



Consulting Engineers

Structural - Engineering - Solutions

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7th May 2018

Rex Gotz
c/- Stamm Surveys
PO Box 707
ROTORUA 3040

**RE: GEOTECHNICAL INVESTIGATION FOR THE PROPOSED SUBDIVISION
OF 22 ALASTAIR AVENUE, OWHATA, ROTORUA**

OUR REF: 22164

1.0 BRIEF

This report has been commissioned by Rex Gotz acting as our client. The purpose of this report is to provide a geotechnical assessment for the proposed subdivision of 22 Alastair Avenue, Rotorua. This report includes foundation design and stormwater disposal recommendations for future development.

The foundation recommendations outlined in Section 8.0 must be satisfied in order for a Producer Statement: Construction Review (PS4) to be issued for the foundations.

2.0 SITE DESCRIPTION

The site is located within a residential area at 22 Alastair Avenue, Owhata, Rotorua. The property is legally defined as Lot 45 DPS 8048. The property has an area of 928m² and slopes gently downward towards the north.

There is an existing two storey dwelling which is located at the southern end of the property. There is also a small existing rock retaining wall (approximately 0.4m high) that runs across the proposed new lot.

3.0 PROPOSED DEVELOPMENT

It is proposed to subdivide the property creating a new lot with an area of 539m² (372m² net) at the northern end of the existing section. The new lot will be accessed via the existing driveway which will also serve as a right of way for the existing dwelling. There are no current plans for a new dwelling at this stage.

A site plan is provided in Appendix A.

4.0 INVESTIGATIONS

The level of subsoil investigation required for any specific site and development proposal depends on numerous factors. Building type, building complexity, proposed foundation system, likelihood of ground hazards and consequence of ground hazards all require consideration.

The risk from ground hazards is considered to be low (discussed further in Section 7.0 below). It is expected that any future development will be of relatively low complexity and relatively light weight given the residential nature of the area. Based on this, the following investigations were considered suitable and were carried out for the proposed development:

1. A desktop study, including review of the Rotorua Lakes Council (RLC) District Plan Hazard Maps, the RLC property file, and the RLC 'Geyserview' GIS server. A review of local site geology and previous work carried out near the site was also undertaken.
2. A site walkover inspection to assess any subsoil constraints that were not identified in the desktop study.
3. Shallow subsoil testing consisting of five Scala-Penetrometer tests to depths of 3.0m to 3.9m below ground level, and three hand auger boreholes to depths of 2.1 to 2.2m below ground level. One of these boreholes was used to undertake a soakage test.

5.0 GEOLOGICAL SETTING

Review of the regional geological map '*Geology of the Rotorua Area*'¹ indicates that the site is underlain by material of the Hinuera Formation (Tauranga Group) consisting of "Laminated, commonly cross-bedded, fluvial sands and gravels, dominated by fragments of pumice and ash, plus quartz and feldspar crystals, and lava fragments; younger part is derived predominantly from reworking of the Oruanui Formation. Includes some primary ignimbrite". This material is from the late Pleistocene period (from the last 20,000 to 100,000 years).

The RLC soft ground hazard map² identifies the site as Zone B – Huka Group sediments and material from the Hinuera Formation. This material is relatively old and soft soils are expected to be consolidated.

6.0 GROUND CONDITIONS

At the test locations, topsoil overlaid silty sand down to a depth 0.7 to 1.1m below ground level. Below this, fine and medium grained sands were found down to a depth of 1.5 to 1.6m below ground level. A layer of dark brown silt/sandy silt was encountered down to a depth of 1.8 to 1.9m below ground level. Below this, light brown fine sand was found. At test location P3, coarse pumice sand was found from

¹ Leonard G.S, Begg J.G, Wilson C.J.N (compilers) (2010), *Geology of the Rotorua Area – Geological Map 5*. Institute of Geological and Nuclear Sciences.

2.0m below ground level. The soil became wet with depth but the ground water table was not encountered.

NZS3604:2011 considers 'good ground' to be soil with an Ultimate Bearing Capacity (UBC) of greater than 300kPa (subject to other factors). Our scala-penetrometer results show that the material down to 1.0m below ground level has a very low bearing capacity. Below this, the material was found to have a UBC ranging from approximately 200kPa to 300kPa. 'Good ground' was struck at a depth of approximately 1.0 to 1.4m below ground level.

A test location plan and Scala-Penetrometer results with borehole logs are attached in Appendices A and B respectively.

7.0 POTENTIAL GROUND HAZARDS

No specific hazards were identified as part of the hazard map review. However all potential hazards have been considered and are discussed below.

7.1 STATIC SETTLEMENT

The site is not considered to be 'good ground' as the material near the surface was found to have an Ultimate Bearing Capacity less than 300kPa and there is the risk that this material could settle under the load of any new structure.

Based on our foundation recommendations (refer to Section 8.0) the weaker near surface subsoils will be removed from beneath the foundations or the foundations will be founded upon suitable material below this. Hence the risk of static settlement for this project is considered to be low provided that our recommendations are followed.

7.2 LIQUEFACTION

Liquefaction is the term used to describe the loss of bearing strength experienced when uniformly graded; saturated sands and silts are subjected to dynamic shaking. Its effects can range from harmless sand boils to serious ground damage such as subsidence, lateral spreading and loss of bearing strength.

During our investigation, we did not encounter the water table and there are also no significant nearby bodies of water. Based on our bore logs there is a minimum 2.2m non-liquefiable raft at the surface. This is expected to minimise the effects of liquefaction at the surface. Due to this, the liquefaction risk at this site is considered to be low.

7.3 SLOPE INSTABILITY

The site is identified in the RLC landslide potential hazard map² as having very low landslide susceptibility. However, there is a gentle slope on the site that slopes down

² Dellow G.D (2010), Rotorua District Council Hazard Studies: Landslide hazards. GNS Consultancy Report 2010/81

toward the north. We did not identify any signs of slope instability on the site and it is recommended that any cut on the property is retained or battered at a maximum slope of 1:3. Based on this, slope instability risk is considered to be low.

7.4 ACTIVE FAULTLINES

The Ministry for the Environment document, 'Planning for Development of Land on or close to Active Faults', defines a Fault Avoidance Zone for structures. This zone is a distance of 20m on either side of the fault rupture zone.

According to the RLC District Plan Hazard Maps, the closest known fault line to this site is approximately 2.1km to the South. Based on this, the risk of fault rupture at this site is low.

7.5 GEOTHERMAL

The site is not located within a geothermal field and the Rotorua Geothermal Field is located approximately 1.5km to the west of the site. Hence, the geothermal risk at the site is considered to be low.

7.6 INTERNAL EROSION

Internal erosion is the term used to describe the formation of underground cavities, referred to as tomos. Tomos are usually formed by flowing groundwater. As there is no evidence of flowing groundwater or any indications of surface depressions we consider the risk of internal erosion at this site to be low.

7.7 GROUNDWATER FLOODING AND INUNDATION

During the subsoil testing and investigation, the groundwater table was not encountered. In addition to this, the site is well outside of the inundation restriction levels (from the RLC hazard maps). Therefore, groundwater rising to the surface or flooding is not expected to be a significant hazard at this site.

8.0 **FOUNDATION RECOMMENDATIONS**

The site is not considered to be 'good ground' as per the definition in NZS3604:2011 however we consider the site to be suitable for the proposed subdivision and a future dwelling provided that the following foundation recommendations are adhered to.

- Ensure all topsoil, organic and unsuitable material is removed from beneath all foundations and slabs.
- Bored concrete encased timber piles shall be founded at a minimum depth of 1.0m below existing ground level and designed by a Chartered Professional Engineer familiar with this report for an Ultimate Bearing Capacity (UBC) of 200kPa (un-factored). Piles founded at a minimum depth of 1.4m below existing ground level (into 'good ground') can be as per NZS3604:2011. Note that the lateral capacities of piles must be assessed by a Chartered Professional Engineer where located on sloping ground.

- Shallow pad foundations (foundation pads, perimeter footings, internal slab thickenings) shall be founded at or over-excavated to a minimum depth of 1.0m below existing ground level and designed by a Chartered Professional Engineer familiar with this report for a UBC of 200kPa (un-factored). Shallow pad foundations founded at or over-excavated to a minimum depth of 1.4m below existing ground level can be as per NZS3604:2011 (into 'good ground'). Note that no over excavation is required beneath reinforced concrete slabs subject to inspection by an Engineer. Over-excavations shall be backfilled with clean, imported fill material compacted in 150mm maximum layers up to the underside of the foundations in order to achieve a minimum UBC of 300kPa.
- A proprietary rib-raft foundation can be utilised provided that it is founded at or over-excavated to a minimum depth of 0.6m below existing ground level. Any over-excavation shall extend to 1.0m beyond the building footprint and shall be backfilled with clean, imported fill material compacted in 150mm maximum layers up to the underside of the foundations in order to achieve a minimum UBC of 300kPa.
- The site may potentially be cut/filled to create a flat building platform. Any proposal for filling above the existing contour shall be approved by a Chartered Professional Engineer familiar with this report. The minimum depths required as specified above are in relation to the EXISTING ground levels not the finished ground levels.
- Cut slopes shall be suitably retained and may be subject to a building consent and/or resource consent as required by the local authority.
- Batters shall have a maximum slope of 1:3.
- The recommendations made in this report shall be confirmed by a Chartered Professional Engineer upon review of preliminary plans for a house proposal on the site.

Engineer's inspections:

- A Chartered Professional Engineer (or their representative) shall be engaged to inspect the subgrade of all excavations prior to any backfill or concrete being placed. Further isolated excavation may be required at the Engineer's discretion.
- The Chartered Professional Engineer (or their representative) shall then return to the site to test any fill compaction.
- The Chartered Professional Engineer shall provide a Producer Statement: Construction Review (PS4) upon completion covering the subgrade and fill compaction if applicable.

9.0 STORMWATER DISPOSAL

The soils encountered provide satisfactory soakage. A 50 year recurring storm event has been used for the stormwater discharge calculations as the site slopes down towards a neighbouring property.

The soakage test yielded a soakage rate of 1500mm/hr. This value has been used in the stormwater disposal calculations. One 900mm diameter by 1.7m deep soakhole (chamber type) with its base at a depth of 2.0m below ground level is required for every 31m² of roof area. This depth allows for 300mm of cover above the lid. The base of all soakholes should be within the sandy subsoil layer.

Soakholes should have permeable liners to extend their life. Soakholes should be located a minimum of 3m away and not on the uphill side of any foundations. If further soakholes are installed to serve sealed/paved areas, these should incorporate a cesspit to assist with maintenance. Refer to Appendix C for our stormwater disposal calculations.

10.0 LIMITATIONS

The recommendations and opinions contained in this report are based on the subsoils encountered at discrete locations. We have made assumptions about the nature of the ground conditions across the site, based on this limited information. Actual ground conditions may vary from that assumed in this report. If any variations from the assumed ground conditions are found to exist during construction, then the matter should be referred back to BSK Consulting Engineers Ltd.

This report has been prepared with specific reference to the proposed development described to us. Any significant change to the proposal should be referred back to BSK Consulting Engineers Ltd for comment. Additional work may be required once the proposed development is confirmed.

This report has been prepared solely for the benefit of Rex Gotz as our client for the purposes of the specific brief stated in this report. No liability is accepted by BSK Consulting Engineers Ltd in respect to any matters arising from the use of the information given in this report by any other person for any other purpose.

We trust this provides the information required at this stage. Please contact us if we can assist further.

Yours faithfully,

Reviewer




B N Christie
BE Civil (Hons), NZDE (Civil)

B C Walshe
BE Civil (Hons), CMEngNZ, CPEng

BSK CONSULTING ENGINEERS LTD BSK CONSULTING ENGINEERS LTD

Appendix A

SITE/TEST LOCATION PLAN

Proposed Subdivision
22 Alastair Ave
Rotorua

Our Ref: 22164

Date: 7th May 2018

Appendix B

SCALA PENETROMETER RESULTS AND BORELOGS

Proposed Subdivision
22 Alastair Ave
Rotorua

Our Ref: 22164

Date: 7th May 2018



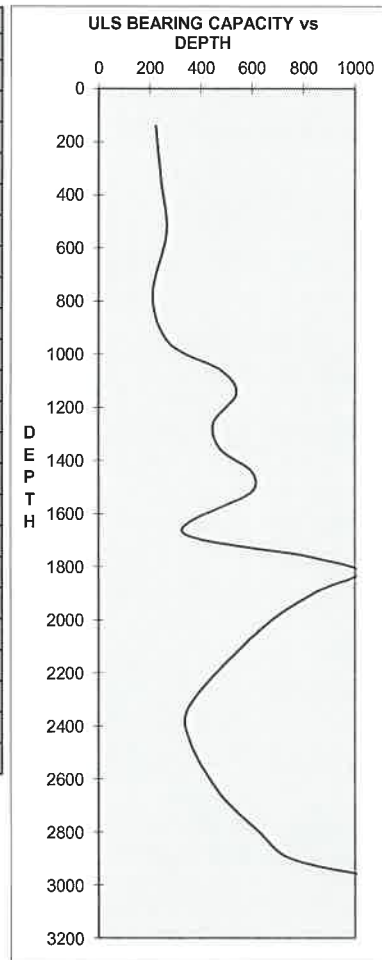
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SCALA PENETROMETER & BORELOG TEST SHEET

JOB REF 22164
CLIENT Rex Gotz
TEST SITE P1
DATE. 12/04/2018
LOCATION. 22 Alastair Ave, Rotorua

DEPTH (mm)	PENETRATION (mm)	BLOWS No	mm/BLOW	ULS BEARING PRESSURE
0	0	-	0	-
140	140	3	46.67	225
350	210	5	42	246
540	190	5	38	267
780	240	5	48	213
960	180	5	36	279
1060	100	5	20	480
1150	90	5	18	540
1260	110	5	22	450
1360	100	5	20	480
1440	80	5	16	600
1520	80	5	16	600
1670	150	5	30	330
1760	90	10	9	810
1820	60	10	6	1020
1900	80	10	8	840
2040	140	10	14	630
2320	280	10	28	360
2460	140	5	28	360
2660	200	10	20	480
2800	140	10	14	630
2900	100	10	10	750
2960	60	10	6	1020



Depth (mm)	Borelog
0 - 300	Topsoil
300 - 1100	Brown mottled silty SAND, moist
1100 - 1300	Light brown medium SAND, minor silt, wet
1300 - 1600	Brown medium SAND, compact, moist
1600 - 1800	Brown sandy SILT, some small pumice stone, moist to wet
1800 - 2200	Very light brown, very fine SAND, compact, wet
2200	End of bore



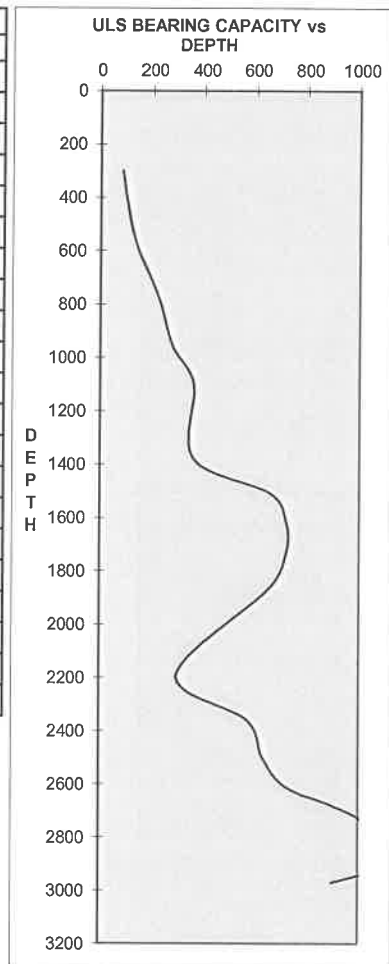
Consulting Engineers

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SCALA PENETROMETER & BORELOG TEST SHEET

JOB REF 22164
CLIENT Rex Gotz
TEST SITE P2
DATE. 12/04/2018
LOCATION. 22 Alastair Ave, Rotorua

DEPTH (mm)	PENETRATION (mm)	BLOWS No.	mm/BLOW	ULS BEARING PRESSURE
0	0	0	-	
300	300	1	300	84
550	250	3	83.33	130.5
780	230	5	46	225
960	180	5	36	279
1100	140	5	28	360
1380	280	10	28	360
1510	130	10	13	660
1620	110	10	11	720
1730	110	10	11	720
1860	130	10	13	660
2190	330	10	33	297
2360	170	10	17	570
2500	140	10	14	630
2610	110	10	11	720
2680	70	10	7	900
2740	60	10	6	1020
2800	60	10	6	1020
2850	50	10	5	1140
2900	50	10	5	1140
2970	70	10	7	900





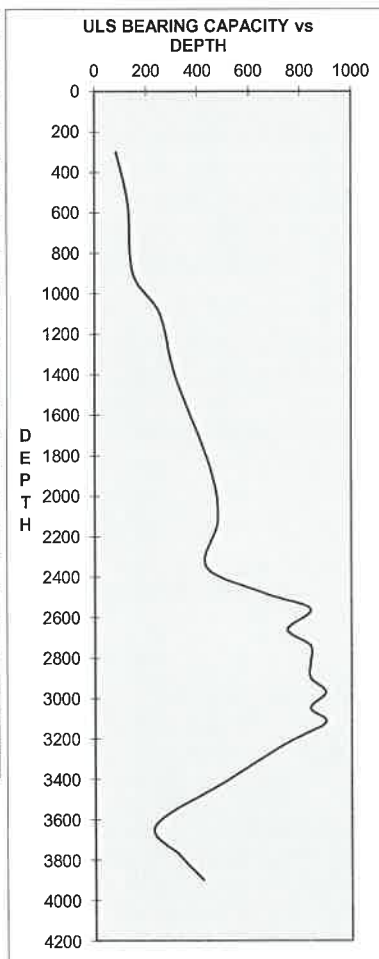
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SCALA PENETROMETER & BORELOG TEST SHEET

JOB REF 22164
CLIENT Rex Gotz
TEST SITE P3
DATE 12/04/2018
LOCATION 22 Alastair Ave, Rotorua

DEPTH	PENETRATION	BLOWS	mm/BLOW	ULS BEARING
(mm)	(mm)	No.		PRESSURE
0	0	0	-	
300	300	1	300	84
550	250	3	83.33	130.5
900	350	5	70	150
1100	200	5	40	255
1410	310	10	31	315
1860	450	20	22.5	450
2120	260	13	20	480
2350	230	10	23	435
2480	130	10	13	660
2560	80	10	8	840
2660	100	10	10	750
2740	80	10	8	840
2820	80	10	8	840
2900	80	10	8	840
2970	70	10	7	900
3050	80	10	8	840
3120	70	10	7	900
3220	100	10	10	750
3410	190	10	19	510
3630	220	5	44	234
3780	150	5	30	330
3900	120	5	24	420



Depth (mm)	Borelog
0 - 300	Topsoil
300 - 1200	Brown silt SAND, moist
1200 - 1400	Light brown medium SAND, moist
1400 - 1600	Brown fine SAND, compact, moist
1600 - 1800	Dark brown SILT, minor sand, wet
1800 - 2200	Light brown/grey silty SAND, dense, wet
2200	End of bore



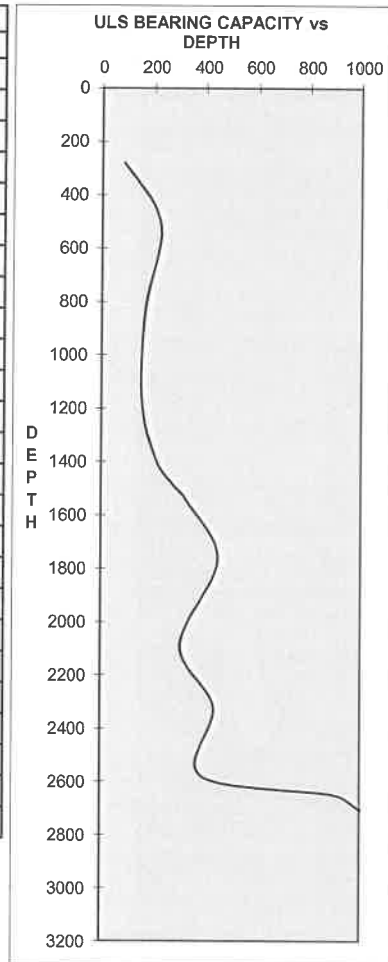
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SCALA PENETROMETER & BORELOG TEST SHEET

JOB REF 22164
CLIENT Rex Gotz
TEST SITE P4
DATE 12/04/2018
LOCATION 22 Alastair Ave, Rotorua

DEPTH	PENETRATION	BLOWS	mm/BLOW	ULS BEARING
(mm)	(mm)	No.		PRESSURE
0	0	0	-	
280	280	1	280	84
510	230	5	46	225
820	310	5	62	169.5
1160	340	5	68	154.5
1400	240	5	48	213
1550	150	5	30	330
1770	220	10	22	450
2090	320	10	32	306
2320	230	10	23	435
2580	260	10	26	390
2650	70	10	7	900
2710	60	10	6	1020
2750	40	10	4	1350
2810	60	10	6	1020
2860	50	10	5	1140
2920	60	10	6	1020
2970	50	10	5	1140





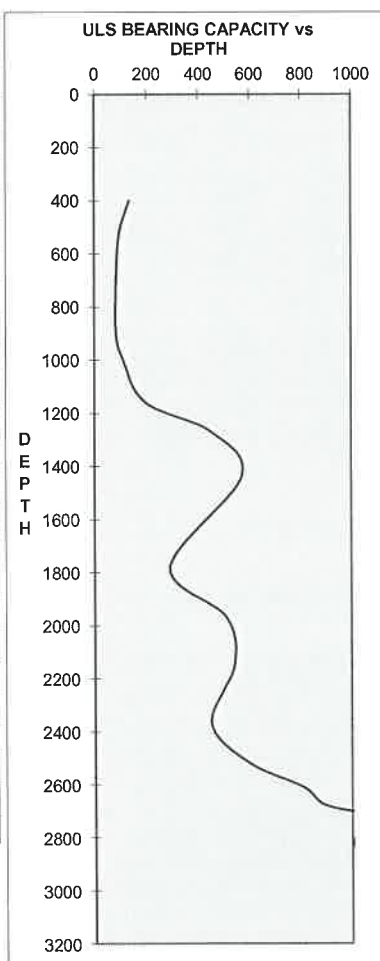
Consulting Engineers

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SCALA PENETROMETER & BORELOG TEST SHEET

JOB REF 22164
CLIENT Rex Gotz
TEST SITE P5
DATE 12/04/2018
LOCATION 22 Alastair Ave, Rotorua

DEPTH	PENETRATION	BLOWS	mm/BLOW	ULS BEARING
(mm)	(mm)	No.		PRESSURE
0	0	0	-	
400	400	5	80	135
530	130	1	130	96
710	180	1	180	84
900	190	1	190	84
1000	100	1	100	111
1160	160	3	53.33	195
1270	110	5	22	450
1440	170	10	17	570
1780	340	10	34	291
1970	190	10	19	510
2150	180	10	18	540
2370	220	10	22	450
2520	150	10	15	600
2610	90	10	9	810
2680	70	10	7	900
2730	50	10	5	1140
2790	60	10	6	1020
2850	60	10	6	1020
2900	50	10	5	1140
2950	50	10	5	1140
3010	60	10	6	1020



Depth (mm)	Borelog
0 - 100	Topsoil
100 - 700	Orangy brown very fine SAND, minor silt, moist
700 - 1100	Light brown fine SAND, moist, becoming medium grained
1100 - 1500	Very light brown, very fine SAND, dense, moist
1500 - 1900	Brown sandy SILT, some minor black streaks, dense, wet
1900 - 2000	Light brown silty SAND, dense, wet
2000 - 2100	Coarse brown pumice SAND, compact, wet
2100	End of bore

Appendix C

STORMWATER DISPOSAL CALCULATIONS

Proposed Subdivision
22 Alastair Ave
Rotorua

Our Ref: 22164

Date: 7th May 2018



Consulting Engineers

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JOB TITLE	Proposed subdivision/new dwelling	JOB NO.	22164
ADDRESS	22 Alastair Ave, Rotorua	DATE	5-May-18

SOAKHOLE DESIGN AS PER NZ BUILDING CODE E1/VM1: SECTION 9

Is soakhole overflow able to flow to neighbouring property?

yes

Rainfall intensity based on: **2% AEP Rain Event**
1hr duration
2.5° temperature increase for climate change

Rainfall intensity, $I =$ 72.1 mm/hr (From NIWA HIRDS Database)

<u>Surface 1</u>	Roof	<u>Surface 2</u>	Roof	<u>Surface 3</u>	Roof
C1	0.9	C2	0.9	C3	0.9
A1 (m ²)	31	A2 (m ²)	0	A3 (m ²)	0

Discharge, $Q =$ 2.01 m³/hr

Soakage rate = 1500 mm/hr (From attached soakage test results)

Soakhole type = chamber type
Soakhole diameter = 900 mm
Soakhole depth = 2 m
Soakhole cover = 0.3 m
Effective soakhole depth = 1.7 m

Soakhole area = 0.64 m²
Soakhole volume = 1.08 m³

$V_{\text{soak}} =$ 0.95 m³/hr

$V_{\text{store}} =$ 1.08 m³/hr

$V_{\text{total}} =$ 2.04 m³/hr

No. soakholes required 1

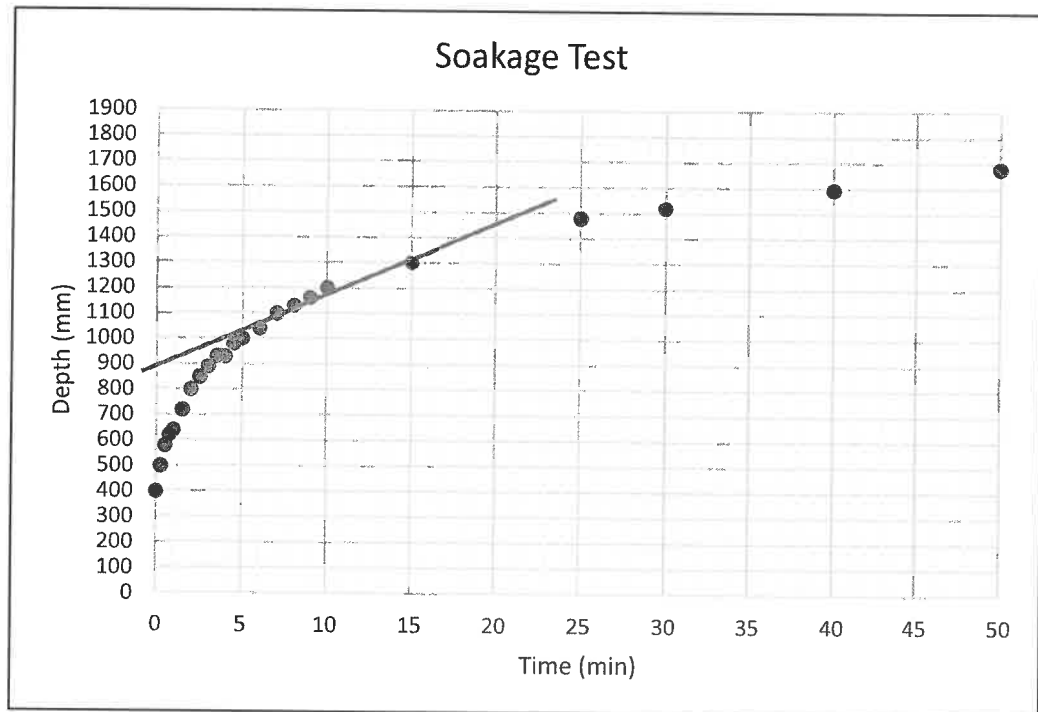


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JOB TITLE	Proposed subdivision/new dwelling	JOB NO.	22164
ADDRESS	22 Alastair Ave, Rotorua	DATE	5-May-18

Time (min)	Depth (mm)
0	400
0.25	500
0.5	580
0.75	620
1	640
1.5	720
2	800
2.5	850
3	890
3.5	930
4	930
4.5	980
5	1000
6	1040
7	1100
8	1130
9	1160
10	1200
15	1300
20	
25	1480
30	1520
40	1595
50	1680
60	1740
70	
80	
90	
100	
110	



Determination of soakage rate as per NZBC E1/VM1, clause 9.0.2 (d):

"Plot the drop in water level against time on a graph, and the soakage rate in mm/hr is determined from the minimum slope of the curve. If there is a marked decrease in soakage rate as the hole becomes nearly empty, the lower rates may be discarded and the value closer to the average can be adopted."

Move the orange line into position and choose two points on the line:

	Depth (mm)	Time (min)
Point 1 (lower point)	1100	7
Point 2 (upper point)	1300	15

Soakage rate = 1500 mm/hr

RAINFALL INTENSITIES FROM NIWA HIGH INTENSITY RAINFALL SYSTEM V3

Extreme rainfall assessment with climate change

Projected temperature change: 2.5° C

Rainfall intensities (mm/h)

ARI (y)	aep	Duration									
		10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	71.4	50.4	41.0	29.0	19.1	9.8	6.5	4.2	2.5	1.9
2.00	0.500	76.8	54.6	44.6	31.5	20.8	10.7	7.0	4.6	2.7	2.0
5.00	0.200	99.6	70.8	57.8	41.1	27.2	14.1	9.4	6.2	3.7	2.7
10.00	0.100	118.2	84.0	68.8	48.9	32.5	17.1	11.3	7.5	4.5	3.3
20.00	0.050	139.2	99.3	81.2	58.1	38.8	20.4	13.6	9.1	5.4	4.0
30.00	0.033	152.4	109.2	89.8	64.1	42.9	22.7	15.2	10.2	6.1	4.5
40.00	0.025	162.6	116.7	95.8	68.5	45.9	24.3	16.2	10.9	6.5	4.8
50.00	0.020	171.6	122.7	100.8	72.1	48.3	25.6	17.1	11.5	6.9	5.1
60.00	0.017	178.8	127.8	105.2	75.1	50.4	26.7	17.9	12.0	7.2	5.3
80.00	0.012	190.8	136.5	112.0	80.3	53.8	28.5	19.1	12.8	7.7	5.7
100.00	0.010	201.0	143.7	118.0	84.4	56.6	30.0	20.1	13.5	8.1	6.0

In preparing this table, all reasonable skill and care was exercised using best available data & methods. Nevertheless, NIWA does not accept any liability, whether direct, indirect or consequential, arising out the use of HIRDSV3. ©2018 NIWA

To:
 Group Manager Infrastructure
 Rotorua District Council
 Private Bag
 ROTORUA

1A - STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION

Subdivision: Two lot subdivision of 22 Alastair Ave

Owner/Developer: Rex Gotz

Location: 22 Alastair Ave, Ohwhata, Rotorua

I, Brett Christopher Walshe of BSK Consulting Engineers Ltd, 314 Mulhroy Rd
 (Full Name) (Name & Address of Firm)
Rotorua

hereby confirm that:

I am a Chartered Professional Engineer/~~Geoprotectional~~ experienced in the field of geotechnical engineering and was retained by the owner/developer as the Geotechnical Expert on the above subdivision.

Site investigations have been carried out under my direction and are described in my report dated 7/5/18.

I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:

Subdivision Scheme Plan by Stamm Surveys Ltd, Drawing 18016-S-1, 29 March 2018
 (Insert reference to all drawings including dates of latest amendments)

I confirm that I have given consideration to the level of complexity as identified in the Rotorua Civil Engineering Industry Standard Chapter 3.

In my professional opinion, not to be ^{constructed} ~~constructed~~ as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, providing that:

a) The recommendations made in our Geotechnical Investigation Report,
ref: 22164, dated 07/05/18, are adhered to.

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This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express conditions that it will not be relied upon by any other person and does not remove the necessity for further inspection during the course of the works.

Signed: BC Noble ^{CPENG} 130859 on behalf of BSK Consulting Engineers Ltd

Date: 7/05/18

☒ Council's property file/LIM has been viewed for relevant information.