



24 December 2009
Project No. 42172547

Waitaki District Council
Private Bag 50058
Oamaru 9444

Attention: Dougall McIntyre
Property and Parks Manager

Dear Dougall

Subject: Ground Investigations at Forrester Heights, Oamaru

1 Introduction

URS New Zealand Limited (URS) has undertaken a geotechnical ground investigation at the Forrester Heights Subdivision in Oamaru at the request of Waitaki District Council. Tasks undertaken as part of this investigation include:

- Logging of site test pits to NZ Geotechnical Society Inc. "Field Description of Soil and Rock", 2005, to confirm loess and rock levels on site for the proposed subdivision.
- A brief desk study of available material on the site

This letter summarises the findings of the ground investigation

2 Site Description

The site is approximately 225m by 100m between Test Street and Avon Street in Oamaru, to the east of currently residential properties, overlooking Oamaru Harbour. The site slopes to the north towards the harbour.

2.1 Geological Setting

The site is underlain by Pleistocene windblown Loess deposits, with occasional raised beach deposits. Below this is Eocene age volcanic rock types including tuffs, agglomerates and basaltic pillow lavas.

3 Test Pitting

Nine test pit locations (TP1 to TP9) were initially considered for excavation (Figure 1), along the proposed roadway. The locations were chosen as the deepest points in cuttings for the proposed roadway. These depths varied between 3m and 6m. Two locations (TP4 and TP5) were eliminated from the proposed investigation due to their proximity to TP6 (within 20m). TP9 was also eliminated when the potential location was found to be on a public footpath and within a couple of meters of an existing roadway cutting, which would potentially be made unstable by excavation.

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URS House, 287 Durham Street
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T: 64 3 374 8500
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The remaining locations (TP1, TP2, TP3, TP6, TP7 and TP8) were excavated on the 15th and 16th December 2009.

Test pit logs and photographs are attached to this report, together with a plan showing the pit locations.

The depths of all the pits were targeted to reach the elevation of the base of the proposed road cutting. TP2, TP6, TP7 and TP8 were excavated to the planned depths, encountering topsoil and loess. TP1 and TP3 were terminated above their respective target depths on refusal following hard digging. TP1 encountered rock at a depth of 3.8m. Excavation of TP3 was difficult due to hard ground conditions from relatively shallow depths, and was eventually terminated at 3.9m below ground level.

All test pits encountered loess below topsoil. Topsoil depths varied from nil to 0.2m. Loess was encountered to a maximum depth of 4.5m (TP2, which was terminated at target depth).

The loess encountered was generally clay/silt, light brown, homogeneous, firm to very stiff, dry to slightly damp, and of varying plasticity.

Groundwater was not encountered in any of the test pits.

All pits remained stable, with no signs of potential collapse.

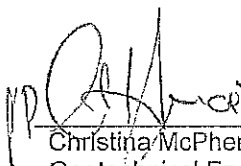
4 Conclusions


Loess was identified in all pits immediately below topsoil. The Loess extended from ground level to depths corresponding to the base of the road cutting in all locations investigated except for TP1 and TP3.

TP1 encountered rock at 3.8m below ground level, which is above the expected road cutting base level.

Excavation of the Loess in TP3 was difficult from a relatively shallow depth due to the soil being hard and dry. Refusal was reached at a depth of 3.9m below ground level.

Yours sincerely
URS New Zealand Limited


Christina McPherson
Geotechnical Engineer


Gary Cross
Senior Associate

Enclosures: Site Plan
Test Pit Logs
Test Pit Photographs



WAITAKI DISTRICT COUNCIL
GROUND INVESTIGATION
FORRESTER HEIGHTS, OAMARU
LOCATION PLAN

URS



TEST PIT LOG

TP1

Sheet 1 of 1

| | | | | |
|--|-------------------------------|--|---------------------------------|--|
| URS New Zealand Limited 287 Durham Street, Christchurch | | Phone: 64.3.374.8500 Fax: 64.3.377.0655 | Project No.: 42172547 | Project Reference: Forrester Heights, Oamaru |
| Contractor: Whitestone | | | Grid: Datum: | Client: Waitaki District Council |
| Excavation Method: 20 tonne excavator | Logged By: CM | Relative Level: mRL | Permit No: | |
| | Checked By: | Coordinates: mN mE | | |
| | Date Started: 16-12-09 | Date Finished: 16-12-09 | Location: Chainage 340 | |

| DESCRIPTION OF STRATA | GRAPHIC LOG | DEPTH (m) | GROUND WATER DATA AND COMMENTS |
|--|-------------|-----------|--------------------------------|
| CLAY/SILT with some rootlets, dark brown. Firm, dry, highly plastic. | | 0.0 | |
| CLAY/SILT, light brown, homogeneous. Firm to stiff, dry, low plasticity. | | | Dry. |
| becomes light yellow brown at 0.9m. | | | |
| | | 1.0 | Dry. |
| | | 2.0 | Dry. |
| CLAY/SILT, light grey brown to light brown. Firm, slightly damp, low plasticity. | | | Slightly damp. |
| | | 3.0 | Slightly damp. |
| Dark grey, mottled white, medium grained AGGLOMERATE, moderately strong. | | | Dry. |
| Test pit terminated at 3.8m. | | 4.0 | |

| COMMENTS | TEST PIT SECTION | TEST PIT TERMINATED AT: |
|--|------------------|---|
| Pit walls stable Refusal at 3.8m, on fine grained granite, locally known as "rotten rock" by contractors. | | Target Depth <input type="checkbox"/> |
| | | Refusal <input checked="" type="checkbox"/> |
| | | Flooding <input type="checkbox"/> |
| | | Caving/collapse <input type="checkbox"/> |
| | | SAMPLE TYPE: |
| | | Bag Sample BAG |
| | Tube Sample TUBE | |
| | Vane Sample VANE | |



TEST PIT LOG

TP2

Sheet 1 of 1

| | | | | |
|--|----------------------|--|---------------------------------|--|
| URS New Zealand Limited 287 Durham Street, Christchurch | | Phone: 64.3.374.8500 Fax: 64.3.377.0655 | Project No.: 42172547 | Project Reference: Forrester Heights, Oamaru |
| Contractor: Whitestone | | | Grid: Datum: | Client: Waitaki District Council |
| Excavation Method: 20 tonne excavator | Logged By: CM | Relative Level: mRL | Permit No: | |
| | Checked By: | Coordinates: mN mE | | |
| Date Started: 15-12-09 | | Date Finished: 15-12-09 | Location: Chainage 520 | |

| DESCRIPTION OF STRATA | | GRAPHIC LOG | DEPTH (m) | GROUND WATER DATA AND COMMENTS |
|---|------------------|-------------|-----------|--|
| CLAY/SILT, brown. Firm to stiff, dry, highly plastic. | | | 0.0 | Dry. |
| CLAY/SILT, light brown, homogeneous. Stiff, dry. | | | 1.0 | Dry. |
| | | | 2.0 | Dry. |
| | | | 3.0 | Dry. |
| | | | 4.0 | Dry. |
| Test pit terminated at 4.5m. | | | | |
| COMMENTS | TEST PIT SECTION | | | TEST PIT TERMINATED AT: |
| Pit walls stable | | | | Target Depth <input checked="" type="checkbox"/> |
| | | | | Refusal <input type="checkbox"/> |
| | | | | Flooding <input type="checkbox"/> |
| | | | | Caving/collapse <input type="checkbox"/> |
| | | | | |
| | | | | SAMPLE TYPE: |
| | | | | Bag Sample BAG |
| | | | | Tube Sample TUBE |
| | | | | Vane Sample VANE |

URS

TEST PIT LOG

TP3

URS New Zealand Limited
287 Durham Street, Christchurch

Phone: 64.3.374.8500
Fax: 64.3.377.0655

Project No.: 42172547

Project Reference:

Forrester Heights, Oamaru

Contractor: **Whitestone**

Grid:
Datum:

Excavation Method:

20 tonne excavator

Logged By: CM

Checked By:

Date Started: 15-12-09

Date Finished: 15-12-09

Relative Level: mRL

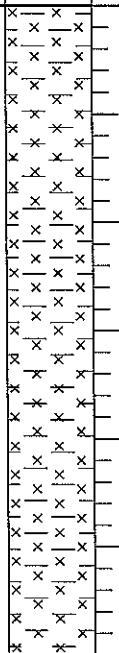
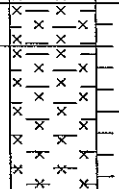
Coordinates:

Permit No:

Client:

Waitaki District Council

| |
|------------------------|
| Location: Chainage 250 |
|------------------------|

| DESCRIPTION OF STRATA | | | | | | | | | | GRAPHIC LOG | DEPTH (m) | GROUND WATER DATA AND COMMENTS |
|--|--|--|--|--|--|--|--|--|--|---|-----------|--------------------------------|
| CLAY/SILT, light brown. Stiff to hard, dry, highly plastic. | | | | | | | | | |  | 0.0 | Dry. |
| | | | | | | | | | | | 1.0 | |
| | | | | | | | | | | | 2.0 | |
| | | | | | | | | | | | 3.0 | |
| CLAY/SILT with traces of sand, medium brown. Stiff, slightly damp, highly plastic. | | | | | | | | | |  | | Slightly damp. |
| Slightly clayey SILT, white. Stiff to hard, dry. | | | | | | | | | | | | Dry. |
| Test pit terminated at 3.9m. | | | | | | | | | | | 4.0 | |
| | | | | | | | | | | | | |

| COMMENTS | TEST PIT SECTION | | | | | | | | | | TEST PIT TERMINATED AT: | | |
|---|------------------|--|--|--|--|--|--|--|--|-------------|-------------------------|-------------------------------------|--|
| Pit walls stable Slow digging due to hard ground Refusal at 3.9m, no pieces of material could be brought to surface for identification, suspected igneous material. | | | | | | | | | | | Target Depth | <input type="checkbox"/> | |
| | | | | | | | | | | | Refusal | <input checked="" type="checkbox"/> | |
| | | | | | | | | | | | Flooding | <input type="checkbox"/> | |
| | | | | | | | | | | | Caving/collapse | <input type="checkbox"/> | |
| | | | | | | | | | | | SAMPLE TYPE: | | |
| | | | | | | | | | | | Bag Sample | BAG | |
| | | | | | | | | | | Tube Sample | TUBE | | |
| | | | | | | | | | | Vane Sample | VANE | | |



TEST PIT LOG

TP6

Sheet 1 of 1

URS New Zealand Limited
287 Durham Street, ChristchurchPhone: 64.3.374.8500
Fax: 64.3.377.0655Project No.:
42172547

Project Reference:

Forrester Heights, OamaruContractor: **Whitestone**Grid:
Datum:

Excavation Method:

20 tonne excavatorLogged By: **CM**

Checked By:

Date Started: **15-12-09**Date Finished: **15-12-09**

Relative Level: mRL

Coordinates: mN

mE

Client:

Waitaki District Council

Permit No:

Location: **Chainage 150**

DESCRIPTION OF STRATA

SILT, light brown, homogeneous. Stiff, slightly damp, moderate plasticity,
with rare patches of white staining around rootlets at 1.2m.

GRAPHIC LOG

DEPTH (m)

GROUND
WATER
DATA AND
COMMENTS

Slightly damp.

Slightly damp.

Slightly damp.

Slightly damp.

Slightly damp.

Test pit terminated at 3.5m.

4.0

COMMENTS

TEST PIT SECTION

TEST PIT TERMINATED AT:

Pit walls stable

Target Depth

☒

Refusal

☐

Flooding

☐

Caving/collapse

☐

SAMPLE TYPE:

Bag Sample


BAG

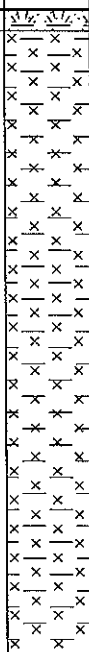
Tube Sample

TUBE

Vane Sample

VANE

| | | | | |
|---|--|--|--|--|
|  | | <h1>TEST PIT LOG</h1> | | Sheet 1 of 1 |
| | | <h2>TP7</h2> | | |
| URS New Zealand Limited 287 Durham Street, Christchurch | | Phone: 64.3.374.8500 Fax: 64.3.377.0655 | | Project No.: 42172547 Project Reference: Forrester Heights, Oamaru |
| Contractor: Whitestone | | Grid: Datum: | | |
| Excavation Method: 20 tonne excavator | | Logged By: CM Checked By: Date Started: 15-12-09 Date Finished: 15-12-09 | | Client: Waitaki District Council |
| | | Relative Level: mRL Coordinates: mN mE | | |
| | | Permit No: | | Location: Chainage 480 |

| DESCRIPTION OF STRATA | | | | | | | | GRAPHIC LOG | DEPTH (m) | GROUND WATER DATA AND COMMENTS |
|---|------------------|--|--|--|--|--|-------------|--|--|--|
| CLAY/SILT, dark brown. Firm to stiff, dry, highly plastic. | | | | | | | | | 0.0 | |
| CLAY/SILT, light brown, homogeneous. Stiff, dry, moderate plasticity. becomes light yellowish brown at 0.5m. | | | | | | | |  | 0.5 1.0 1.5 2.0 2.5 3.0 | Dry. Dry. Dry. Dry. |
| Test pit terminated at 3m. | | | | | | | | | 3.6 4.0 | |
| COMMENTS | TEST PIT SECTION | | | | | | | TEST PIT TERMINATED AT: | | |
| Pit walls stable | | | | | | | | Target Depth | <input checked="" type="checkbox"/> | |
| | | | | | | | | Refusal | <input type="checkbox"/> | |
| | | | | | | | | Flooding | <input type="checkbox"/> | |
| | | | | | | | | Caving/collapse | <input type="checkbox"/> | |
| | | | | | | | | SAMPLE TYPE: | | |
| | | | | | | | | Bag Sample | BAG | |
| | | | | | | | Tube Sample | TUBE | | |
| | | | | | | | Vane Sample | VANE | | |



TEST PIT LOG

Sheet 1 of 1

TP8

URS New Zealand Limited
287 Durham Street, ChristchurchPhone: 64.3.374.8500
Fax: 64.3.377.0655Project No.:
42172547

Project Reference:

Forrester Heights, OamaruContractor: **Whitestone**Grid:
Datum:

Excavation Method:

Logged By: **CM**Relative Level: **mRL**

Client:

Waitaki District Council**20 tonne excavator**

Checked By:

Coordinates: **mN**Date Started: **15-12-09**

mE

Date Finished: **15-12-09**

Permit No:

Location: **Chainage 420**

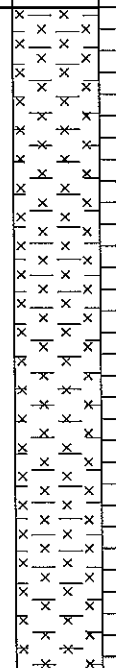
DESCRIPTION OF STRATA

GRAPHIC LOG

DEPTH (m)

GROUND
WATER
DATA AND
COMMENTS

CLAY/SILT, dark brown, homogeneous. Firm to stiff, dry, moderate plasticity.
becomes brown at 0.1m.
becomes light brown at 0.8m.



Dry.

Dry.

Dry.

Dry.

Test pit terminated at 3.1m.

4.0

COMMENTS

TEST PIT SECTION

TEST PIT TERMINATED AT:

Pit walls stable

Target Depth

☒

Refusal

☐

Flooding

☐

Caving/collapse

☐

SAMPLE TYPE:

Bag Sample

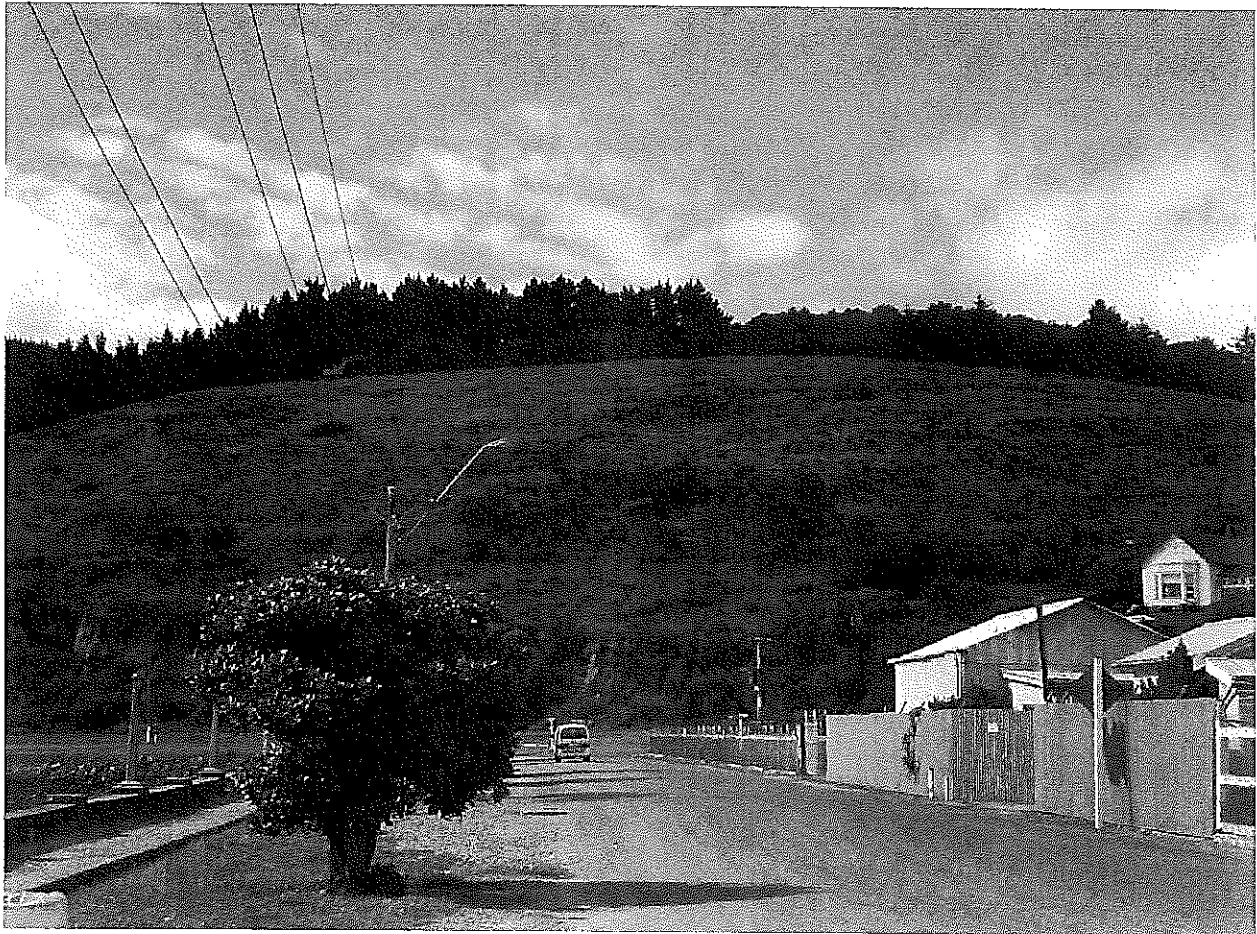
BAG

Tube Sample

TUBE

Vane Sample

VANE



Forrester Heights, Oamaru

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**



Test Pit TP1

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**



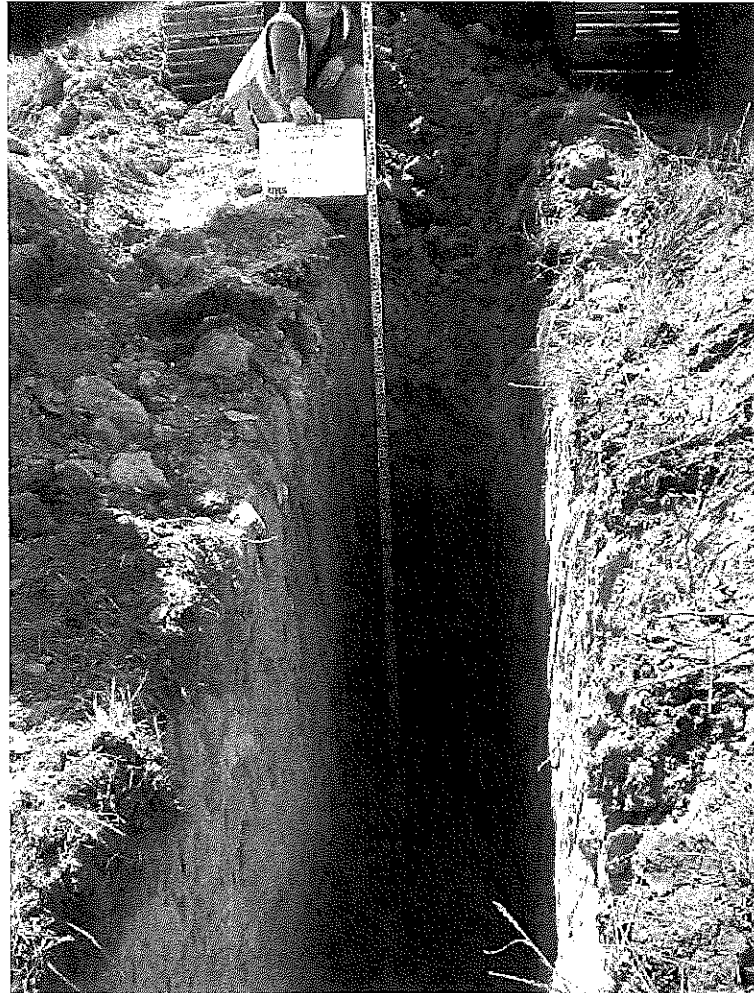
Test Pit TP2

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**



Test Pit TP3

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**



Test Pit TP6

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**



Test Pit TP7



| |
|-------|
| TITLE |
|-------|

Test Pit Photographs

PROJECT: 42172547 REV: A



Test Pit TP8

URS New Zealand
Engineering and Environmental Management

TITLE

Test Pit Photographs

PROJECT: **42172547** REV: **A**