Appendix H

Lower Maungakotukutuku Geotech Feasibility

Interpretative Report
Factual Report
Lower Maungakotukutuku Dam
Factual Geotechnical Report

July 2010
Kapiti Coast District Council

Issue 1
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Issue 1

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Approved for issue: .......................... 20/7/2010
Stephen McInerney Date
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1.0 Introduction

This report summarises the results of reconnaissance level geological mapping, trial pitting and drilling carried out to investigate the suitability of the Maungakotukutuku Dam site.

The proposed Maungakotukutuku Dam is located on the Maungakotukutuku stream, a tributary of the Waikanae River as shown on Figure 1.1. The proposed dam and reservoir is a means of providing in-catchment storage to augment water supply during periods of low flow in the Waikanae River.

The dam site can be accessed from SH1 to Nikau Palm Rd, Maui Pomari Rd and to the end of Mahaki Rd from where a farm track leads to the Maungakotukutuku Valley upstream of the dam.

The dam site was identified in the late 90’s and is located where the valley narrows downstream of a wider valley section. This takes advantage of the inherent reduced length of the dam in the narrow section and the increased volume of reservoir in the wider section of the valley. The dam site is approximately 3 km upstream of the confluence with the Waikanae River.

2.0 Physiography

The dam site spans a section of narrow valley immediately downstream from a flat-floored basin. At the dam site the valley is approximately symmetrical with steep slopes extending above the proposed abutment from about RL 120 m. At the base of the valley there is an inner river gorge, approximately 10m deep, which traverses through the dam site and continues downstream.

Above the river gorge, the right bank has a well-developed alluvial terrace at about RL104 m. An equivalent terrace on the left bank is small and constrained in area.

There are two saddles on the NW perimeter of the proposed reservoir, which both constrain the top reservoir level and are potential seepage locations. Saddle locations are shown in Drawing WS909/20/27 REV0 included in Appendix A.
3.0 Dam Site Investigations

3.1 Geological Mapping

Reconnaissance level geological mapping was carried by Royden Thompson and Mark Anderson on the 12th of April 2010. The area inspected comprised; the dam site, a short distance up and downstream of the dam site and the ridge above the left abutment. Further inspection of the river gorge was undertaken by Andrew Kilby and Matthew Knox on the 14th of July 2010. The extent of the reconnaissance mapping is shown on the field maps included in Appendix B.

The basement rock in the area of the dam site and reservoir is greywacke. At this stage, no attempt has been made to differentiate the greywacke, or map variations within the greywacke in plan across the dam site.

Upstream of the dam (near point 34, figure 1a, Appendix B) the greywacke tends to be uniformly dark green, possible ferrous staining, and gives the impression that the mass has been previously strongly sheared, then rehealed.

The greywacke downstream towards the dam footprint tends to be hard, siliceous, and black while Sub vertical shear zones were also apparent within this area. Shear zones consisted of light grey pulverised rock with high clay content. An example of a shear zone is shown in Figure 3.1. The shear zones are between 100mm and 300mm wide and are aligned sub parallel to the axis of the proposed dam.

There was little obvious structure e.g. bedding, nor was there evidence of any low angle shear zones in the basement greywacke.

Terraces on both banks at the dam site are the result of previous river valley aggradation. Exposures on the right bank show approximately 3m of relatively fine alluvium. Wedges of river alluvium are present at the same level on the left bank.

Colluvium mantles the steeper slopes on the abutment areas. There is a small mass movement debris tongue which extends out onto the terrace approximately 60m upstream from the right abutment.

3.2 Drilling

Five continuous rotary core drillholes were drilled in the dam foundation to explore the depth of overburden, quality of bedrock and presence of active faulting.

Drillhole locations are shown on Drawing WS909/20/25 included in Appendix A. Drillhole logs are included in Appendix C. Core photographs are included in Appendix D.

Drill hole details and observations are summarised in Table 3.2.

Two helicopter transportable wire line rigs operated by Websters Drilling Ltd., carried out the drilling using HQ sized triple tube wireline equipment and HW casing.

Drilling was supervised on site by Damwatch. Core was wrapped and packaged in plastic core boxes before being transported to Websters Drilling Ltd yard in Porirua. Core logging and photography was performed by Royden Thompson.

Drillholes LM1 to LM4 inclusive were grouted upon completion with cement grout. Drillhole LM5 was grouted within the greywacke with a 32mm standpipe piezometer installed within the overlying alluvium and colluvium. As built standpipe piezometer details are included in Appendix C.
3.3 Lugeon Tests

Lugeon tests were carried out over sections of the drill holes using single packers. A total of fourteen lugeon tests were undertaken. A summary of Lugeon test results is tabulated in Appendix E.

Testing was carried out using both pneumatic and hydraulic packers. Based on field inspection of the rock core, sections were chosen progressively as the hole was advanced to target zones of highly fractured rock. These zones were anticipated to be of higher permeability.

Testing was carried out by Websters Drilling Ltd and supervised by Damwatch.
Table 3.2. Summary of Drillhole Details and Observations

<table>
<thead>
<tr>
<th>Hole Number</th>
<th>Details</th>
<th>Geologic Summary</th>
</tr>
</thead>
</table>
| LM-1        | Vertical hole to 20.0m depth. Located on left abutment. Grouted on completion. | • 0.35m to 5.87m colluvium.  
• 5.87m to 20.0m predominately sandstone dominated, siliceous Greywacke.  
• Pervasive green alteration.  
• Zones of mostly indurated, pervasive shearing, assumed to be ‘old’.  
• No distinct bedding.  
• Generally closely to very closely spaced defects of variable orientation. |
| LM-2        | Drilled 34.37m in length, 70° from horizontal at a bearing of 149°. Located on left abutment. Grouted on completion. | • 0.0m to 1.30m river alluvium.  
• 1.30m to 34.37m greywacke of variable quality.  
• Rock ranges from strong sandstone dominated, siliceous greywacke to weaker argilliceous zones.  
• Limited patchy green alteration  
• Zones of high core loss with very grey muddy drill flush returns. Inferred shear zones filled by crushed/pulverised rock and clay gouge.  
• No defined low angle shears. |
| LM-3        | Drilled 54.03m in length, 45° from horizontal at a bearing of 329°. Located on right abutment. Grouted on completion. | • 0.0m to 9.40m river alluvium.  
• 9.40m to 54.03m generally sandstone dominated greywacke with very minor argillite and quartz veining.  
• Bedding obscure and only rarely identifiable.  
• Well jointed and sheared rock with minor oxidation at the top.  
• No defined low angle shears.  
• Patchy, but subordinate alteration in the greywacke. |
| LM-4        | Vertical hole drilled to 14.93m depth on the right abutment. Grouted on completion. | • 0.35m to 5.10m river alluvium.  
• 5.10m to 14.93m generally sandstone dominated greywacke with diffuse, patchy, argillite.  
• Closely jointed and sheared.  
• No defined low angle discontinuities. |
| LM-5        | Vertical hole drilled to17.02m depth on right abutment. PVC standpipe and steel standup cover installed on completion. | • 0.20m to 3.15m Loess with colluvium detritus.  
• 3.15m to 9.14m river alluvium.  
• 9.14m to17.02m generally sandstone dominated, siliceous Greywacke.  
• Closely jointed and sheared.  
• No defined low angle discontinuities. |
4.0 Saddle Investigation

4.1 Road Saddle

Two trial pits were excavated using a 20 tonne excavator on the ‘road saddle’. Test pit locations are shown on Drawing WS909/20/27 in Appendix A. Test pit photographs and logs are included in Appendix F.

Test pit MA-1 on the NW side of the saddle revealed greywacke at 3.90m below ground level overlain by Loess. The greywacke surface rises towards the saddle. In test pit MA-2 alluvium with a loess cover was encountered to the final depth of 4.1m. Alluvium with a loess cover also exists in the south west road batter at the saddle. No groundwater was encountered in test Pit MA-1. Small groundwater inflows at 2.70m depth were encountered in MA-2. After completion test pits were backfilled with excavated material and compacted with the excavator bucket. All excavated material was returned to the excavated pits.

A sketch geological section through the saddle based on the test pits is shown in Figure 4.1.

The level RL 120m was estimated on site based on topographic mapping and requires confirmation by survey control.

4.2 Pond Saddle

Approximately 150m NW of the dam centre there is another low saddle containing a long narrow pond that has a low embankment at both ends. This saddle is shown in Figure 4.2.

Although no trial pitting was undertaken, greywacke was observed outcropping in the track cuts on either side of the saddle gully.

To gain a better understanding of the pond saddles potential for overtopping, levels and accurate topographic data need to be established for the pond saddle.
5.0 Borrow Areas

5.1 Test Pits

Three test pits were excavated, using a 20 tonne excavator, in cultivated land in the Maungakotukutuku Basin to investigate the river alluvium and greywacke bedrock as a potential aggregate. Test pit locations are shown on WS909/20/27 in Appendix A, with test pit photographs and logs in Appendix F.

Test pit MA-3 and MA-4 established the presence of alluvium greater than 4m thick in the mid basin area. While greywacke clasts are relatively fresh and strong, the alluvium tends to have high silt/clay content. Fines would be required to be removed by washing if it is to be used as an aggregate. Small groundwater seeps were only encountered in test pit MA-3 at 3.2m.

Test pit MA-5 encountered greywacke at a depth of 2.6m. Greywacke is slightly weathered, closely jointed and blocky. There is some penetration of fines along defects.

In close proximity to MA-5 the grassy area is rough, lower in elevation and moist suggesting greywacke may be present with minimal overburden.

Test pits were photographed and logged by Royden Thompson, before backfilling and compaction on completion.
### Appendix A: Drawings

<table>
<thead>
<tr>
<th>Document Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS909/20/21</td>
<td>Lower Maungakotukutuku RCC Dam – Scenario 1 - General Arrangement – Reservoir Inundation</td>
</tr>
<tr>
<td>WS909/20/22</td>
<td>Lower Maungakotukutuku RCC Dam – Scenario 1 – Plan and Typical Sections</td>
</tr>
<tr>
<td>WS909/20/23</td>
<td>Lower Maungakotukutuku RCC Dam – Scenario 2 - General Arrangement – Reservoir Inundation</td>
</tr>
<tr>
<td>WS909/20/24</td>
<td>Lower Maungakotukutuku RCC Dam – Scenario 2 – Plan and Typical Sections</td>
</tr>
<tr>
<td>WS909/20/25</td>
<td>Lower Manugakotukutuku Dam – Geotechnical Drilling Setting Out</td>
</tr>
<tr>
<td>WS909/20/27</td>
<td>Lower Manugakotukutuku Dam – Test Pit Locations</td>
</tr>
</tbody>
</table>
Live storage volume (m³): 1931000
Reservoir inundation area (m²): 280200
Live storage volume (m$^3$): 193,100
Reservoir inundation area (m$^2$): 280,200
NOTES:
1. Top of siltstone horizons and Erosions based on field GPS with max range of the order of 20cm. Actual coordinates are subject to surveying.
2. Top of siltstone levels (and subsequently bottoms of hole levels) are based on topographical contours. Actual levels are subject to survey.

CONCEPTUAL GEOLOGICAL SECTION A-A (LOOKING DOWNSTREAM)
Appendix B: Reconnaissance Field mapping
Fig. 1b Geological Section on Dam Axis

Scale 1:1000 H = V

RT May 19
Appendix C: Drill Hole Logs
**DESCRIPTION OF CORE**

**WEATHERING, HARDNESS, STRENGTH, COLOUR, ROCK OR SOIL TYPE, DEFECT SPACING, LITHOLOGICAL FEATURES (bedding, foliation, mineralogy, texture, cement, etc.); STRATIGRAPHIC NAME**

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>CORE DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>0-0.35</td>
<td>Soil w. scattered gneis-felsite flakes</td>
</tr>
<tr>
<td>0.35-5.87</td>
<td>Colluvium</td>
</tr>
<tr>
<td></td>
<td>Diagonal gneis-felsite in a dirty matrix. Dry and hard.</td>
</tr>
</tbody>
</table>

**DETRITAL MATERIALS**

<table>
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<th>DEPTH</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>0-0.35</td>
<td>Soils</td>
</tr>
<tr>
<td>0.35-5.87</td>
<td>Colluvium</td>
</tr>
</tbody>
</table>

**DESCRIPTION OF COELENOLOGY**

<table>
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<th>DEPTH</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
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<td>Soils</td>
</tr>
<tr>
<td>0.35-5.87</td>
<td>Colluvium</td>
</tr>
</tbody>
</table>

**LOG OF DRILL HOLE**

**HOLE NO.** LM 1

**PROJECT** Lennox

**GRID REF.** T.B.C.

**LOCATION** Lower Maungatokuaro

**DATE** 01-01-01

**WATER DRILL LEVEL** 0 ft

**HARD COLLAR**

**CORE LENGTH** 20 ft

**ORIGINAL VERTICAL**

**SCALE**

**CORE BOXES**

**LOGGED** 12 ft

**TRACED**

**EXPLANATION**

**DRILLER**

**STARTED** 1.6.10

**FINISHED** 16.6.10

**PROJECT**

**HOLE NO.** LM 1
**Damwatch Services**

**LOG OF DRILL HOLE**

**HOLE NO.** LM 1

**DESCRIPTION OF CORE**

- Weathering, hardness, strength, colour, rock or soil type, defect spacing, lithological features (bedding, foliation, mineralogy, texture, cement, etc.)

**Core Depth**

- Raw.
- Lift.
- H.A.
- G.
- Core orientation.
- Fracture log.
- Rock defects (prominent joints, bedding, seams, veins)

**Fracture log**

- Spacing of natural fractures.
- Presence of natural fractures.
- Fracture index.

**Rock defects**

- Prominent joints, bedding, seams, veins.
- Shatter, shear, and crush zones.
- Foliation, schistosity (attitude, width, spacing, smoothness).

**OR Soil description**

- Consistency, compaction, water content, group symbol, etc.

**Water drill level water loss**

- Water pressure tests (Lugoces or Permeability-10m).

**Driller:**

- Weber.

**Started:**

- 10/6/16

**Finished:**

- 16/6/16

**Explanation:**

- No alluvial at site.
- Gravels & cobbles are Subangular to Subrounded.
- Shatter, shear, and crush zones.
- More of shear and tension fractures from sand and gravels appear old (Raytown Origin).
- Some, more recent data determined likely.

**Note:**

- GENERAL REMARKS:
- Core orientation.
- Core orientation.
- Core orientation.

**Date:**

- 20-00

**Logged:**

- 7/1

**Project:**

- K.C.C.

**Hole No.:**

- LM 1

**Length:**

- 20.00

**Checked:**

- ORIGINAL VERTICAL:

- CORE BOXES:

- SHEET:

- 3.03
### Damwatch Services

**LOG OF DRILL HOLE**

**HOLE NO.:** LM 2

**PROJECT:** K.C. O.C

**FEATURE:**

**GRID REF.:** T.R.C

**COORD.:** T.R.C

**DIRECTION:** 149°

**H.A.D.:** T.R.C

**H.A.D. COLLAR:** T.R.C

**ANGLE FROM HORIZONTAL:** 7°

**DESCRIPTION OF CORE**

- Weathering, hardness, strength, colour, rock or soil type, defect spacing, lithological features (bedding, foliation, mineralogy, texture, cement, etc.

**ROCK WEATHERING**

**ROCK HARDNESS**

**DEPTH**

**COORD.**

**LOGGING**

**WEATHERING**

**HARDNESS**

**LIFT %**

**H.A.D.**

**LOG**

**SPACING OF NATURAL FRAC TURES**

**FRACTURE LOG**

**ROCK DEFECTS**

- Prominent joints, bedding, veins, shear, crush zones, foliation schistosity (attitude, width, steepness, smoothness)

**OR SOIL DESCRIPTION**

- Consistency, compaction, water content, group symbol etc.

**WATER DRILL LEVEL**

**WATER LOSS %**

**WATER PRESSURE TESTS - Lugares**

**PERMEABILITY - D.T.M.A.**

**DATE**

**LOGGED P.T.**

**PROJECT:** K.C. O.C

**HOLE NO.:** LM 2

**TRACED LENGTH:** 34.37

**CHECKED:**

**ORIGINAL VERTICAL:**

**SCALE:** 1:10

**CORE BOXES:**

**SHEET:** 2 OF 5

**ORIGIN NO.:**
**Description of Core**

Weathering, Hardness, Strength, Colour, Rock or Soil Type, Defect Spacing, Lithological Features (bedding, foliation, mineralogy, texture, cement, etc.) Stratigraphic Name

**Rock Weathering**

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

**Rock Hardness**

- Vf - Very hard
- H - Hard
- Mh - Moderately hard
- M - Moderately soft
- S - Soft
- Vs - Very soft

**Fracture Log**

Spacing of natural fractures

**Log of Drill Hole**

- Core Loss
- Rubble

**Date:** 26/6/10

**Project:** KCDC

**Driller:** H. Hester

**Started:** 26/6/10

**Finished:** 27/11/10

**Explanations:**

- Grey, siliceous with Abundant quartz veins.
- Some dark grey clays within, becoming paler with depth.

- Dark grey, with Abundant quartz veins.
- Dark argillaceous laminating within.
- Some dark grey clays within, becoming paler with depth.

**T0 = 34.37**
0-35
Silt/Alluvium mix.

0.35 - 5.10
River Alluvium
Indicating coarse alluvium in the complete sequence. Expose sandy gravely sand (Sd). Clayey subrounded rippled gravel (Sw). Recovered material mostly clean — likely to be dirty in Sw.

5.10 - 12.00
Gypsum
Pale brown-grey, powdery calcite (chabazite) with crystalline structure.

Driller: J. M. Kallo
Started: 31/6/10
Finished: 8/6/10
Explaination:

Rock Weathering
Unweathered (UW)
Slight weathered (SW)
Moderately weathered (MW)
Highly weathered (HW)
Completely weathered (CW)

Rock Hardness
Very hard (VH)
Hard (H)
Moderately hard (MH)
Soft (S)
Very soft (VS)

Fracture Log
Spacing of natural features
Fractional

Logged:

Traced:

Checked:

Original Vertical:

Scale:

Sheet: 1 of 2

Project:

Hole:

Length:

Core Boxes:

Original Vertical:

Scale:

Sheet: 1 of 2

Drill:

Explaination:
**DESCRIPTION OF CORE**

- Weakening, hardness, strength, colour, rock or soil type, defect spacing, lithological features (bedding, foliation, mineralogy, texture, cement, etc.), stratigraphic name.

### Core Description

- 38.9 cm: Dark grey, very weak, poorly bedded.
- 57 cm: Light grey, more distinct, weakly bedded.
- 87 cm: Greyish white, strong, well bedded.

### Core Samples

- Sample 1: 38.9 cm
- Sample 2: 57 cm
- Sample 3: 87 cm

### Core Measurements

- Depth: 38.9 cm
- Diameter: 5 cm
- Core length: 30 cm

### Core Description

- Weakening, hardness, strength, colour, rock or soil type, defect spacing, lithological features (bedding, foliation, mineralogy, texture, cement, etc.), stratigraphic name.

### Core Sample Analysis

- Sample 1: 38.9 cm
- Sample 2: 57 cm
- Sample 3: 87 cm

### Core Quality

- Quality: High
- Condition: Fresh

### Core Preservation

- Preservation: Excellent
- Integrity: Good

### Core Interpretation

- Interpretation: Weak bedded layers with distinct bedding planes.

### Core Summary

- Core: 38.9 cm
- Sample: 57 cm
- Analysis: 87 cm

---

**Log of Drill Hole**

- Project: LC DC
- Feature: Dam
- Location: Lower Makaraka Turu Koi
- Hole: LM 5
- Angle from Horizontal: 90°
- Direction: HAD
- Datum: GND
- Grid Ref.: GND
- Co-Ord.: GND
- Had: GND

**Rock Weathering**

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

**Rock Hardness**

- VH: Very hard
- H: Hard
- M: Moderately hard
- MS: Moderately soft
- S: Soft
- VS: Very soft

**Fracture Log**

- Spacing of natural features
- Features/m of core

**Rock Defects**

- Prominent joints, bedding, seams, veins, shear, and crush zones, foliation, schistosity (attitude, width, spacing, striations)

**Soil Description**

- Consistency, compactness, water content, group symbol etc.

---

**Driller:**

- Name: B. T
- Started: 3/5/18
- Finished: 8/6/18

**Explaination**

- Sheet: 3 of 3
- DRG No.: GND

---

**Water Pressure Tests**

- Date: GND
- GND
- Water Pressure Tests: GND
- GND
- Water Pressure Tests: GND
- GND

**Drill:**

- GND
- GND
- GND
- GND

---

**Date:**

- GND
- GND
- GND
- GND

**Hole No.:**

- LM 5
- GND
- GND
- GND

**Traced:**

- Length: 17.0
- GND
- GND
- GND

**Checked:**

- Original Vertical: GND
- Core Boxes: GND
- Scale: GND
**LM-5 Piezometer Installation Sketch**

- **32mm PVC pipe**
- **Steel up-stand (0.5m)**
- **Ground Level**
- **Cement**
- **0.5m**
- **1.0m**
- **Bentonite**
- **6m slotted PVC pipe**
- **Sand Filter**
- **7.60m**
- **Cement grout**
- **17.02m**
Appendix D: Drill Hole Core Photos
LM 4  Box 5

LM 4  Box 6
Appendix E: Lugeon Test Results Summary
<table>
<thead>
<tr>
<th>Drillhole</th>
<th>Test Section</th>
<th>Test Pressure (Bar)</th>
<th>Lugeon Value</th>
<th>Interpretation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM1</td>
<td>From 10.00, To 11.03, Length 1.03</td>
<td>1.25</td>
<td>0.0</td>
<td>No water taken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.29</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.98</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.29</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.25</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>LM1</td>
<td>From 16.70, To 20.00, Length 3.30</td>
<td>1.25</td>
<td>0.0</td>
<td>No water taken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.29</td>
<td>0.0</td>
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</tr>
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<td></td>
<td>1.25</td>
<td>0.0</td>
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</tr>
<tr>
<td>LM2</td>
<td>From 6.20, To 7.90, Length 1.70</td>
<td>1.27</td>
<td>9.3</td>
<td>Lugeons increasing as test progresses (except stage 5) suggesting washout of defects. The zone tested was running sub parallel to the open river gorge walls. Due to the relaxed state of the rock mass in the gorge walls higher permeabilities were expected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.30</td>
<td>15.3</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>2.99</td>
<td>25.6</td>
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<td></td>
<td>1.27</td>
<td>27.8</td>
<td></td>
</tr>
<tr>
<td>LM2</td>
<td>From 17.20, To 20.96, Length 3.76</td>
<td>2.29</td>
<td>0.0</td>
<td>Insignificant water taken during stage 2 &amp; 5. Essentially no flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.67</td>
<td>0.4</td>
<td></td>
</tr>
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<td>5.05</td>
<td>0.0</td>
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<td>3.67</td>
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<table>
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<th>Drillhole</th>
<th>From (m)</th>
<th>To (m)</th>
<th>Length (m)</th>
<th>Test Pressure (Bar)</th>
<th>Lugeon Value</th>
<th>Interpretation*</th>
</tr>
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<tbody>
<tr>
<td>LM2</td>
<td>25.10</td>
<td>28.71</td>
<td>3.61</td>
<td>1.95</td>
<td>2.8</td>
<td>Lugeons are about equal over all test pressures. Laminar flow</td>
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<tr>
<td></td>
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<td></td>
<td>2.98</td>
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<td>3.67</td>
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<td></td>
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<td>0.00</td>
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<tr>
<td>LM3</td>
<td>14.67</td>
<td>15.67</td>
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<td>1.64</td>
<td>0.0</td>
<td>No water taken</td>
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<td></td>
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<td>29.53</td>
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<td>3.36</td>
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<td>Highest lugeon occurs at highest test pressure, suggesting dilation of defects</td>
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<td>5.77</td>
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<td>3.36</td>
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## Test Section

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<th>From (m)</th>
<th>To (m)</th>
<th>Length (m)</th>
<th>Test Pressure (Bar)</th>
<th>Lugeon Value</th>
<th>Interpretation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM3</td>
<td>36.60</td>
<td>38.10</td>
<td>1.50</td>
<td>2.33</td>
<td>0.0</td>
<td>Insignificant water taken only during stage 2. Essentially no flow</td>
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<tr>
<td></td>
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<td>4.12</td>
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<tr>
<td>LM3</td>
<td>37.90</td>
<td>41.24</td>
<td>3.34</td>
<td>3.02</td>
<td>0.5</td>
<td>Lugeons increase during stage 2 and then progressively decrease through to stage 5. Suggesting void filling of defects during stages 3, 4 &amp; 5</td>
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<td>3.02</td>
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<td>LM3</td>
<td>46.50</td>
<td>54.03</td>
<td>7.53</td>
<td>3.70</td>
<td>0.4</td>
<td>Highest lugeons occurring at lowest pressures suggesting turbulent flow. Lugeons values remain very low.</td>
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<th>Drillhole</th>
<th>Test Section From (m)</th>
<th>To (m)</th>
<th>Length (m)</th>
<th>Test Pressure (Bar)</th>
<th>Lugeon Value</th>
<th>Interpretation*</th>
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<td>10.00</td>
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<td>0.90</td>
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<td>14.93</td>
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<td>Highest lugeon occurs at highest test pressure, suggesting dilation of defects</td>
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Appendix F: Trial Pit logs and Photograph
TRIAL PIT LOG

**STRATA**

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<tr>
<th>Depth</th>
<th>No</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>0.00-0.30</td>
<td></td>
<td>Topsoil</td>
</tr>
<tr>
<td>0.30-3.90</td>
<td></td>
<td>LOESS, Silty CLAY with some fine sand; Compact, Moist, Medium brown, Firm but readily excavated.</td>
</tr>
<tr>
<td>3.90-4.20</td>
<td></td>
<td>GREYWACKE; Moderately weathered, no obvious structural features. Hard to excavate.</td>
</tr>
<tr>
<td>4.20</td>
<td></td>
<td>3.90 Loess/Greywacke contact subparallel to surface</td>
</tr>
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**SPECIALS & TESTS**

**GENERAL REMARKS**

To investigate lithologies on North side of road saddle. Ground surface sloping at approx 10 deg to NW. Levels and co-ordinates based on handheld gps (+/-3m).

**All dimensions in metres**

Scale 1:57.5

**Client**
Kapiti District Council

**Method/Plant Used**
20 tonne excavator

**Logged By**
Royden Thomson

---

Shoring/Support: None
Stability: Hole stable
**TRIAL PIT LOG**

**Project**

KCDC

**TRIAL PIT No**

TP MA2

**Job No**

DW909

**Date**

16-03-10

**Ground Level (m)**

120.00

**Co-Ordinates (°)**

E 2,681,805.0  N 6,029,663.0

**Contractor**

Kapiti District Council

**Sheet**

1 of 1

---

### STRATA

<table>
<thead>
<tr>
<th>Depth</th>
<th>No</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td></td>
<td>Topsoil</td>
</tr>
<tr>
<td>0.30-1.30</td>
<td></td>
<td>LOESS; Orange brown, massive, firm.</td>
</tr>
<tr>
<td>1.30-2.70</td>
<td></td>
<td>RIVER ALLUVIUM; Dirty, cobbly, sandy GRAVEL (GW). Fines (silt/clay) adhere to surfaces. Clasts are sub angular - sub rounded greywacke. Moist, dark brown.</td>
</tr>
<tr>
<td>2.70-3.70</td>
<td></td>
<td>LAKE DEPOSITS; Clayey SILT (ML) with some very fine sand. Very compact. Firm, mostly light grey. 2.70 Small water inflows</td>
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<tr>
<td>3.70-4.10</td>
<td></td>
<td>RIVER ALLUVIUM; Dirty, cobbly, sandy GRAVEL (GW). Substantial silt/clay in voids. Clasts are MnO stained. Some cementing.</td>
</tr>
<tr>
<td>4.10</td>
<td></td>
<td>End of Hole</td>
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---

**GENERAL REMARKS**

To investigate lithologies on SE side of saddle. Ground sloping at approx 3-4 deg to NE. Alluvial units anticipated to be low k & expected to penetrate through saddle to RL 120 (approx). Levels and co-ordinates based on handheld gps (+/-3m).

---

**Shoring/Support:** None

**Stability:** Hole stable

---

**All dimensions in metres**

**Client**

Kapiti District Council

**Method/Plant Used**

20 tonne excavator

**Logged By**

Royden Thomson
### STRATA

<table>
<thead>
<tr>
<th>Depth</th>
<th>No</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td></td>
<td>Topsoil</td>
</tr>
<tr>
<td>0.30-0.60</td>
<td></td>
<td>Very dirty (soily) sandy, GRAVEL (GW); Rewatered surficial alluvium.</td>
</tr>
<tr>
<td>0.60-1.40</td>
<td></td>
<td>RIVER ALLUVIUM; Cobbly, sandy, GRAVEL (GW) with rare silt. Clasts are angular - sub rounded greywacke. Loose, dry, medium brown.</td>
</tr>
<tr>
<td>1.40-3.20</td>
<td></td>
<td>RIVER ALLUVIUM; Dirty, sandy, GRAVEL (GW) with some cobbles. Silt/clay largely infills voids. Clasts angular/sub rounded greywacke. Firm, moist, medium brown.</td>
</tr>
<tr>
<td>3.20-4.30</td>
<td></td>
<td>RIVER ALLUVIUM; Dirty, cobbly, sandy, GRAVEL (GW) with some boulders (max 0.70m). Clasts angular - sub rounded greywacke. Hard, only slight clast weathering. Voids largely infilled with clay/silt (clay is tackey - more clay than silt). Medium brown, moist to locally saturated.</td>
</tr>
<tr>
<td>4.30</td>
<td></td>
<td>End of Hole</td>
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</tbody>
</table>

### GENERAL REMARKS

To investigate aggregate potential of valley floor alluvium. Ground surface sub horizontal. Alluvium dirty - v.dirty, anticipated to be low k. Levels and co-ordinates based on handheld gps (±3m).
TRIAL PIT LOG

**Project:** TCDC  
**Job No:** DW909  
**Date:** 16-03-10  
**Ground Level (m):** 109.00  
**Co-Ordinates ( ):** E 2,681,969.0  N 6,029,614.0

**Contractor:**

**Legend:**

**STRATA**

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<th>Depth</th>
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<td>0.00-0.30</td>
<td><strong>TOPSOIL</strong></td>
</tr>
<tr>
<td>0.30-0.80</td>
<td><strong>LOESS; Light brown.</strong></td>
</tr>
<tr>
<td>0.80-4.70</td>
<td><strong>RIVER ALLUVIUM; Dirty, cobbly, sandy GRAVEL (GW) with rare boulders (max 0.5m). Clasts angular - sub rounded Greywacke. Hard (vw/sw). Fines (silty/clay) tend to infill voids. Tackey. Moist. No inflows. Light to medium brown. Fair horizontally bedded.</strong></td>
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<table>
<thead>
<tr>
<th>Depth</th>
<th>Remarks/Tests</th>
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<tr>
<td>3.00</td>
<td>Tends dirtier</td>
</tr>
<tr>
<td>4.70</td>
<td>End of Hole</td>
</tr>
</tbody>
</table>

**SHORING/SUPPORT:** None  
**STABILITY:** Hole stable

**GENERAL REMARKS**

To investigate aggregate potential of valley floor alluvium. Ground surface sub horizontal. Alluvium dirty - v.dirty, anticipated to be low k, relatively uniform grading. Minor clasts with MnO staining. Levels and co-ordinates based on handheld gps (+/-4m).

**METHOD/PLANT USED:** 20 tonne excavator

**LOGGED BY:** Royden Thomson
**TRIAL PIT LOG**

**STRATA**

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<tr>
<th>Depth</th>
<th>No.</th>
<th>DESCRIPTION</th>
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<td>0.00-0.30</td>
<td>TOPSOIL</td>
<td></td>
</tr>
<tr>
<td>0.30-0.70</td>
<td>LOESS; Light brown</td>
<td></td>
</tr>
<tr>
<td>0.70-2.60</td>
<td>RIVER ALLUVIUM; Dirty, cobble, sandy, GRAVEL (GW) with rare boulders (max 0.4m). Fines (silty/clay) infill voids. Clasts angular - sub rounded, tend fresh. Wet, medium brown. Poorly bedded.</td>
<td></td>
</tr>
<tr>
<td>2.60-2.90</td>
<td>GREYWACKE; Closely jointed, equant debris, slight penetration of fines along defects. Slightly weathered.</td>
<td></td>
</tr>
<tr>
<td>2.90</td>
<td>End of Hole</td>
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**SAMPLES & TESTS**

Shoring/Support: None  
Stability: Localised fretting on pit walls.

**GENERAL REMARKS**

To investigate aggregate potential of valley floor alluvium. Ground surface sub horizontal. Alluvium, anticipated to be low k. Shallow depth to greywacke, greywacke may be suitable for aggregate. Levels and co-ordinates based on handheld GPS (+/-3m).
Trial Pit MA-1:
Trail Pit MA-2:
Trail Pit MA-2:
Trial Pit MA-3:
Trial Pit MA-4:
Trial Pit MA-5: