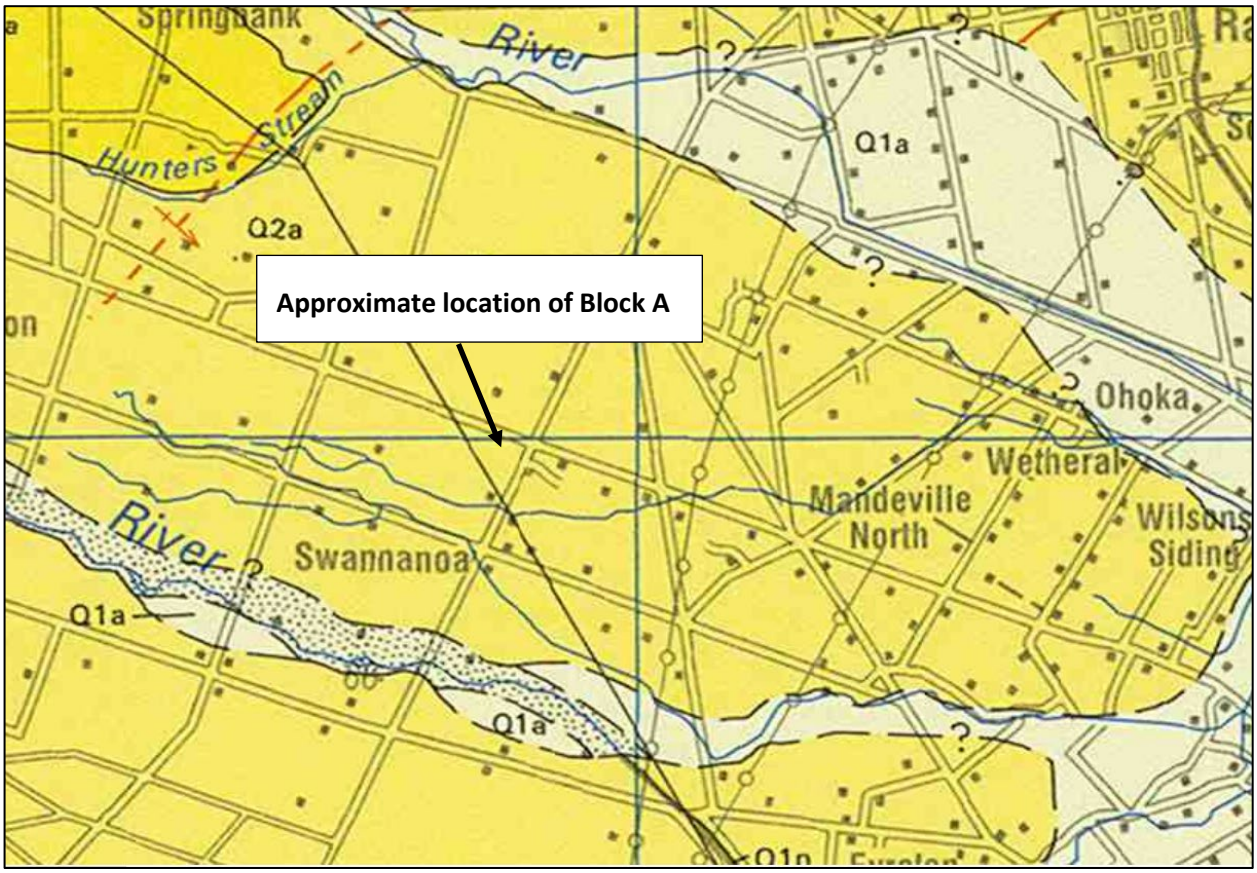


Figure 2: Geological Map of the Swannanoa area indicating the approximate location of Block A.

2.3 New Zealand Geological Database (NZGD)

A review of data available on the New Zealand Geotechnical Database (NZGD) indicates that three test pits numbered TP_169561, TP_169162 and TP_169653 were undertaken at the location of the Mandeville Water Reservoir (937 Two Chain Road, Mandeville located adjacent to the Eastern site boundary of Block A) to an approximate depth of 4.0 m bgl in May 2021.

The test pit logs indicate the site is generally underlain by silty SAND and silty, sandy GRAVEL with minor cobbles inferred to be Late Pleistocene River deposits. Groundwater was not encountered in any of the test pits. The NZGD logs are presented in Appendix B.

2.4 Liquefaction Susceptability

A review of Canterbury Maps 2009 Waimakariri liquefaction susceptibility assessment indicates that Block A is underlain by *"river sediments <10,000 years old (active river beds & flood plains)"* and has a small possibility liquefaction in isolated areas during strong shaking. The Waimakariri District Council natural hazards viewer indicates that no liquefaction assessment has been undertaken west of Two Chain Road where Block A is located.

Due to the depth of the groundwater at the Block A site as described in Section 2.0 the risk of liquefaction is considered to be low.

2.5 Active Faults Database

A review of GNS active faults database (accessed 11/08/2023), indicates that several active faults are located within the general proximity of Block A, based on the distance from the site to any of the nearby mapped active faults there is no direct risk from fault rupture. A summary of the closest active faults to Block A are summarised in Table 3.

Table 3: Summary of the closest mapped active faults in proximity of Block A

Fault Name	Appoximate Distance (km) to fault from Block A	Direction of fault location relative to Block A	Recurrance Interval (RI) years
Greendale	25 km	South	>10,000 to <=20,000
Hororata	35 km	Southwest	Unknown
Ashley	12 km	North	Unknown
Cust	14 km	Northwest	Unknown
Ashley Gorge	26 km	Northwest	Unknown

Notes

1. *Data sourced from GNS Science active fault database (https://data.gns.cri.nz/af), accessed on 11/08/2023.*

2.6 Review of Historical Aerial Photography

The following outlines a review for the available historical aerial photographs.

2.6.1 Retrolens

1941: Western part of Block A is vegetated with pasture grass (farmland). The Eastern part of Block A vegetated with trees – Possibility of potential pit / backfilled area indicated by an area visible in the north-eastern and southern parts of the site where there is a lack of vegetation.

1955: Western half of Block A is vegetated with pasture grass (farmland). Eastern part of Block A vegetated with trees the same previously indicated areas with no vegetation are still visible.

1975: Western part of Block A is vegetated with pasture grass (farmland). Trees vegetating eastern part of Block A, appear to have been harvested (photo has poor resolution).

1979: Western part of Block A is vegetated with pasture grass (farmland). Eastern part of Block A is revegetated with trees. Area of poor growth still visible in the northeastern part of the site. The northwestern corner of the Block A has been cleared (reason unknown)**.**

1984: Western part of Block A is vegetated with pasture grass (farmland). Eastern part of Block A. No change same as 1979. Trees growth is more advanced.

1994: Western part of Block A is vegetated with pastural grass (farmland). Eastern part of Block A, Northwestern corner of the site has been replanted. The balance of the site appears to have been harvested.

2.6.2 Canterbury Maps:

1995 - 1999: Western part of Block A is vegetated with pasture grass (farmland). Eastern part of Block A, replanted with trees. Formed drain visible along the southern part of Block A.

2000-2004: Western half of Block A is cultivated (farmland). Block A, revegetated with trees. Area of poor growth still visible in the northeastern part of the site.

2004-2010: Western part of Block A has been subdivided into Lots 5 and 7, both Lots have had houses and sheds constructed at the site. Eastern part of Block A is generally vegetated with trees.
937 Two Chain Road (Mandeville water supply) has been cleared and construction of started on water supply.

2010- Present day: Construction of water supply plant completed; eastern part of Block 1 still vegetated with trees.

3.0 Conclusion

Based on the foregoing desktop review, the following geotechnical hazards may be present at the Block A location:

- The natural soils are underlying Block A generally comprise silty SAND and silty, sandy GRAVEL with minor cobbles inferred to be Late Pleistocene River deposits. No compressible organic materials have been identified during the desktop review.
- Due to the proximity of Block A to mapped active faults the risk of significant land damage due to fault rupture is considered low.
- The Waimakariri Liquefaction susceptibility map (2009) indicates that Block A may experience liquefaction in small, isolated areas during strong shaking. Due to the depth of the groundwater ranging between approximately 6.9 and 7.2 m bgl beneath Block A, the risk of liquefaction is considered low.
- Assessment of available historical aerial imagery indicate that the ground in the eastern part of Block A may have been a potential pit and reinstated prior to being vegetated with trees. The extent of any former pit, and composition of any material used to backfill the excavation is unknown and may potentially be subject to risks which include but are not limited to compressible soil (organics), ground subsidence and slope instability.
- This geotechnical desktop hazard assessment is based only publicly available information and no site-specific investigations within Block A have been undertaken.

Based on the foregoing there are no geotechnical risks at the Block A site that would preclude residential development of the site.

4.0 References

Canterbury Maps: https://canterburymaps.govt.nz/, accessed 10/08/2023.

Environment Canterbury Well Search: https://www.ecan.govt.nz/data/well-search, accessed on 10/08/2023.

Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compiler) 2008. Geology of the Christchurch area. Institute Geological and Nuclear Sciences 1:250,000 geological map 16. 1 sheet + 67 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

GNS Active Fault Database: https://data.gns.cri.nz/af/, accessed 11/08/2023.

New Zealand Geotechnical Database (www.nzgd.co.nz), accessed 10/08/2023.

Retrolens Historical Image Resource: https://retrolens.co.nz/ - Accessed 10/08/2023.

Waimakarirri District Natural Hazards interactive Viewer: https://waimakariri.maps.arcgis.com/apps/MapSeries/index.html - Accessed 10/08/2023.

5.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Andrew McAllister and others (not directly contracted by PDP for the work), including the New Zealand Geotechnical Database and Retrolens. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Andrew McAllister for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

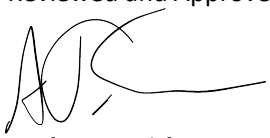
PATTLE DELAMORE PARTNERS LIMITED

Prepared by

Jason Grieve

Senior Engineering Geologist

Reviewed and Approved by



Andrew Smith

Technical Director (Geotechnics)

Appendix A: Ecan Well Search

M35/9021 details

Details

Well Number	M35/9021	**File Number**	CO6C/17996
Owner	Waimakariri District Council	**Well Status**	Active (exist, present)
Street/Road	Tram Road	**NZTM Grid Reference**	BW23:58465-98099
Locality	Swannanoa	**NZTM X and Y**	1558465 - 5198099
Location Description	WDC propertiy sorrounded by fenc-locked door behind the building	**Location Accuracy**	2 - 15m
CWMS Zone	Waimakariri	**Use**	Small Community Supply,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	106.80m	**Water Level Count**	1
Diameter	300mm	**Initial Water Level**	7.65m below MP
Measuring Point Description	ToC	**Highest Water Level**	7.58m below MP
Measuring Point Elevation	61.15m above MSL (Lyttelton 1937)	**Lowest Water Level**	7.58m below MP
Elevation Accuracy	< 0.5 m	**First reading**	25 May 2011
Ground Level	0.25m below MP	**Last reading**	25 May 2011
Strata Layers	42	**Calc Min 80%**	7.58m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	5
Drill Date	28 Jan 2002	**Max Tested Yield**	30 l/s
Driller	Clemence Drilling Contractors	**Drawdown at Max Tested Yield**	48 m
Drilling Method	Rotary/Percussion	**Specific Capacity**	1.08 l/s/m
Casing Material		**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	01 Aug 2017
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Stainless steel	92.6	102.3				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
28 Jan 2002	1	6	79.1891	5.555	0.6
28 Jan 2002	2	12	158.3782	13.14	0.6666667
28 Jan 2002	3	18	237.5673	22.87	0.6666667
28 Jan 2002	4	24	316.7564	32.46	0.6666667
28 Jan 2002	5	30	395.9455	48.15	0.6666667

Comments

COMMENT DATE	COMMENT
25 Jun 2003	Constant discharge test data for pumping well only available on file/Trim
11 Jan 2005	Gridref changed from: M35:6851-5987. Discussionwith Brian Earnshaw (WDC) found that bore has been incorrectly located on GIS. Bore has been located from Brian's description over the phone.

COMMENT DATE	COMMENT
17 Mar 2005	Originally drilled to 259.3m. Finished with 9m screen and 4.24m sump, 700 blank. 1.55m leader.
17 Feb 2012	NZMG Easting/Northing updated from:2468462-5759718 Shifted 196 m, from aq test on M35/18638
12 Jun 2012	NZMG Map Reference updated from: M35:68455-59522 shifted 196m, the above was a location error. Confirmed location by GPS as 2468462-5759718.
11 Dec 2015	This is an emergency backup well for the Mandeville community drinking water supply. The primary supply well is M35/18638. There is also another emergency backup well, M35/5585. See Records Manager C15C/160533.
05 Jul 2016	Updated Ground Level from MP from -2.58m to -0.25m based on photos.
27 Aug 2018	Common Flowmeter which records water usuage of bores M35/18638 & M35/0921 - Data is recorded under M35/18638.
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was 57.18 and the QAR RL was 4. The method of calculating the original RL was: Interpolated DTM. If GL from MP is updated in future please assess if RL also needs to be updated.

M35/9652 details

Details

Well Number	M35/9652	**File Number**	CO6C/20362
Owner	MRS E D PETRIE & EST. MR M R PETRIE	**Well Status**	Active (exist, present)
Street/Road	1401 TRAM ROAD	**NZTM Grid Reference**	BW23:58093-98341
Locality	Swannanoa	**NZTM X and Y**	1558093 - 5198341
Location Description	LOT 4	**Location Accuracy**	10 - 50m
CWMS Zone	Waimakariri	**Use**	Domestic and Stockwater,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	18.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	8.10m below MP
Measuring Point Description	ToC	**Highest Water Level**	
Measuring Point Elevation	63.56m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.35m below MP	**Last reading**	
Strata Layers	3	**Calc Min 80%**	9.18m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	1
Drill Date	02 Sep 2003	**Max Tested Yield**	5 l/s
Driller	East Coast Drilling	**Drawdown at Max Tested Yield**	7 m
Drilling Method	Rotary Rig	**Specific Capacity**	0.70 l/s/m
Casing Material	Steel	**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Stainless steel	16.5	18				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
08 Sep 2003	1	5	65.99092	7.1	1.5

Comments

COMMENT DATE	COMMENT
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was 60.18 and the QAR RL was 4. The method of calculating the original RL was: Interpolated DTM. If GL from MP is updated in future please assess if RL also needs to be updated.

M35/9653 details

Details

Well Number	M35/9653	**File Number**	CO6C/20362
Owner	MRS E D PETRIE & EST. MR M R PETRIE	**Well Status**	Active (exist, present)
Street/Road	1401 TRAM ROAD	**NZTM Grid Reference**	BW23:58283-98321
Locality	Swannanoa	**NZTM X and Y**	1558283 - 5198321
Location Description	LOT 5	**Location Accuracy**	10 - 50m
CWMS Zone	Waimakariri	**Use**	Domestic and Stockwater,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	18.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	7.50m below MP
Measuring Point Description	ToC	**Highest Water Level**	
Measuring Point Elevation	62.46m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.35m below MP	**Last reading**	
Strata Layers	3	**Calc Min 80%**	8.94m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	1
Drill Date	02 Sep 2003	**Max Tested Yield**	3 l/s
Driller	East Coast Drilling	**Drawdown at Max Tested Yield**	5 m
Drilling Method	Rotary Rig	**Specific Capacity**	0.60 l/s/m
Casing Material	Steel	**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Stainless steel	16.5	18				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
09 Sep 2003	1	3	39.59455	5	1.5

Comments

COMMENT DATE	COMMENT
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was 59.04 and the QAR RL was 4. The method of calculating the original RL was: Interpolated DTM. If GL from MP is updated in future please assess if RL also needs to be updated.

M35/9654 details

Details

Well Number	M35/9654	**File Number**	CO6C/20362
Owner	MRS E D PETRIE & EST. MR M R PETRIE	**Well Status**	Active (exist, present)
Street/Road	1401 TRAM ROAD	**NZTM Grid Reference**	BW23:58053-98191
Locality	Swannanoa	**NZTM X and Y**	1558053 - 5198191
Location Description	LOT 6	**Location Accuracy**	2 - 15m
CWMS Zone	Waimakariri	**Use**	Domestic and Stockwater,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	21.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	6.70m below MP
Measuring Point Description	ToC	**Highest Water Level**	
Measuring Point Elevation	63.55m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 0.5 m	**First reading**	
Ground Level	0.35m below MP	**Last reading**	
Strata Layers	3	**Calc Min 80%**	5.52m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	1
Drill Date	02 Sep 2003	**Max Tested Yield**	6 l/s
Driller	East Coast Drilling	**Drawdown at Max Tested Yield**	5 m
Drilling Method	Rotary Rig	**Specific Capacity**	1.33 l/s/m
Casing Material	Steel	**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Slotted Casing	12	15				
2	Stainless steel	19.5	21				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
09 Sep 2003	1	6	79.1891	4.5	1.5

Comments

COMMENT DATE	COMMENT
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was 59.61 and the QAR RL was 4. The method of calculating the original RL was: Interpolated DTM. If GL from MP is updated in future please assess if RL also needs to be updated.

M35/9655 details

Details

Well Number	M35/9655	**File Number**	CO6C/20362
Owner	MRS E D PETRIE & EST. MR M R PETRIE	**Well Status**	Active (exist, present)
Street/Road	1401 TRAM ROAD	**NZTM Grid Reference**	BW23:58203-98151
Locality	Swannanoa	**NZTM X and Y**	1558203 - 5198151
Location Description	LOT 7	**Location Accuracy**	10 - 50m
CWMS Zone	Waimakariri	**Use**	Domestic and Stockwater,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	15.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	7.20m below MP
Measuring Point Description	ToC	**Highest Water Level**	
Measuring Point Elevation	62.82m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.35m below MP	**Last reading**	
Strata Layers	4	**Calc Min 80%**	8.92m below MP (Estimated)
Aquifer Name		**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	1
Drill Date	02 Sep 2003	**Max Tested Yield**	6 l/s
Driller	East Coast Drilling	**Drawdown at Max Tested Yield**	4 m
Drilling Method	Rotary Rig	**Specific Capacity**	1.62 l/s/m
Casing Material	Steel	**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Slotted Casing	12	15				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
09 Sep 2003	1	6	79.1891	3.7	1.5

Comments

COMMENT DATE	COMMENT
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was 58.8 and the QAR RL was 4. The method of calculating the original RL was: Interpolated DTM. If GL from MP is updated in future please assess if RL also needs to be updated.

M35/18638 details

Details

Well Number	M35/18638	**File Number**	CO6C/32333
Owner	Waimakariri District Council	**Well Status**	Active (exist, present)
Street/Road	Two Chain Road	**NZTM Grid Reference**	BW23:58405-97922
Locality	Swannanoa	**NZTM X and Y**	1558405 - 5197922
Location Description		**Location Accuracy**	< 50m
CWMS Zone	Waimakariri	**Use**	Small Community Supply,
Groundwater Allocation Zone	Eyre River	**Water Level Monitoring**	
Depth	77.03m	**Water Level Count**	0
Diameter	300mm	**Initial Water Level**	7.58m below MP
Measuring Point Description	Top of Casing	**Highest Water Level**	
Measuring Point Elevation	61.07m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.50m below MP	**Last reading**	
Strata Layers	9	**Calc Min 80%**	
Aquifer Name		**Aquifer Tests**	2
Aquifer Type		**Yield Drawdown Tests**	4
Drill Date	27 Jun 2011	**Max Tested Yield**	26 l/s
Driller	Clemence Drilling Contractors	**Drawdown at Max Tested Yield**	24 m
Drilling Method	Rotary/Percussion	**Specific Capacity**	2.50 l/s/m
Casing Material	Stainless Steel	**Last Updated**	29 Jun 2023
Pump Type		**Last Field Check**	25 May 2011
Water Use Data	No		

Screens

SCREEN NO.	SCREEN TYPE	TOP (M)	BOTTOM (M)	SLOT SIZE (MM)	SLOT LENGTH (MM)	DIAMETER (MM)	LEADER LENGTH (MM)
1	Stainless steel	55	69				
2	Stainless steel	71.01	75.01				

Step Tests

STEP TEST DATE	STEP	YIELD (L/S)	YIELD (GPM)	DRAWDOWN (M)	STEP DURATION (HOURS)
25 May 2011	1	14	184.774567	5.6	1.08333337
25 May 2011	2	18	237.5673	12.9	1
25 May 2011	3	22	290.360046	18.6	1
25 May 2011	4	26	343.152771	23.9	1.33333337

Comments

COMMENT DATE	COMMENT
17 Feb 2012	NZMG Easting/Northing updated from:2468400-5759550 Shifted 4m, from Aq test
23 Oct 2013	Aquifer test received. To date other Bore Reports have not been received
11 Dec 2015	This is the primary community drinking water supply well for Mandeville. There are also two emergency backup wells, M35/9021 and M35/5585. See Records Manager C15C/160533. Borelog not previously received. Came attached to above document so strata details entered as per Clemence Drilling borelog.
27 Aug 2018	Common Flowmeter which records water usuage of bores M35/18638 & M35/0921 - Data is recorded under M35/18638.
08 Jun 2022	NZTM Easting/Northing updated from:1558408-5197930 shifted 8m
10 Jan 2023	Reference Level updated using LiDAR imagery in Dec 2022. The existing RL was null and the QAR RL was 5. The method of calculating the original RL was: no height assigned. If GL from MP is updated in future please assess if RL also needs to be updated.

Appendix B: New Zealand Geotechnical Database (NZGD)

Log Key Sheet

CLASSIFICATION
Based on USBR Unified Soil Classification System

WATER

Water level on date shown

METHOD

OB	open barrel
W	wash boring
TT	triple tube
UT	thin walled undisturbed tube
ISPT	standard penetration test
MA	machine auger
HA	Hand Auger
PS	piston sample
SNC	Sonic drilling
VE	Vacuum Extraction
CP	Cable Percussion

SAMPLES

D	Small disturbed sample
B	Bulk disturbed sample
U	Undisturbed sample
UT	Thin wall open drive tube sample (push tube)
W	Water sample

MOISTURE

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when Remoulding
S	Saturated, soil below water table

SOIL AND ROCK DESCRIPTIONS
Soil and Rock Descriptions are generally as described in the NZ Geotechnical Society “Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes”, dated December 2005.
Vane Shear Strength measurements in accordance with the NZ Geotechnical Society “Guideline for hand held shear vane test” dated August 2001.

INSITU TESTS

SV	= 40/10	Insitu shear strength and remoulded shear strength respectively, as measured by Pilcon Shear Vane
τ	= 50/12	Vane shear strength and remoulded vane shear strength respectively, corrected to BS1377
UTP	=	Unable To Penetrate with Shear Vane
N	= 15	SPT uncorrected blow count for 300mm penetration

★ Laboratory Test(s) carried out:

AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

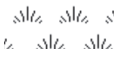
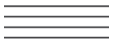
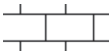
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils		Undrained Shear Strength (kPa)
VS	Very soft	<12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very stiff	100 to 200
H	Hard	>200

Non-cohesive Soils		SPT – Uncorrected
VL	Very loose	0 to 4
L	Loose	4 to 10
MD	Medium dense	10 to 30
D	Dense	30 to 50
VD	Very dense	>50

GRAPHIC LOG (1 or a combination of the following)

Organic Material		Cobbles		Siltstone	
Mudstone		Sandstone		Asphalt	
Gravel		Limestone		Sand	
Silt		Clay		No Core	

ORGANIC SOILS
Von Post Classification

H1	Completely unconverted and mud-free peat, when pressed gives clear water and plant structure is visible.
H2	Practically unconverted and mud-free peat, when pressed gives almost clear water and plant structure is visible.
H3	Very slightly decomposed or very slightly muddy peat, when pressed gives marked muddy water, no peat substance passes through the fingers and plant structure is less visible.
H4	Slightly decomposed or slightly muddy peat, when pressed gives marked muddy water and plant structure is less visible.
H5	Moderately decomposed or very muddy peat with growth structure evident but slightly obliterated.
H6	Moderately decomposed or very muddy peat with indistinct growth structure.
H7	Fairly well decomposed or very muddy peat but the growth structure can just be seen.
H8	Well decomposed or very muddy peat with very indistinct growth structure.
H9	Practically decomposed or mud-like peat in which almost no growth structure is evident.
H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

NZGD ID: TP_169561

Test Pit Log

Test Pit ID: TP01

Sheet 1 of 1

Project:	Mandeville Water Reservoir	**Project number:**	3366120
Site location:	937 Two Chain Road, Mandeville	**Client:**	Waimakariri District Council
Location:	Refer to Site Plan	**Coordinate system:**	NZTM
		Northing:	5198111.0
		Easting:	1558443.0
		Vertical datum:	NZVD 2016
		Ground level (mRL):	74.00
		Location method:	hhGPS

Groundwater (m)	In Situ Tests: Su (kPa)	In Situ Tests: Scala blows/50mm	Samples	Depth (m)	RL (m)	Graphic Log	Soil/ Rock Description	Geological Unit
		2 2 10		0.0	74.0		Silty fine to coarse SAND, some gravel, minor rootlets, trace clay; dark brown; dry; low plasticity (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke). [TOPSOIL]	
				0.5	73.5		Silty fine to coarse SAND, some fine to coarse gravel, trace clay; light yellowish brown; dry; low plasticity. Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	Late Pleistocene River Deposits
				1.0	73.0		Fine to coarse GRAVEL, some fine to coarse sand, minor cobbles, trace clay, trace rootlets; light yellowish brown; dry; non plastic (matrix). Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
		1 4 12+ 10+		1.5	72.5		Fine to coarse GRAVEL, some fine to coarse sand, trace cobbles; grey; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke). Fine to coarse sandy fine to coarse GRAVEL, trace silt, trace cobbles; light brown; dry; non plastic (matrix). Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				2.0	72.0		Fine to coarse GRAVEL, some fine to coarse sand, trace cobbles; brownish grey; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke). Fine to coarse gravelly SAND, trace silt, trace cobbles; light brown; dry; non plastic (matrix). Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				2.5	71.5		Fine to coarse sandy GRAVEL, trace silt, minor cobbles; light brown; dry; non plastic (matrix). Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				3.0	71.0		Fine to coarse SAND, some gravel, trace silt; light brown; dry; non plastic (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				3.5	70.5		Fine to coarse sandy GRAVEL, trace silt, minor cobbles; light brown; dry; non plastic (matrix). Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke). *3.50m: Moist.*	
				4.0	70.0		4.00m - End of test pit, terminated at target depth.	
				4.5	69.5			

Date started:	11/05/2021	**Logged by:**	DA	**Comments:**
Vane ID:	N/A	**Contractor:**	On Grade Drainage & Excavation Ltd	Test Pit terminated at target depth of 4m bgl. Coordinates by hhGPS to an accuracy of +/-5 m. Elevations to an accuracy of +/-5 m. Groundwater not observed.
Vane type:	N/A	**Equipment:**	Komatsu PC130-8 13T Excavator	
Vane width:	N/A	**Method:**	TP	
Face orientation:	N/A			

For Explanation of Symbols and Abbreviations See Key Sheet

NZGD ID: TP_169561

Log Key Sheet

CLASSIFICATION
Based on USBR Unified Soil Classification System

WATER

Water level on date shown

METHOD

OB	open barrel
W	wash boring
TT	triple tube
UT	thin walled undisturbed tube
ISPT	standard penetration test
MA	machine auger
HA	Hand Auger
PS	piston sample
SNC	Sonic drilling
VE	Vacuum Extraction
CP	Cable Percussion

SAMPLES

D	Small disturbed sample
B	Bulk disturbed sample
U	Undisturbed sample
UT	Thin wall open drive tube sample (push tube)
W	Water sample

MOISTURE

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when Remoulding
S	Saturated, soil below water table

SOIL AND ROCK DESCRIPTIONS
Soil and Rock Descriptions are generally as described in the NZ Geotechnical Society "Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", dated December 2005.
Vane Shear Strength measurements in accordance with the NZ Geotechnical Society "Guideline for hand held shear vane test" dated August 2001.

INSITU TESTS

SV	= 40/10	Insitu shear strength and remoulded shear strength respectively, as measured by Pilcon Shear Vane
τ	= 50/12	Vane shear strength and remoulded vane shear strength respectively, corrected to BS1377
UTP	=	Unable To Penetrate with Shear Vane
N	= 15	SPT uncorrected blow count for 300mm penetration

★ Laboratory Test(s) carried out:

AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

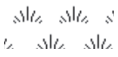
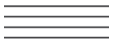
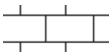
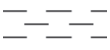
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils		Undrained Shear Strength (kPa)
VS	Very soft	<12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very stiff	100 to 200
H	Hard	>200

Non-cohesive Soils		SPT – Uncorrected
VL	Very loose	0 to 4
L	Loose	4 to 10
MD	Medium dense	10 to 30
D	Dense	30 to 50
VD	Very dense	>50

GRAPHIC LOG (1 or a combination of the following)

Organic Material		Cobbles		Siltstone	
Mudstone		Sandstone		Asphalt	
Gravel		Limestone		Sand	
Silt		Clay		No Core	

ORGANIC SOILS
Von Post Classification

H1	Completely unconverted and mud-free peat, when pressed gives clear water and plant structure is visible.
H2	Practically unconverted and mud-free peat, when pressed gives almost clear water and plant structure is visible.
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H4	Slightly decomposed or slightly muddy peat, when pressed gives marked muddy water and plant structure is less visible.
H5	Moderately decomposed or very muddy peat with growth structure evident but slightly obliterated.
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H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

NZGD ID: TP_169562

Test Pit Log

Test Pit ID: TP02
Sheet 1 of 1

Project:	Mandeville Water Reservoir	**Project number:**	3366120
Site location:	937 Two Chain Road, Mandeville	**Client:**	Waimakariri District Council
Location:	Refer to Site Plan	**Coordinate system:**	NZTM
		Northing:	5198095.0
		Easting:	1558434.0
		Vertical datum:	NZVD 2016
		Ground level (mRL):	75.00
		Location method:	hhGPS

Groundwater (m)	In Situ Tests: Su (kPa)	In Situ Tests: Scala blows/50mm	Samples	Depth (m)	RL (m)	Graphic Log	Soil/ Rock Description	Geological Unit
		2 2 16+					Silty fine to coarse SAND, minor gravel, minor rootlets, trace clay; light greyish brown; dry; low plasticity (matrix). Sand/Gravel: Subrounded to subangular, slightly weathered, sandstone (greywacke). [TOPSOIL]	
				0.5	74.5		Fine to coarse sandy SILT, some fine to coarse gravel, trace clay; light yellowish brown; dry; low plasticity; quick. Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	Late Pleistocene River Deposits
				1.0	74.0		Fine to coarse GRAVEL, some fine to coarse sand; light yellowish grey; dry; non plastic (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				1.5	73.5		Fine to coarse sandy fine to coarse GRAVEL, some cobbles, trace silt; light yellowish brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
							Fine to coarse GRAVEL, some fine to coarse sand; light grey; dry; non plastic (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				2.0	73.0		Fine to coarse sandy fine to coarse GRAVEL, trace cobbles, trace silt; light brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				2.5	72.5		Fine to coarse GRAVEL, some fine to coarse sand; grey; dry; non plastic (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				3.0	72.0		Fine to coarse gravelly SAND, some cobbles, trace silt; brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				3.5	71.5		Fine to coarse sandy fine to coarse GRAVEL, some cobbles, trace silt; brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke). *3.50m: Moist.*	
				4.0	71.0		4.10m - End of test pit, terminated at target depth.	
				4.5	70.5			

Date started:	11/05/2021	**Logged by:**	DA	**Comments:**
Vane ID:	N/A	**Contractor:**	On Grade Drainage & Excavation Ltd	Test Pit terminated at target depth of 4.1m bgl. Coordinates by hhGPS to an accuracy of +/-5 m. Elevations to an accuracy of +/-5 m. Groundwater not observed.
Vane type:	N/A	**Equipment:**	Komatsu PC130-8 13T Excavator	
Vane width:	N/A	**Method:**	TP	
Face orientation:	N/A			

For Explanation of Symbols and Abbreviations See Key Sheet

NZGD ID: TP_169562

Log Key Sheet

CLASSIFICATION
Based on USBR Unified Soil Classification System

WATER

Water level on date shown

METHOD

OB	open barrel
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TT	triple tube
UT	thin walled undisturbed tube
ISPT	standard penetration test
MA	machine auger
HA	Hand Auger
PS	piston sample
SNC	Sonic drilling
VE	Vacuum Extraction
CP	Cable Percussion

SAMPLES

D	Small disturbed sample
B	Bulk disturbed sample
U	Undisturbed sample
UT	Thin wall open drive tube sample (push tube)
W	Water sample

MOISTURE

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Vane Shear Strength measurements in accordance with the NZ Geotechnical Society “Guideline for hand held shear vane test” dated August 2001.

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N	= 15	SPT uncorrected blow count for 300mm penetration

★ Laboratory Test(s) carried out:

AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

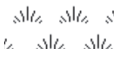
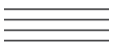
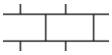
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils		Undrained Shear Strength (kPa)
VS	Very soft	<12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very stiff	100 to 200
H	Hard	>200

Non-cohesive Soils		SPT – Uncorrected
VL	Very loose	0 to 4
L	Loose	4 to 10
MD	Medium dense	10 to 30
D	Dense	30 to 50
VD	Very dense	>50

GRAPHIC LOG (1 or a combination of the following)

Organic Material		Cobbles		Siltstone	
Mudstone		Sandstone		Asphalt	
Gravel		Limestone		Sand	
Silt		Clay		No Core	

ORGANIC SOILS
Von Post Classification

H1	Completely unconverted and mud-free peat, when pressed gives clear water and plant structure is visible.
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H8	Well decomposed or very muddy peat with very indistinct growth structure.
H9	Practically decomposed or mud-like peat in which almost no growth structure is evident.
H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

NZGD ID: TP_169563

Test Pit Log

Test Pit ID: TP03

Sheet 1 of 1

Project:	Mandeville Water Reservoir	**Project number:**	3366120
Site location:	937 Two Chain Road, Mandeville	**Client:**	Waimakariri District Council
Location:	Refer to Site Plan	**Coordinate system:**	NZTM
		Northing:	5198082.0
		Easting:	1558437.0
		Vertical datum:	NZVD 2016
		Ground level (mRL):	72.00
		Location method:	hhGPS

Groundwater (m)	In Situ Tests: Su (kPa)	In Situ Tests: Scala blows/50mm	Samples	Depth (m)	RL (m)	Graphic Log	Soil/ Rock Description	Geological Unit
		2 4 7 8 11+ 8 9 12+ 12+		0.5	71.5		Silty fine to coarse SAND, some gravel, minor rootlets, trace clay; brown; dry; low plasticity (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke). [TOPSOIL]	
							Fine to coarse gravelly fine to coarse SAND, minor silt, trace clay, trace rootlets; light yellowish brown; dry; low plasticity (matrix). Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
		3 7 14+ 33+		1.0	71.0		Fine to coarse sandy fine to coarse GRAVEL, minor cobbles, trace silt; brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
				1.5	70.5		Fine to coarse GRAVEL, some sand, trace silt; grey; dry; non plastic. Sand/Gravel: Subrounded to rounded, slightly weathered, sandstone (greywacke).	
							Fine to coarse sandy fine to coarse GRAVEL, trace silt; brown; dry; non plastic. Sand/Gravel/Cobbles: Subrounded to rounded, slightly weathered, sandstone (greywacke).	Late Pleistocene River Deposits
				2.0	70.0			
				2.5	69.5			
				3.0	69.0			
				3.5	68.5		*3.70m: Moist.*	
				4.0	68.0		4.00m - End of test pit, terminated at target depth.	
				4.5	67.5			

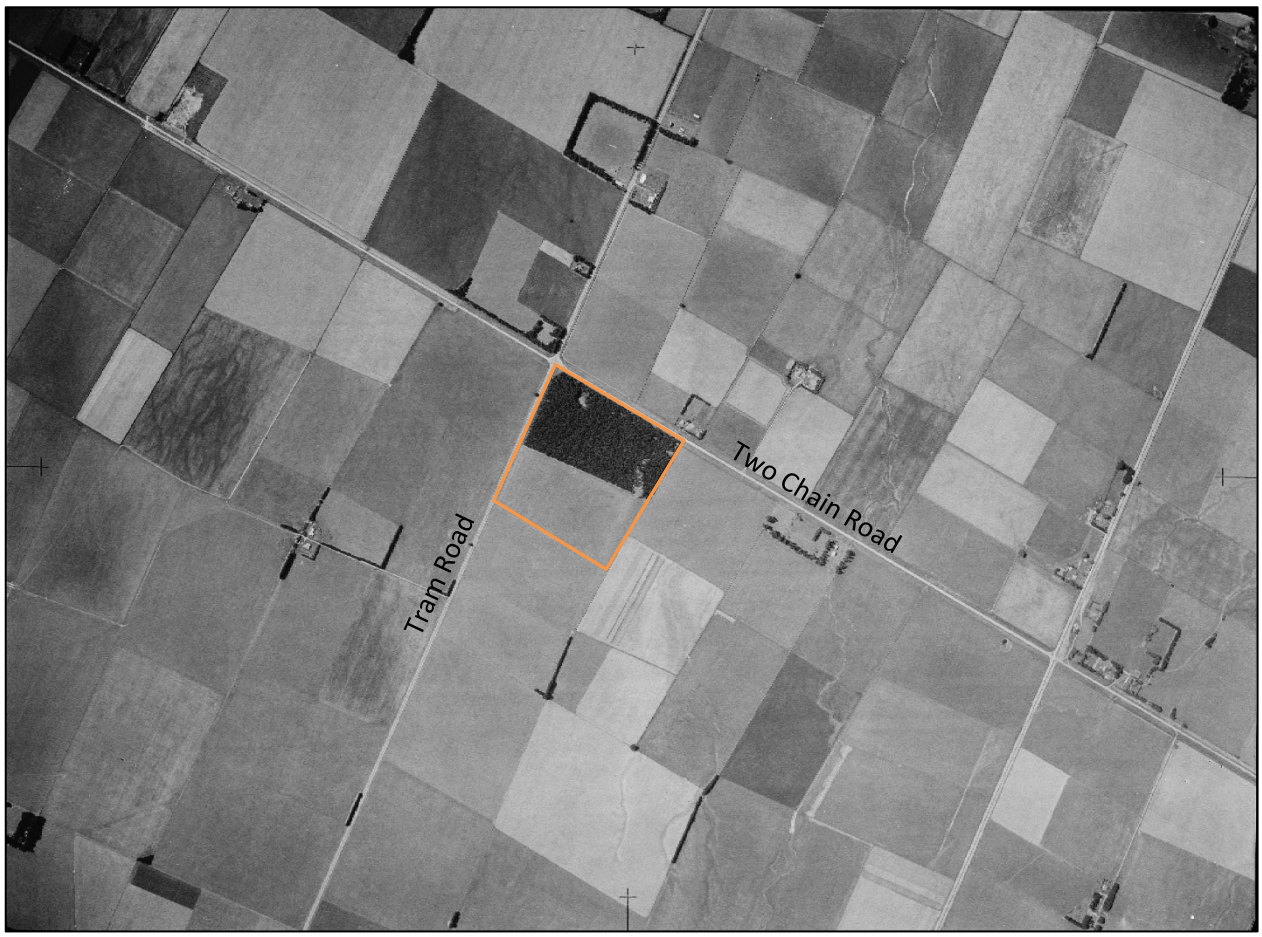
Date started:	11/05/2021	**Logged by:**	DA	**Comments:**
Vane ID:	N/A	**Contractor:**	On Grade Drainage & Excavation Ltd	Test Pit terminated at target depth of 4m bgl. Coordinates by hhGPS to an accuracy of +/-5 m. Elevations to an accuracy of +/-5 m. Groundwater not observed.
Vane type:	N/A	**Equipment:**	Komatsu PC130-8 13T Excavator	
Vane width:	N/A	**Method:**	TP	
Face orientation:	N/A			

For Explanation of Symbols and Abbreviations See Key Sheet

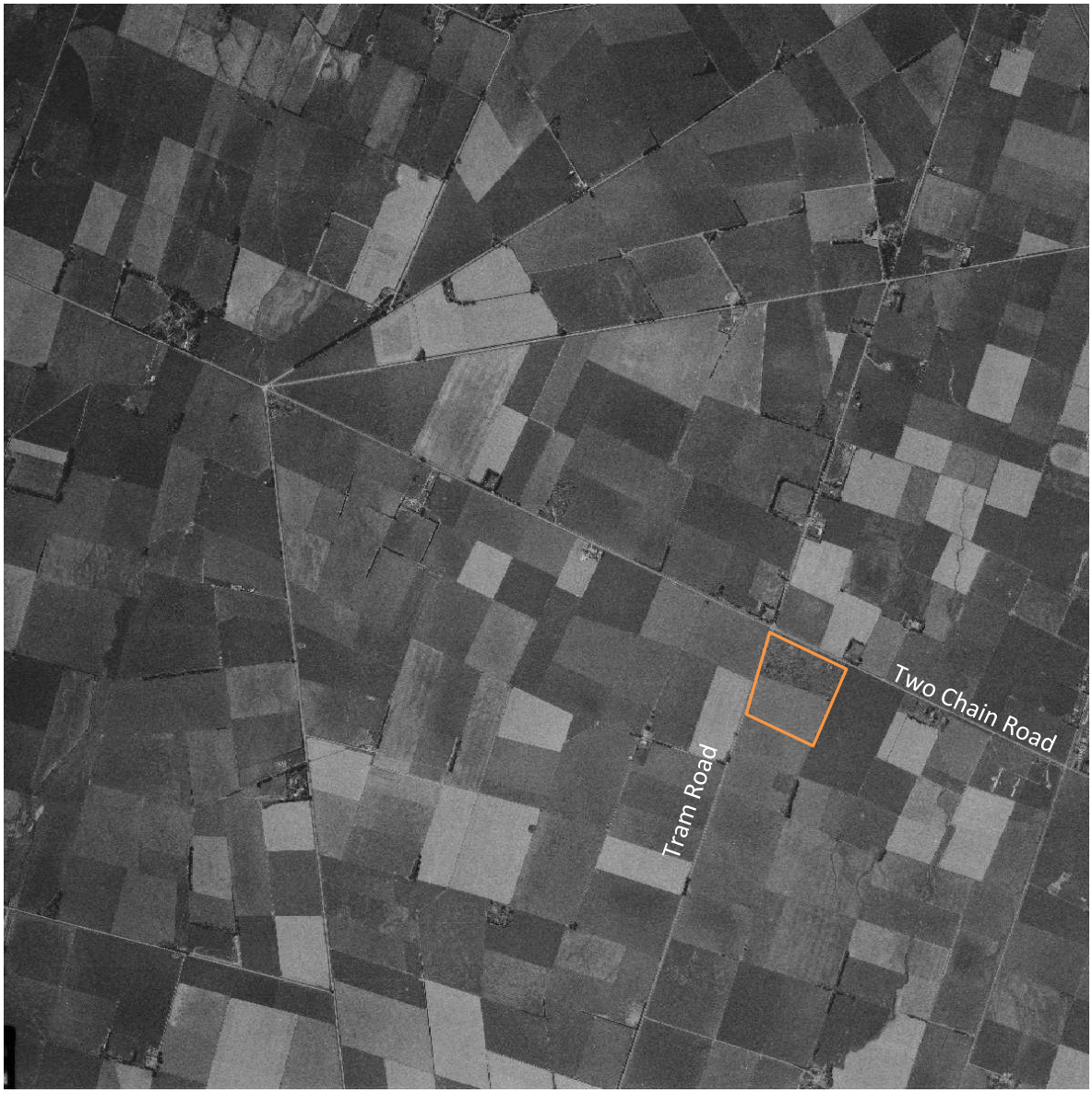
NZGD ID: TP_169563

Appendix C: Historical Imagery – Block A

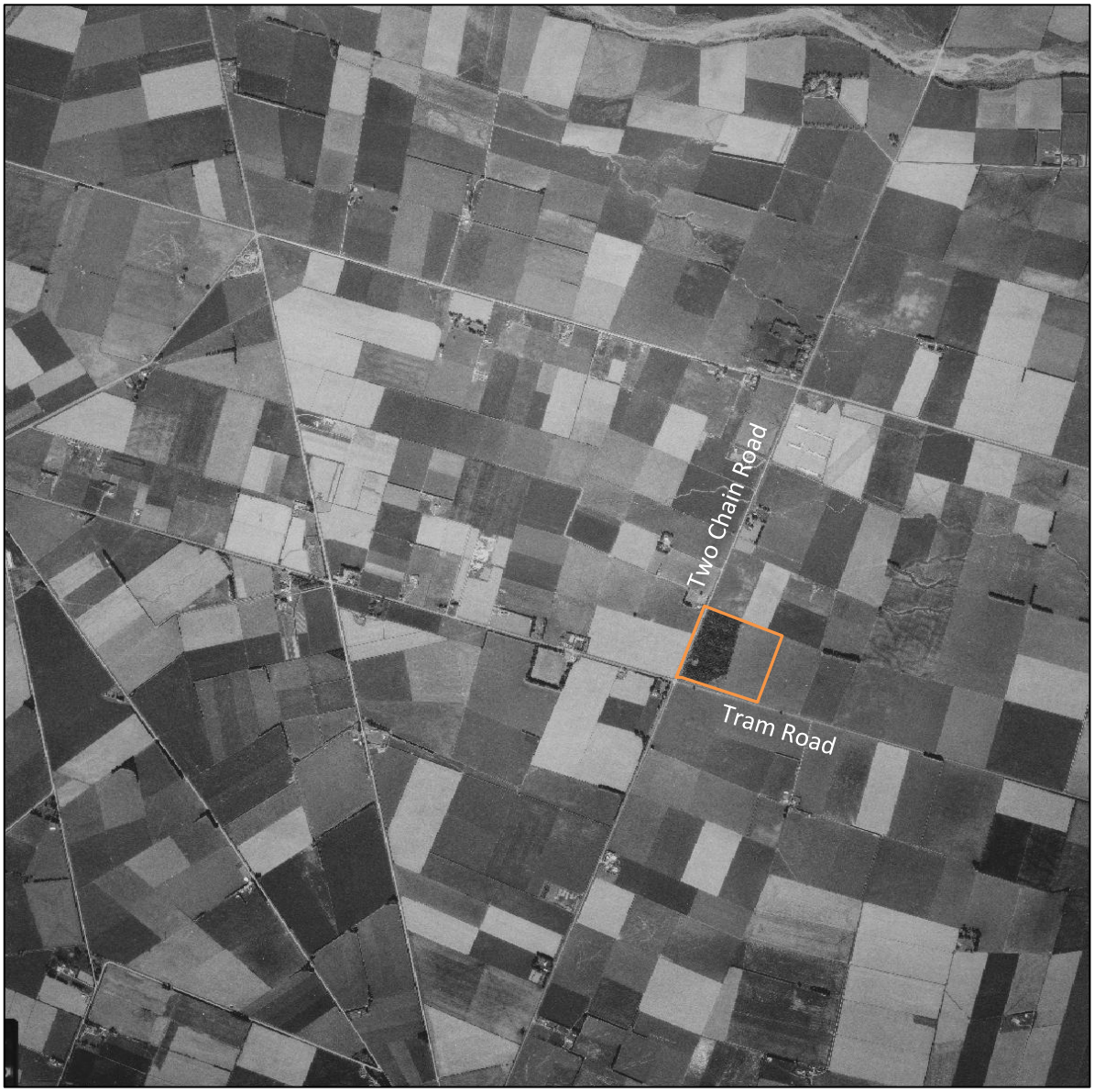
Photograph 1: 1941: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).



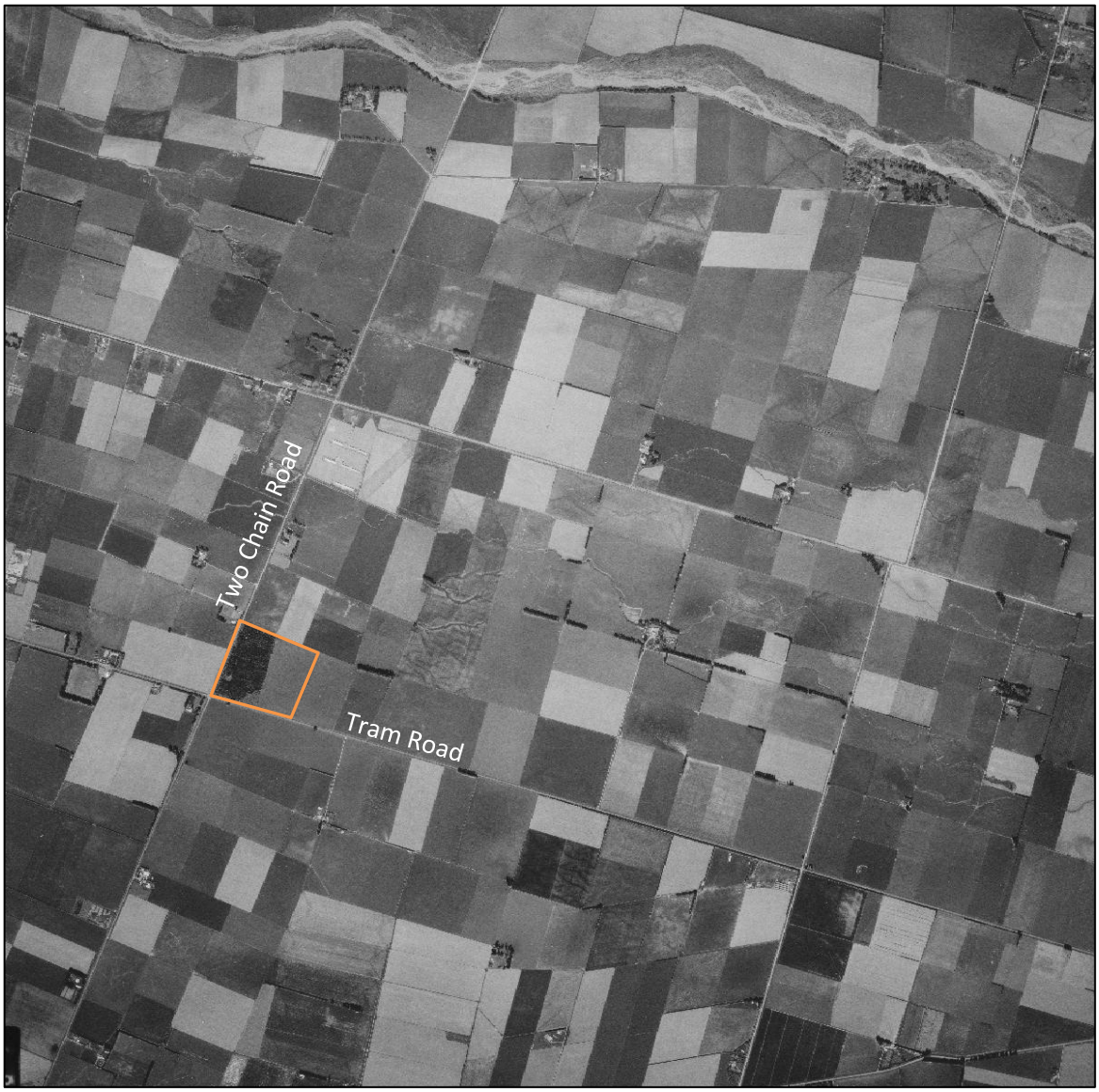
Photograph 2: 1955: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).



Photograph 3: 1975: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).



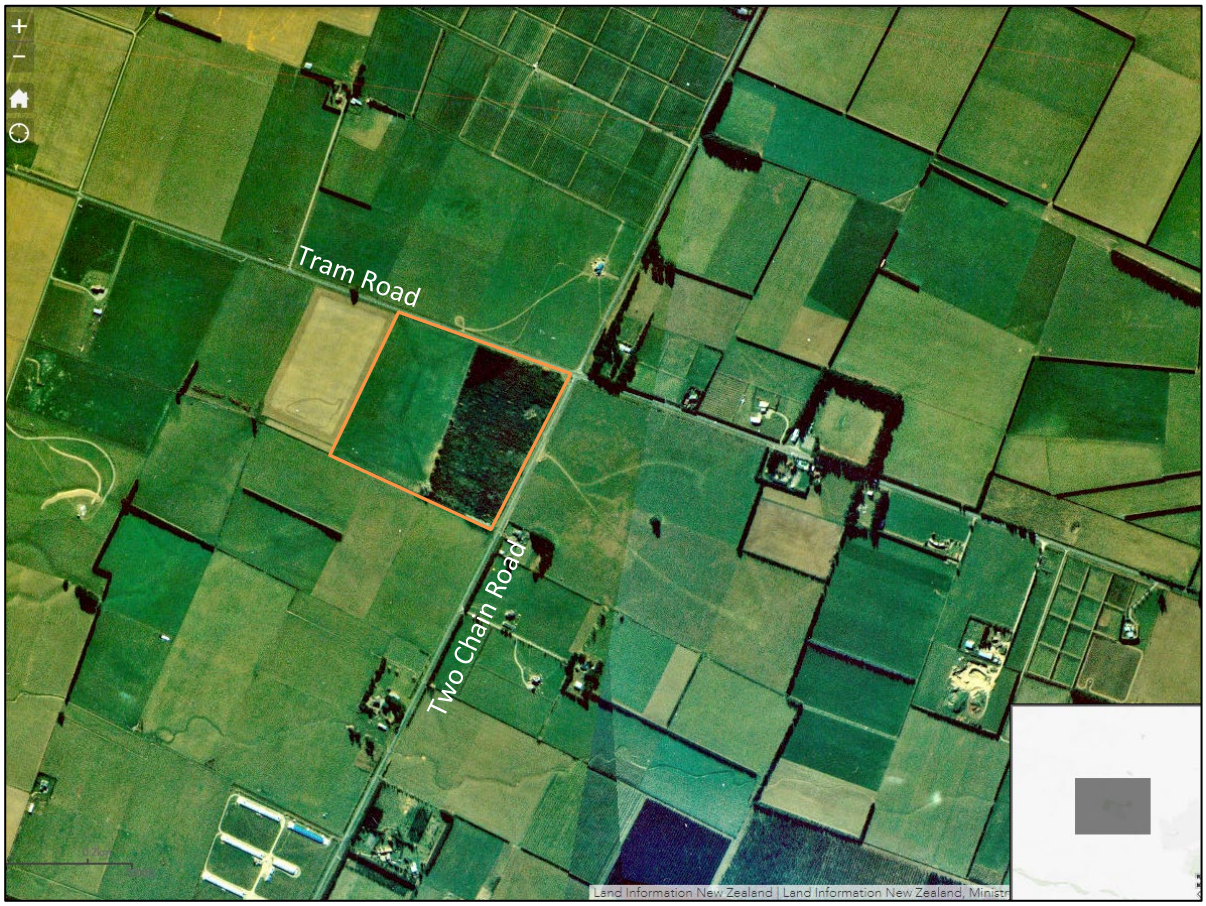
Photograph 4: 1979: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).



Photograph 5: 1984: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).

Photograph 6: 1994: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).

Photograph 7: 2000: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Retrolens).



Photograph 8: 1995-1999: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Canterbury Maps).

Photograph 9: 2000-2004: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Canterbury Maps).

Photograph 10: 2004-2010: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Canterbury Maps).

Photograph 11: 2010-2015: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Canterbury Maps).

Photograph 12: 2004-2010: Block A - 1401, 1419 and 1379 Tram Road, Swannanoa indicated by orange outline (Source Canterbury Maps).